Sittig's Handbook of Pesticides and Agricultural Chemicals

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Second Edition

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Great care has been taken in the preparation of this reference work and, to the best knowledge of the Publisher and the Editors, the information contained herein is factual and accurate and the opinions expressed are those of qualified experts. This publication is not intended as a primary source of research information. This publication is a generic summary, designed to give the user a basic level of background information about the substances in question. Data are offered in this work solely for your consideration, investigation, and verification. The information and data are not to be taken as a warranty or representation for which the Publisher or Editors assume legal responsibility. Furthermore, the Publisher does not assume any responsibility or liability for the accuracy or completeness of, or consequences from, such information. The Publisher and Editors make no representations and assume no liability for any direct, incidental or consequential damages resulting from its use. The reader must accept therefore that this work has no legal status and cannot be relied upon in any legal proceedings. Mention of trade names or commercial products in the work does not constitute endorsement or recommendation for use by the Publisher or Editors. All registered Trademarks, Service marks, and proprietary names are the property of the owner.

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DEDICATION

Stanley A. Green

About the Editor

Richard P. Pohanish is the author of numerous technical and scientific works, including *Wiley Guide to Chemical Incompatibilities*, Third Edition*, HazMat Data for First Response, Transportation, Storage, and Security*, Second Edition, and (with Stanley A. Greene) *The Hazardous Substance Resource Guide, Second Edition,* which was selected by the American Library Association as a Notable Reference in 1994. Mr. Pohanish is also the editor of the best-selling *Sittig's Handbook of Toxic and Hazardous Chemicals and Carcinogens, Sixth Edition, Volumes I and II,* also published by Elsevier, Inc., and *Machinery's Handbook Pocket Companion* published by Industrial Press.

Preface to the Second Edition

For more than thirty years *Sittig's Handbook of Toxic and Hazardous Chemicals and Carcinogens* has been helping occupational, environmental, and emergency professionals by providing critical information in an easy-to-use and portable format. It is the objective and special challenge of this volume, a companion to *Sittig's Handbook*, to focus on more than 450 pesticides and agricultural chemicals and to offer the reader help and guidance in identifying and evaluating hazards associated with this important class of chemicals. The second edition of *Sittig's Handbook of Pesticides and Agricultural Chemicals* offers essential advice on dealing with the protection of working people – factory workers and field hands – emergency personnel and the public. This handbook is an important addition to the collections of all who come in contact with pesticides and agricultural chemicals at work or at home.

This second edition provides critical information on many of the most-used pesticide materials and agricultural chemical products of special interest. In keeping with the format and spirit of *Sittig's Handbook of Toxic and Hazardous Chemicals and Carcinogens*, this work continues to cover regulated chemicals – which implies recognition by various government agencies and/or rule-making body – and to present new and valuable information within a handy single-volume handbook. The main body of this work consists of a series of monographs of products arranged in alphabetical order. All monographs are organized in a format similar to those found in *Sittig's Handbook* with common names, chemical synonyms, trade names, chemical formulae, U.S. EPA (United States Environmental Protection Agency) pesticide codes, EEC (European Economic Community) number, RTECS® (Registry of Toxic Effects of Chemical Substances), CAS (Chemical Abstract Service) numbers, and other unique identifiers so that all who may have contact with or interest in these pesticides can easily find needed information. For example, the "Regulatory Authority and Advisory Information" section has been expanded, now containing current U.S. federal citations as well as selected European and Californian (the largest agricultural state) sources. The latter includes potential groundwater pollutants and the latest California Proposition 65 information related to carcinogen and developmental dangers of specific products. Also added are European and International hazard data, including important regulatory mandates and safety warnings, symbol codes, risk and safety phrases and, where assigned, WGK (German Aquatic Class) values, Rotterdam Convention Annex III [Chemicals Subject to the Prior Informed Consent Procedure (PIC)]; List of Stockholm Convention Persistent Organic Pollutants (POPs). Many records contain special warnings, including notes and reminders to health care professionals. Detailed discussions on all possible solutions to problems are not feasible in the limited space available. Nevertheless, it is hoped the guidance and data provided will be of value to a broad audience of interests: formulators, distributors, applicators, regulators, news outlets, worker protection professionals, and all responsible for the proper disposal of pesticide and agricultural products. Many of the first edition's directories have been eliminated. So much of this information is not urgently needed by most users and is widely available on the Internet. Data are furnished, to the extent currently available, in a multi-section uniform format to make it easy for users who wish to find information quickly or to compare data within various records in any or all of these important categories:

- Chemical Name
- Use Type
- CAS Number
- Formula
- Alert
- Synonyms
- Trade Names
- Chemical Class
- EPA/OPP PC Code
- California DPR Chemical Code
- HSDB Number
- UN/NA ERG Number
- RTECS® Number
- EC Numbers (includes Annex I Index numbers where assigned)
- Uses
- U.S. Maximum Allowable Residue Levels (with CFR citations)
- Human toxicity (long-term)
- Fish toxicity (threshold)
- Regulatory Authority and Advisory Information
- Description (appearance, odor, physical properties, fire data, and water solubility)
- Incompatibilities
- Permissible Exposure Limits in Air
- Determination in Air
- Permissible Concentration in Water
- Determination in Water
- Routes of Entry
- Harmful Effects and Symptoms
- Short Term Exposure
- Long Term Exposure
- Points of Attack
- Medical Surveillance
- First Aid
- Personal Protective Methods
- Respirator Selection
- Storage
- Shipping
- Spill Handling
- Fire Extinguishing
- Disposal Method Suggested
- References

It should be noted that a “regulated chemical” need not indicate that it is a “registered product.” Products are constantly being registered, canceled, or transferred in the United States by the Environmental Protection Agency (EPA). Nevertheless these “canceled” products may be acceptable for use on crops in other countries. If, for example, when pesticides are used on food products imported into the United States, they may be subjected to inspection by the U.S. Department of Agriculture (USDA) at ports of entry.

Although every effort has been made to produce an accurate and highly useful handbook, the author appreciates the need for constant improvement. Any comments, corrections, or advice from readers and users of this book are welcomed by the author, who asks that all correspondence be submitted in writing and mailed to the publisher, who maintains a file for reprints and future editions.

ACKNOWLEDGMENTS

First of all, a special thanks to Stanley A. Greene, who inspired and was the lead author of the first edition. I wish to thank the following individuals and institutions for their generous help with the first edition of this work. Wendy Kramer, Administrative Librarian, and Judith Foster, Information Technology Assistant, both at the USDA Agriculture Research Service, Eastern Region Research Center in Wyndmoor, PA; and Ken Pfeiffer, Pest Management Specialist/Agronomist, USDA/NRCS National Water and Climate Center. The library staff at the Delaware Valley College in Doylestown, PA, was most helpful in explaining the information needs of professionals in the agriculture industry. The author would like to thank some individuals and institutions, without whose expertise and generous help the 2nd edition would not have been possible. Much of the data for this volume was compiled by utilizing important documents and databases of agencies of federal, state, and foreign governments and prominent professional and advisory organizations. In particular, I want to acknowledge the good work of the United States Environmental Protection Agency (EPA), United States Department of Labor: Occupational Safety and Health Administration (OSHA), The National Institute for Occupational Safety and Health (NIOSH), Centers for Disease Control and Prevention (CDC), The Agency for Toxic Substances and Disease Registry (ATSDR), The National Library of Medicine (NLM), United States Department of Energy (DOE), National Toxicolgy Program (NTP), United States Department of Energy, United States Department of Agriculture, National Oceanic and Atmospheric Administration (NOAA), and The National Fire Protection Association (NFPA). At the U.S. Coast Guard Headquarters I wish to thank the recently-retired Alan Schneider, D.Sc., of the Marine Technical and Hazardous Materials Division. Thanks to the American Conference of Governmental Industrial Hygienists (ACGIH) for granting permission to use threshold limit values (TLVs) from their booklet entitled *Threshold Limit Values for Chemical Substances and Physical Agents and Biological Exposure Indices.* This booklet is revised on an annual basis. Also thanks to Dr. Andrew Greene of the University of Hertfordshire for his help and allowing me to use parts of the University’s *Pesticide Properties Database* (PPDB) developed by the Agriculture & Environment Research Unit (AERU), University of Hertfordshire, funded by UK national sources and the EU-funded FOOTPRINT project (FP6-SSP-022704). I am also grateful to my publisher, Matthew Deans, and his excellent staff at Elsevier, Oxford, UK. I appreciate the vigilant care of Peter Gane and Nicky Carter in preparing this work for publication.

Introduction

A pesticide is any substance or mixture of substances intended to preserve crops by preventing, destroying, repelling, or mitigating a pest. Though often misunderstood to refer only to insecticides, the term "pesticide" also applies to herbicides, rodenticides, fungicides, miticides, and various other pest control substances and formulations. Under many laws, including those of the United States (FIFRA), a pesticide is also any substance or formulation intended for use as a plant regulator, defoliant, or desiccant. And, because they are designed to kill or otherwise adversely affect living organisms, pesticides are inherently toxic and most of them create some risk of harm to humans, animals, useful insects, such as bees, or the environment At the same time, pesticides are important and useful to society because they can preserve crops by killing potential disease-causing organisms and control insects, rodents, weeds, and other pests[94].

Following are important facts and trends about the global market for pesticides and its single largest market, the United States. In February 2011 the EPA's report, *Pesticide Industry Sales and Usage: 2006 and 2007 Market Estimates*, contained the latest statistics on agricultural and nonagricultural use and sales of pesticides. The previous report on pesticide industry sales and usage was published by the EPA in 2001. Approximately 5.2 billion pounds of pesticides were used worldwide in both 2006 and 2007 and world expenditures on pesticides totaled more than $35.8 billion in 2006 and more than $39.4 billion in 2007. By comparison, in 2001 worldwide expenditures totaled more than $32 billion. Herbicides accounted for the largest portion of total use, followed by other pesticides, insecticides, and fungicides. In 2007, the United States accounted for 22% of total world pesticide amount used and sales amounted to approximately $12.5 billion, or almost one-third of the world's overall expenditures. Eighty percent of all U.S. pesticide use was in agriculture. Between 2000 and 2007 total pounds of U.S. pesticides used decreased by 8% from 1.2 to 1.1 billion pounds. From 2002 to 2007 use of conventional pesticides decreased about 3% and the decrease was down 11% from 1997 to 2007[94].

Among the top 10 pesticides used in the agricultural market (in terms of pounds applied) were the herbicides glyphosate, atrazine, metolachlor-S, acetochlor, 2,4-D, and pendimethalin, and the fumigants metam-sodium, dichloropropene, methyl bromide, and chloropicrin. Herbicides were also the most widely used type of pesticide in the home and garden and industrial, commercial, and governmental market sectors, and the herbicides 2,4-D and glyphosate were the most widely used active ingredients[94].

The toxic chemicals problem in the United States, and indeed in all the world, is frightening and news stories abound. According to the Food and Agricultural Organization of the United Nations Programme on the Prevention and Disposal of Obsolete Pesticides, "half a million tons (tonnes) of obsolete pesticides are scattered throughout the developing world. These toxic chemicals, often stored outdoors in leaking containers, are seeping into the soil and water." In the U.S. alone, nearly five million chemical poisonings occur annually, resulting in thousands of deaths. According to the U.S. EPA, poison control centers respond to more than 3.6 million calls each year (approximately one call every eight seconds). According to the American Association of Poison Centers and data collected from poison centers, nearly 150,000 calls are made with concerns about exposure to common household pesticides. About half of these calls involve young children. Still fresh in one's mind is the world's worst industrial accident on the night of December 2, 1984. In Bophal, India, an estimated 7500 to 8000 people died initially, and more than 25,000 total, from a leak of methyl isocyanate gas. Methyl isocyanate is used as an intermediate chemical in the production of carbamate pesticides. Local news outlets frequently report incidents that do not reach national attention. In the mid-90s near Bakersfield, California, 22 farm workers, including three pregnant women, were affected when a crop-dusting plane applied a mixture of chlorpyrifos, fenpropathrin, and profenofos to a neighboring cotton field. In addition, as many as 225 farm workers in nearby grape fields were exposed from the "air drift." Most were hospitalized and later released. In another, more recent incident (June 2013 in Wilsonville, Oregon), a massive bumblebee kill occurred. It was reported to be the largest mass poisoning of its kind documented to date and it impacted an estimated 50,000 bumble bees (300-plus colonies) following application of a relatively new and controversial group of chemicals known as of neonics (neonicotinoids are similar to nicotine). Neonics were used to control sticky residue-secreting insects on ornamental linden trees. The trees were sprayed because the aphids were a nuisance to parked automobiles. These chemicals are the subject of a recent ban (limited, for the time being, to 2 years) in the European Union[114].

The widespread use of pesticides and other chemicals on our food supply and other crops is a constant, potential threat to the health and economic livelihood of millions of farm workers. In the U.S. alone this workforce is estimated to be approximately 2.5 million, with California employing more than 600,00. These workers face the highest rate of chemical-related illness of any occupational group in a workplace. Moreover, in many cases, collateral exposure in their homes and drinking water occurs. It can be assumed that not all cases are reported and that pesticides can have a long-term effect on workers and their families, including cancer, neurological disorders, and infertility, from run-off into their water supply, from ambient air, and from living in or near fields that have been treated with pesticides. Readers may find that some of the products covered in this volume's monographs may be "unregistered" or "canceled" for use in some countries. Nevertheless, many of these pesticides may be legally manufactured, formulated, and supplied by one country and sold to customers in other countries. In other words, "canceled" or "non-registered" "obsolete" or "banned" products may still be acceptable for use somewhere in the world; and, for that reason, these have been included. The use of this reference is not meant to be a substitute for environmental or workplace hazard communication programs required by regulatory bodies such as U.S. EPA, USDA, or OSHA, and/or any other U.S., foreign, or international regulatory agencies. If data are required for legal purposes, the original source documents and appropriate agencies, which are referenced, should be consulted.

How to Use This Book

More than 400 pesticide and agricultural chemical substances are profiled in this reference work and the information is organized into sections described here. When a category is omitted from a monograph, it usually indicates a lack of available information; and, rather than indicate "no information." that category has been removed to conserve space for additional pesticide materials.

Chemical Name: Each record is arranged alphabetically by a chemical name used by regulatory and advisory bodies. In most cases, this is not a product or trade name. See also "Synonyms" and "Trade Names" below.

Use Type: The general agricultural use is given, e.g., herbicide, insecticide, fungicide, rodenticide, miticide, fertilizer, biocide, etc. The U.S. Department of Agriculture recognizes the following types of pesticides that are related because they are used against the same type of pests.

- Acaricides: Kill mites, ticks, and spiders that feed on plants and animals. Also called miticides.
- Algicides: Control algae in lakes, canals, swimming pools, water tanks, and other sites.
- Antifouling agents: Kill or repel organisms that attach to underwater surfaces, such as boat bottoms.
- Antimicrobials: Kill microorganisms (such as bacteria and viruses).
- Attractants: Attract pests, e.g., to lure an insect or rodent to a trap. Food is not considered a pesticide when used as an attractant.
- Avicides: Kill birds.
- Biopesticides: These are certain types of pesticides derived from such natural materials as animals, plants, bacteria, and certain minerals.
- Biocides: Kill microorganisms.
- Defoliants: Cause leaves or other foliage to drop from a tree or growing plant, usually to facilitate harvest. Various highly persistent types have been used by the military.
- Desiccants: Promote drying of living tissues, such as unwanted plant tops.
- Disinfectants and sanitizers: Kill or inactivate disease-producing microorganisms on inanimate objects.
- Fungicides: Kill fungi (including blights, mildews, molds, and rusts).
- Fumigants: Produce gas or vapor intended to destroy pests in buildings or soil.
- Herbicides: Kill weeds, grasses and other plants that grow where they are not wanted. May be organic or inorganic.
- Insect growth regulators: Disrupt the molting, maturity from pupal stage to adult, or other life processes of insects.
- Insecticides: Kill insects and arthropods.
- Miticides: Kill mites, ticks, and spiders that feed on plants and animals. Also called acaricides.
- Microbial pesticides: Microorganisms that kill, inhibit, or out-compete pests, including insects or other microorganisms.
- Molluscicides: Kill snails and slugs.
- Nematicides: Kill nematodes (microscopic, worm-like organisms that feed on plant roots).
- Ovicides: Kill eggs of insects and mites.
- Pheromones: Biochemicals used to disrupt the mating behavior of insects.
- Piscicides: Kill fish.
- Plant growth regulators: Substances (excluding fertilizers or other plant nutrients) that alter the expected growth, flowering, or reproduction rate of plants.
- Predacides: Kill vertebrate predators.
- Repellents: Repel pests, including insects (such as mosquitoes) and birds.
- Rodenticides: Control mice and other rodents.
- Synergists: Improve the performance of another pesticide. Usually an inert ingredient.

CAS Number: The CAS number is a unique identifier assigned to each chemical registered with the Chemical Abstracts Service (CAS) of the American Chemical Society. CAS numbers, in the format nnn…-nn-n, [two or more numeric characters (dash) two numeric characters (dash) followed by a single numeric check digit]. CAS numbers should always be used in conjunction with substance names to ensure positive identification and avoid confusion with like-sounding names, e.g., benzene (71-43-2) and benzine (8032-32-4). This 2nd edition contains some alternate CAS numbers that may now be considered related, retired, obsolete and/or widely and incorrectly used in the literature. In this section, the first CAS number(s), before the word "alternate," is considered (based on several sources) to be the correct CAS number(s). Ultimately, it is the responsibility of the user to find and use the correct number.

Formula: Generally, this has been limited to a commonly used one-line empirical or atomic formula. In most cases for organic compounds, the Hill system has been used, showing number of carbons (if present), number of hydrogens (if present), and then alphabetically by element.

Alert: This section serves as a notice of particularly dangerous attributes of a chemical or pesticide, such as phosphine.

Synonyms: This section contains scientific, product, trade, and other synonym names that are commonly used for each pesticide substance. Most of these names are registered trade names that are the legal property of their owners and carry the registration mark ®. Some synonyms are provided in other major languages other than English, including Spanish. In some cases, "trivial" and nicknames (such as MEK for methyl ethyl ketone) have been included because they are commonly used in general communications and in the workplace. This section is important because the various "regulatory" lists published by federal, state, international, and advisory bodies and agencies do not always use the same name for a specific hazardous substance. Every attempt has been made to ensure the accuracy of the synonyms and trade names found in this volume, but errors are inevitable in compilations of this magnitude. Please note that this volume may not include the names of all products currently in commerce, particularly mixtures, that may be formulated from regulated chemicals.

The synonym Appendix 2 contains all synonym names listed in alphabetical order. It should be noted that organic chemical prefixes and interpolations such as (α-) alpha-, (β-) beta-, (γ-) gamma-, (δ-) delta-, (*o*-) ortho-, (*m*-) meta-, (*p*-) para-, *(sec*-) secondary-, *trans*-, *cis*-, (*n*-) normal-, and numbers (1-; 1,2-), etc. are not conventionally used when searching for a chemical name. In other words, these prefixes are not treated as part of the chemical name for the purposes of alphabetization. Users should use the substance name without the prefix. For example, to locate *n*-Butane, search for Butane; to locate 3,3´-Dichlorobenzidine, search for Dichlorobenzidine; and to locate α-Cyanotoluene or *alpha*-Cyanotoluene, search for Cyanotoluene.

Trade Names: Most of the registered trade names included in this work were registered at one time or are in current use. In many cases, the trade names are also sold in foreign markets. Where available, trade names of pesticides made by foreign manufacturers and marketed primarily in foreign countries are also included. Many trade names are formulations that include the product and may not be the pure material that is subject of the monograph.

Chemical Class: This field describes pesticide family, i.e., carbamate, organophosphate, triazine, etc.

EPA/OPP PC Code: This field contains a unique six-digit numerical pesticide code assigned by the U.S. EPA.

California DPR Chemical Code: This field contains the unformatted numerical pesticide code assigned by the California Department of Pesticide Registration (DPR).

HSDB Number: *The Hazardous Substances Data Bank* (HSDB) is a database of the United States National Library of Medicine's (NLM) *Toxicology Data Network* (TOXNET). Accessible, free of charge, this database contains more than 5000 hazardous chemical records including many pesticides. All records can be searched by chemical names, partial names, synonyms, CAS numbers, etc. This HSDB number is provided to users of this handbook who may require quick access to additional and more detailed information on chemical substances and their toxicology, emergency handling, exposure, personal protection, etc. There are a few (about 21) pesticides without assigned HSDB numbers.

UN/NA & ERG Number: The UN and DOT hazard identification (ID) number are assigned to chemical substances by the U.S. Department of Transportation (DOT) and the United Nations Committee of Experts on the Transport of Dangerous Goods. The numbers are usually identical. The ID number format is "UNnnnn" or "NA nnnn". This ID number identifies regulated substances and must appear on shipping documents, the exterior of packages, and on specified containers. Identification numbers containing a UN prefix are also known as United Nations numbers and are authorized for use with all international shipments of hazardous materials. The "NA" prefix is used for shipments between Canada and the United States *only*, and may *NOT* be used for other international shipments. *The Emergency Response Guide*, ERG, is issued every 4 years and is a joint publication of the Departments of Transportation of the United States (U.S. DOT), Canada [Transport Canada (TC)], and Mexico [Secretariat of Communications and Transportation (SCT)]. Also, Argentina's Chemistry Information Center for Emergencies (CIQUIME) is a publication collaborator. The ERG number comes from the 170 first-responder "Guides" found in the orange-colored section of the ERG. These Guide numbers provide general and evacuation information on how to initially respond (normally in the first 30 minutes) to incidents involving hazardous chemicals.

RTECS Number: The RTECS numbers (Registry of Toxic Effects of Chemical Substances) are unique identifiers assigned and published by NIOSH. The RTECS number in the format "AAnnnnnnn" (two alphabetic characters followed by seven numeric characters) may be useful for online searching for additional toxicologic information on specific substances. It can, for example, be used to provide access to the MEDLARS® computerized literature retrieval services of the National Library of Medicine (NLM) in Washington DC. The RTECS number and the CAS number may serve to narrow down online searches.

EC Number: The European Commission number is a unique seven-digit identification code used within the European Union (EU) by regulatory authorities of the European Environment Agency (EEA) and others to control commercially available chemical substances. The EC number supersedes the outmoded EINECS, ELINCS and NLP numbers and appears in the format NNN-NN-N[r] with the final number (-N[r]) being the check digit. EU numbers start as follows: 2 or 3 (2XX-XXX-X or 3XX-XXX-X) for chemical substances belonging to EINECS (Existing Chemicals); 4 (4XX-XXX-X) for chemical substances belonging to ELINCS (New Chemicals), 5 (5XX-XXX-X) for chemical substances belonging to NLP (No-Longer Polymers). Use of these identification numbers for hazardous materials will (a) serve to verify descriptions of chemicals; (b) provide for rapid identification of materials when it might be inappropriate or confusing to require the display of lengthy chemical names on vehicles; (c) aid in speeding communication of information on materials from accident scenes and in the receipt of more accurate emergency response information; and (d) provide a means for quick access to immediate emergency response information in the "*The Emergency Response Guide (ERG)*."[31] In this latter volume, the various compounds have assigned "ID" numbers (or identification numbers) which correspond closely, but not always precisely, to the UN listing[20].This section also includes *Annex I, Index number* for the Export and Import of Dangerous Chemicals found in Annex I of Regulation (EC) No 689/2008.

Uses: This is a brief summary of agricultural applications and uses found for the substance in other fields. For specific crops, target insects, weeds, varmints and fungi, the user is referred to the reference sources cited at the end of each chemical listing. In many cases, the pesticides are not registered for use in the U.S. but are used in other countries.

U.S. Maximum Allowable Residue Levels: These are the tolerance levels for individual crops. The tolerance levels are established by the EPA and reported in 40 CFR 180. Tolerances are defined by EPA as "The maximum amount of a pesticide allowable in a food or feed product before it is considered adulterated, usually specified in parts per million (ppm)." Readers are cautioned that these levels are for country-wide usages and are reviewed and modified frequently to reflect regulatory changes, petitions by individual companies, or scientific developments; consequently, be encouraged to verify the tolerances in the EPA web site. State exceptions to the federal standards are not included here.

Human toxicity (long-term): This field contains three items: The hazard rating/long-term toxicity level (ppb)/toxicity type. This represents a relative long-term toxicity index for humans. The hazard ratings (Extra High, High, Intermediate, Low, Very Low) are indicators of the relative risk to humans. The figure in ppb is calculated with respect to humans by the U.S. EPA. The last item in this field is the toxicology "type" for the value expressed in ppb. Toxicities are based on availability in the priority order: MCL, HA, and CHCL. HA is used for Cancer Groups C, D, E, and Unclassified. CHCL is used for Cancer Groups A, B1 and B2 when MCL is unavailable.

- MCL (EPA's Maximum Contaminant Level). Maximum permissible long-term pesticide concentration allowed in a public water source.
- HA (Health Advisory). Determined by the U.S. EPA Office of Water (OW). The concentration of a chemical in drinking water that is not expected to cause any adverse non-carcinogenic effects over the lifetime exposure with a margin of safety. In accordance with OW policy, Health Advisories are not calculated for chemicals that are known or probable carcinogens (EPA Cancer class A and B).
- CHCL* (Chronic Human Carcinogen Level, calculated). The concentration at which there is a 1 in 100,000 probability of contracting cancer. A CHCL provides a concentration comparable to an MCL.

Fish toxicity (threshold): This field contains three items: The hazard rating/toxicity threshold (ppb)/toxicity type. The hazard rating (Extra High, High, Intermediate, Low, Very Low) is based on Maximum Acceptable Toxicant Concentration (MATC), the soluble pesticide toxicity level for fish that is an indicator of the relative risk to the environment. The hazard rating is followed by the fish toxicity threshold for an active ingredient expressed in parts per billion (ppb) and determined empirically by performing long-term or life-stage toxicity tests. The final item in this field contains the type of toxicity for the toxicity threshold (MATC).

Regulatory Authority and Advisory Information: Contains a listing of major regulatory and advisory lists containing the chemical of concern, including U.S. EPA, NTP, OSHA, U.S. DOT, ACGIH, DFG, WGK, and the EC GHS. Also included is information specific to the state of California, which has the largest agricultural economy in the United States and annually employs more than 600,000 workers. Many law or regulatory references in this work have been abbreviated. For example, Title 40 of the Code of Federal Regulations, Part 261, subpart 32 has been abbreviated as 40CFR261.32. The symbol "§" may be used as well to designate a "section" or "part." European/International Hazard Symbols, Risk Phrases, and Safety Phrases: Explanation of these symbols and phrases can be found in Appendix 1. The Globally Harmonized System of Classification and Labeling of Chemicals (GHS) has been phased in by many countries.

- Carcinogenicty: The EPA has evaluated chemicals for their carcinogenic potential according to *Fact Sheet: EPA's GUIDELINES FOR CARCINOGEN RISK ASSESSMENT (March 29, 2005)*. Under EPA's 1986 risk assessment guidelines, the weight-of-evidence (WOE) for carcinogenicity is described by categories "A through E," Group A for known human carcinogens through Group E for agents with evidence of noncarcinogenicity.
- *Carcinogenic to Humans*: The Guidelines recommend this descriptor when there is convincing epidemiologic evidence demonstrating causality between human exposure and cancer, or exceptionally when there is strong epidemiological evidence, extensive animal evidence, knowledge of the mode of action, and information that the mode of action is anticipated to occur in humans and progress to tumors.
- *Likely to be Carcinogenic to Humans*: The Guidelines recommend this descriptor when the available tumor effects and other key data are adequate to demonstrate carcinogenic potential to humans, but does not reach the weight-of-evidence for the descriptor "carcinogenic to humans."
- *Suggestive Evidence of Carcinogenic Potential*: The Guidelines recommend this descriptor when the

evidence from human or animal data is suggestive of carcinogenicity, which raises a concern for carcinogenic effects but is judged not sufficient for a stronger conclusion.

- *Inadequate Information to Assess Carcinogenic Potential*: The Guidelines recommend this descriptor when available data are judged inadequate to perform an assessment.
- *Not Likely to be Carcinogenic to Humans*: The Guidelines recommend this descriptor when the available data are considered robust for deciding that there is no basis for human hazard concern.
- NTP: 12th Report on Carcinogens, 2011 [Department of Health and Human Services (DHHS) National Toxicology Program].
- Chemicals on California's Proposition 65 List. *The Safe Drinking Water and Toxic Enforcement Act of 1986* requires that the Governor revise and republish at least once per year the list of chemicals known to the State to cause cancer or reproductive toxicity. This list, *Chemicals Known to the State to Cause Cancer or Reproductive Toxicity,* describes the type of toxicity (cancer and/or male and/or female developmental), the CAS number, and the date listed or delisted. The information shown was revised as of July 26, 2013. For updated information, see http://www.oehha.ca.gov/prop65/prop65_list/files/P65single061104a.pdf.
- Acute Oral Category and label signal word: The Category number is based on the LD^{50}. The LD_{50} value is a statistical estimate of the number of mg of toxicant per kg of body weight required to kill 50% of a large population of test animals. This value provides a "snapshot" of the toxicity category for acute oral dosage only. Readers should be aware that acute dermal, inhalation, primary eye, and primary skin irritation may be higher or lower and must protect themselves accordingly. The EPA assigns a signal word that is a description of the short-term (acute) toxicity of a formulated product. It must be displayed on product labels to alert users to potential hazards. There are four categories of signal words; their levels are shown below. Formulated products contain both active and inert or other ingredients. Examples of inert ingredients are carriers, stickers, solvents, and adjuvants.

Source: 40CFR156.64 (February 12, 2002)
Toxicity (oral) Category: 1, DANGER-Poison
Toxicity (oral) Category: 2, WARNING
Toxicity (oral) Category: 3, CAUTION
Toxicity (oral) Category: 4, Caution

- Health Advisory: Lists known and suspected Nerve Toxin(s), Endocrine Disruptor(s), Mutagen(s), Reproductive Hazard(s), Skin Irritants/sensitizer(s), Developmental toxin(s). Nerve Toxins contain ingredients determined to inhibit the action of cholinesterase, an important enzyme involved in nervous system operation of animal and human nervous systems. Endocrine Disruptors are compounds that "interfere with the synthesis, secretion, transport, binding, action, or elimination of natural hormones in the body that are responsible for the maintenance of homeostasis (normal cell metabolism), reproduction, development, and/or behavior." Many endocrine disruptors are thought to mimic hormones, such as estrogen or testosterone. They have chemical properties similar to hormones that allow binding to hormone-specific receptors on the cells of target organs. More information on endocrine effects can be found at the EPA Endocrine home page at http://www.epa.gov.endocrine. The absence of these designation does not mean a pesticide is free of these characteristics. It may mean that its ingredients have not been completely evaluated or that insufficient data are available to make a determination. Similarly, classification of pesticides may be changed when new data become available. A substance with an air pollutant standard set or recommended by OSHA and/or NIOSH,[58] ACGIH,[1] DFG[3]. The OSHA limits are the enforceable pre-1989 PELs. The transitional limits that were vacated by court order have not been included. The NIOSH and ACGIH airborne limits are recommendations that do not carry the force of law in the United States but are used as standards in may countries.
- Potential Ground Water Pollutant (California): Pesticides labeled for agricultural, outdoor institutional, or outdoor industrial use that are designated as having the potential to pollute ground water listed in Sections 13149 and 12811 of the Food and Agricultural Code (FAC).
- A substance whose allowable concentrations in workplace air are adopted or proposed by the American Conference of Government Industrial Hygienists (ACGIH)[1]. DFG [Deutsche Forschungsgemeinschaft (German Research Society)][3]. Substances whose allowable concentrations in air and other safety considerations have been considered by OSHA and NIOSH[2].
- Substances that are specifically regulated by OSHA under 29CFR1910.1001 to 29CFR1910.1050.
- Highly hazardous chemicals, toxics, and reactives regulated by OSHA's "*Process Safety Management of Highly Hazardous Chemicals*" under 29CFR1910.119, Appendix A. Substances that are Hazardous Air Pollutants (Title I, Part A, §112) as amended under 42USC7412. This list provided for regulating at least 189 specific substances using technology-based standards that employ Maximum Achievable Control Technology (MACT) standards; and possibly health-based standards if required at a later time. §112 of the Clean Air Act (CAA) requires emission control by the EPA on a source-by-source basis.
- Regulated Toxic Substances and Threshold Quantities for Accidental Release Prevention. These appear as Accidental Release Prevention/Flammable Substances, Clean Air Act (CAA) §112(r), Table 3, TQ (threshold quantity) in pounds and kilograms under 40 CFR68.130. The accidental release prevention regulations apply to stationary sources that have present more than a threshold quantity of a CAA §112(r) regulated substance.

- Clean Air Act (CAA) Public Law 101–549, Title VI, *Protection of Stratospheric Ozone*, Subpart A, Appendix A, class I and Appendix B, Class II, Controlled Substances, (CFCs) Ozone depleting substances under 40CFR82.
- Clean Water Act (CWA). Priority toxic water pollutants defined by the U.S. Environmental Protection Agency for 65 pollutants and classes of pollutants which yielded 129 specific substances[6].
- Chemicals designated by EPA as "Hazardous Substances"[4] under the Clean Water Act (CWA) 40CFR116.4, Table 116.4A.
- Clean Water Act (CWA) §311 Hazardous Materials Discharge Reportable Quantities (RQs). This regulation establishes reportable quantities for substances designated as hazardous (see §116.4, above) and sets forth requirements for notification in the event of discharges into navigable waters. Source: 40 CFR117.3, amended at 60FR30937.
- Clean Water Act (CWA) §307 List of Toxic Pollutants. Source: 40CFR401.15.
- Clean Water Act (CWA) §307 Priority Pollutant List. This list was developed from the List of Toxic Pollutants classes discussed above and includes substances with known toxic effects on human and aquatic life, and those known to be, or suspected of being, carcinogens, mutagens, or teratogens. Source: 40CFR423, Appendix A.
- Clean Water Act, §313 Water Priority Chemicals. Source: 57FR41331.
- RCRA Maximum Concentration of Contaminants for the Toxicity Characteristic with Regulatory levels in mg/L. Source: 40CFR261.24.
- RCRA Hazardous Constituents. Source: 40CFR261, Appendix VIII. Substances listed have been shown, in scientific studies, to have carcinogenic, mutagenic, teratogenic or toxic effects on humans and other life forms. This list also contains RCRA waste codes. The words, "waste number not listed" appears when a RCRA number is NOT provided in Appendix VIII.

Characteristic Hazardous Wastes	
Ignitability	A nonaqueous solution containing less than 24% alcohol by volume and having a closed cup flashpoint below 60 °C/140 °F using Pensky-Martens tester or equivalent. An ignitible compressed gas. A non-liquid capable of burning vigorously when ignited or causes fire by friction, moisture absorption, spontaneous chemical changes at standard pressure and temperature. An oxidizer. See §261.21.
Corrosivity	Liquids with a pH equal to or less than 2 or equal to or more than 12.5 or which corrode steel at a rate greater than 6.35 mm (0.25 in) per year @ 55 °C/130 °F. See §261.22.
Reactivity	Unstable substances that undergo violent changes without detonating. Reacts violently with water or other substances to create toxic gases. Forms potentially explosive mixtures with air. See §261.23.
Toxicity	A waste that leaches specified amounts of metals, pesticides, or organic chemicals using Toxicity Characteristic Leaching Procedure (TCLP). See §261, Appendix II, and §268, Appendix I.
Listed Hazardous Wastes	
"F" wastes	Hazardous wastes from nonspecific sources §261.31.
"K" Wastes	Hazardous wastes from specific sources §261.32.
"U" Wastes	Hazardous wastes from discarded commercial products, off-specification species, container residues §261.34. Covers some 455 compounds and their salts and some isomers of these compounds.
"P" Wastes	Acutely hazardous wastes from discarded commercial products, off-specification species, container residues §261.33. Covers some 203 compounds and their salts plus soluble cyanide salts.

Note: If a waste is not found on any of these lists, it may be found on state hazardous waste lists.

RCRA Maximum Concentration of Contaminants for the Toxicity Characteristic. Source: 40CFR261.24, Table I. These are listed with regulatory level in mg/L and "D" waste numbers representing the broad waste classes of ignitability, corrosivity, and reactivity.

EPA Hazardous Waste code(s), or RCRA number, appears in its own field. Acute hazardous wastes from commercial chemical products are identified with the prefix "P." Nonacutely hazardous wastes from commercial chemical products are identified with the prefix "U."

RCRA Universal Treatment Standards. Lists hazardous wastes that are banned from land disposal unless treated to meet standards established by the regulations. Treatment standard levels for wastewater (reported in mg/L) and nonwastewater [reported in mg/kg or mg/L TCLP (Toxicity Characteristic Leachability Procedure)] have been provided. Source: 40CFR268.48 and revision, 61FR15654.

RCRA Ground Water Monitoring List. Sets standards for owners and operators of hazardous waste treatment, storage, and disposal facilities, and contains test methods suggested by the EPA (see Report SW-846) followed by the Practical Quantitation Limit (PQL) shown in parentheses. The regulation applies only to the listed chemical; and, although both the test methods and PQL are provided, they are *advisory only*. Source: 40CFR264, Appendix IX.

Safe Drinking Water Act (SDWA) Maximum Contaminant Level Goals (MCLG) for Organic Contaminants. Source: 40CFR141 and 40CFR141.50, amended 57FR31776.

- Maximum Contaminant Levels (MCL) for Organic Contaminants. Source: 40CFR141.61.
- Maximum Contaminant Level Goals (MCLG) for Inorganic Contaminants. Source: 40CFR141.51.
- Maximum Contaminant Levels (MCL) for Inorganic Contaminants. Source: 40CFR141.62.
- Maximum Contaminant Levels for Inorganic Chemicals. The maximum contaminant level for arsenic applies only to community water systems. Compliance with the MCL for arsenic is calculated pursuant to §141.23. Source: 40CFR141.11.
- Secondary Maximum Contaminant Levels (SMCL). Federal advisory standards for the states concerning substances that effect physical characteristics (i.e., smell, taste, color, etc.) of public drinking water systems. Source: 40CFR143.3.
- CERCLA Hazardous Substances ("RQ" Chemicals). From Consolidated List of Chemicals Subject to the Emergency Planning and Community Right-to-Know Act (EPCRA) and §112(r) of the Clean Air Act, as Amended. Source: EPA 550-B-98-017 *Title III List of Lists*.
- Releases of CERCLA hazardous substances in quantities equal to or greater than their reportable quantity (RQ), are subject to reporting to the National response Center under CERCLA. Such releases are also subject to state and local reporting under §304 of SARA Title III (EPCRA). CERCLA hazardous substances, and their reportable quantities, are listed in 40CFR302, Table 302.4. RQs are shown in pounds and kilograms for chemicals that are CERCLA hazardous substances. For metals listed under CERCLA (antimony, arsenic, beryllium, cadmium, chromium, copper, lead, nickel, selenium, silver, thallium, and zinc), no reporting of releases of the solid is required if the diameter of the pieces of solid metal released is 100 micrometers (0.004 inches) or greater. The RQs shown apply to smaller particles.
- EPCRA §302 Extremely Hazardous Substances (EHS). From Consolidated List of Chemicals Subject to the Emergency Planning and Community Right-to-Know Act (EPCRA) and §112(r) of the Clean Air Act, as Amended. Source: EPA 550-B-98-017 *Title III List of Lists*. The presence of Extremely Hazardous Substances in quantities in excess of the Threshold Planning Quantity (TPQ) requires certain emergency planning activities to be conducted. The Extremely Hazardous Substances and their TPQs are listed in 40CFR355, Appendices A & B. For chemicals that are solids, there may be two TPQs given (e.g., 500/ 10,000). In these cases, the lower quantity applies for solids in powder form with particle size less than 100 microns; or, if the substance is in solution or in molten form. Otherwise, the higher quantity (10,000 pounds in the example) TPQ applies.
- EPCRA §304 Reportable Quantities (RQ). In the event of a release or spill exceeding the reportable quantity, facilities are required to notify State Emergency Response Commissions (SERCs) and Local Emergency Planning Committees (LEPCs). From Consolidated List of Chemicals Subject to the Emergency Planning and Community Right-to-Know Act (EPCRA) and §112(r) of the Clean Air Act, as Amended. Source: EPA 550-B-98-017 *Title III List of Lists*.
- EPCRA §313 Toxic Chemicals. From Consolidated List of Chemicals Subject to the Emergency Planning and Community Right-to-Know Act (EPCRA) and §112(r) of the Clean Air Act, as Amended. Source: EPA 550-B-98-017 *Title III List of Lists*. Chemicals on this list are reportable under §313 and §6607 of the Pollution Prevention Act. Some chemicals are reportable by category under §313. Category codes needed for reporting are provided for the EPCRA§313 categories. Information and Federal Register (FR) references have been provided where a chemical is subject to an administrative stay, and not reportable until further notice.
- From "*Toxic Chemical Release Inventory Reporting Form R and Instructions, Revised 2005 Version,*" EPA document 260-B-06-001 was used for *de minimis* concentrations, toxic chemical categories.
- Chemicals which EPA has made the subject of Chemical Hazard Information Profiles or "CHIPS" review documents.
- Chemicals which NIOSH has made the subject of "Information Profile" review documents on "Current Intelligence Bulletins."

- Carcinogens identified by the National Toxicology Program of the U.S. Department of Health and Human Services at Research Triangle Park, NC[10].
- Substances regulated by EPA[7] under the major environmental laws: Clean Air Act, Clean Water Act, Safe Drinking Water Act, RCRA, CERCLA, EPCRA, etc. A more detailed list appears above. Substances with environmental standards set by some international bodies including those in Europe and Canada[43].
- Also new in the 2nd edition are the water hazard classifications from the German Federal Water Management Act on Water Hazard Classification, *Verwaltungsvorschrift Wassergefährdende Stoffe* (VwVwS). This law requires all chemical substances be evaluated for their detrimental impact on the physical, chemical, or biological characteristics of water. Substances can be classified as non-hazardous to water (*nwg, nicht wassergefährdende*) or assigned to one of three numeric water hazard classes, WGK-1: low hazard to waters (low polluting to water), WGK-2: hazard to waters (water pollutant), or WGK-3: severe hazard to waters (severe pollutant). The English acronym for WGK is WHC (water hazard class). This work uses the German acronym "WGK" so there is no confusion as to its source. Material Safety Data Sheets (MSDS) that use these water hazards also use the German acronym. If additional guidance or compliance assistance is needed, you are encouraged to use the information resources found in the *Appendix.* In particular, the *Directory of Industrial and Professional Agrichemical and Food-related Organizations*, the *Directory of Hotlines, Databases and Web Sites*, and the *Agrichemical Web Sites* directory provide gateways into a wealth of information on agrichemicals and food safety much too extensive to be included in this reference work. In addition, each state in the U.S. has its own statutes and regulations. Their agencies can be located in the *Directory of State Regulatory Agencies*.

Description: This section contains a quick summary of physical properties of the substance including state (solid, liquid or gas), color, odor description, molecular weight, density, boiling point, freezing/melting point, vapor pressure, flash point, autoignition temperature, explosion limits in air, Hazard Identification (based on NFPA-704 M Rating System) in the format: Health (ranked 1 to 4), Flammability (ranked 1 to 4 1 to 4), Reactivity (ranked 1 to 4) (see also below for a detailed explanation of the System and Fire Diamond), and solubility or miscibility in water. This section may also contain special and relevant comments about the substance. Terms in this section are also defined in the glossary.

Odor threshold: This is the lowest concentration in air that most humans can detect by smell. Some value ranges are reported. The value cannot be relied on to prevent over-exposure, because human sensitivity to odors varies over wide limits, some chemicals cannot be smelled at toxic concentrations, odors can be masked by other odors, and some compounds rapidly deaden the sense of smell.

Molecular weight: The MW as calculated from the molecular formula using standard elemental molecular weights (e.g. carbon = 12.1).

Boiling point at 1 atm: The value is the temperature of a liquid when its vapor pressure is 1 atm. For example, when water is heated to 100 °C/212 °F its vapor pressure rises to 1 atm and the liquid boils. The boiling point at 1 atm indicates whether a liquid will boil and become a gas at any particular temperature and sea-level atmospheric pressure.

Melting/Freezing point: The melting/freezing point is the temperature at which a solid changes to liquid or a liquid changes to a solid. For example, liquid water changes to solid ice at 0 °C/32 °F. Some liquids solidify very slowly even when cooled below their melting/freezing point. When liquids are not pure (for example, salt water) their melting/freezing points are lowered slightly.

Flash point: This is defined as the lowest temperature at which vapors above a volatile combustible substance will ignite in air when exposed to a flame. Depending on the test method used, the values given are either Tag Closed Cup (cc) (ASTM D56) or Cleveland Open Cup (oc) (ASTM D93). The values, along with those in *Flammable Limits in Air* and *Autoignition temperature* below, give an indication of the relative flammability of the chemical. In general, the open cup value is slightly higher (perhaps 10 to 15 °F higher) than the closed cup value. The flash points of flammable gases are often far below 0° (F or C) and these values are of little practical value, so the term "flammable gas" is often used instead of the flash point value.

Autoignition Temperature: This is the minimum temperature at which the material will ignite without a spark or flame being present. Values given are only approximate and may change substantially with changes in geometry, gas, or vapor concentrations, presence of catalysts, or other factors.

Flammable Limits in Air: The percent concentration in air (by volume) is given for the LEL (lower explosive-flammable limit in air, % by volume) and UEL (upper explosive flammable limit in air, % by volume), at room temperature, unless other specified. The values, along with those in "Flash point" and "Autoignition temperature," give an indication of the relative flammability of the chemical.

NFPA Hazard Classifications: The NFPA 704 Hazard Ratings (Classifications) are based on those found in "*Fire Protection Guide to Hazardous Materials*," 2001 edition, National Fire Protection Association, Quincy, MA, ©1994. The classifications are defined in Table 1 below.

Table 1 Explanation of NFPA Hazard Classifications

HEALTH HAZARD (blue)	
Classification and Definition	
4	Materials which on very short exposure could cause death or major residual injury (even though prompt medical treatment was given), including those that are too dangerous to be approached without specialized protective equipment.
3	Materials which on short exposure could cause serious temporary or residual injury (even though prompt medical treatment was given), including those requiring protection from all bodily contact.
2	Materials that, on intense or continued (but not chronic) exposure, could cause temporary incapacitation or possible residual injury, including those requiring the use of protective clothing that has an independent air supply.
1	Materials which on exposure would cause irritation but only minor residual injury, including those requiring the use of an approved air-purifying respirator.
0	Materials that on exposure under fire conditions offer no hazard beyond that of ordinary combustible material.
FLAMMABILITY (red)	
Classification number and Definition	
4	This degree includes flammable gases, pyrophoric liquids, and Class IA flammable liquids. Materials which will rapidly or completely vaporize at atmospheric pressure and normal ambient temperature, or which are readily dispersed in air and which will burn readily.
3	Includes Class IB and IC flammable liquids and materials that can be easily ignited under almost all normal temperature conditions.
2	Materials that must be moderately heated before ignition will occur and includes Class II and Class IIIA combustible liquids and solids and semi-solids that readily give off ignitable vapors.
1	Materials that must be preheated before ignition will occur, such as Class IIIB combustible liquids, and solids and semi-solids whose flash point exceeds 200 °F/93.4 °C, as well as most ordinary combustible materials.
0	Materials that will not burn.
REACTIVITY (yellow)	
Classification and Definition	
4	Materials that, in themselves, are readily capable of detonation, explosive decomposition or explosive reaction at normal temperatures and pressures.
3	Materials that, in themselves, are capable of detonation, or explosive reaction, but require a strong initiating source or heating under confinement. This includes materials that are sensitive to thermal and mechanical shock at elevated temperatures and pressures and materials that react explosively with water.
2	Materials that are normally unstable and readily undergo violent chemical change, but are not capable of detonation. This includes materials that can undergo chemical change with rapid release of energy at normal temperatures and pressures. This also includes materials that may react violently with water or that may form potentially explosive mixtures in water.
1	Materials that are normally stable, but that may become unstable at elevated temperatures and pressures and materials that will react with water with some release of energy, but not violently.
0	Materials that are normally stable, even under fire exposure conditions, and that do not react with water.

Table 1 Explanation of NFPA Hazard Classifications—cont'd

OTHER (white)
Classification and Definition
~~W~~ – Materials which react so violently with water that a possible hazard results when they come in contact with water, as in a fire situation. Similar to Reactivity Classification 2.
Oxy – Oxidizing material; any solid or liquid that readily yields oxygen or other oxidizing gas, or that readily reacts to oxidize combustible materials.
It should be noted that OSHA and DOT have differing definitions for the term "flammable liquid" and "combustible liquid." DOT defines a flammable liquid as one which, under specified procedures, has a flashpoint of 140 °F/60 °C or less. A combustible liquid is defined as "having a flashpoint above 140 °F/ 60 °C and below 200 °F/93 °C." OSHA defines a combustible liquid as having a flash point above 100 °F/37.7 °C.

Incompatibilities: Important, potentially hazardous incompatibilities of each substance are listed where available. Where a hazard with water exists, it is described. Reactivity with other materials is described, including structural materials such as metal, wood, plastics, cement, and glass. The nature of the hazard, such as severe corrosion, formation of a flammable gas, is described. This list is by no means complete or all-inclusive. In some cases a very small quantity of material can act as a catalyst and produce violent reactions such as polymerization, disassociation and condensation. Some chemicals can undergo rapid polymerization to form sticky, resinous materials, with the liberation of much heat. The containers may explode. For these chemicals the conditions under which the reaction can occur are given.

Permissible Exposure Limits in Air: The permissible exposure limit (PEL) has been cited as the federal standard where one exists. Inasmuch as OSHA has made the decision to enforce only pre-1989 PELs, we decided to use these values rather than the transitional limits that were vacated by court order. Except where otherwise noted, the PELs are 8-hour work-shift time-weighted average (TWA) levels. Ceiling limits, Short Term Exposure Limits (STEL), and TWAs that are averaged over other than full work-shifts are noted.

The Short-Term Exposure Limit (STEL) values are derived from NIOSH[58], ACGIH[1], and HSE[33] publications. This value is the maximal concentration to which workers can be exposed for a period up to 15 minutes continuously without suffering from: irritation; chronic or irreversible tissue change; or narcosis of sufficient degree to increase accident proneness, impair self-rescue, or materially reduce work efficiency, provided that no more than four excursions per day are permitted, with at least 60 minutes between exposure periods, and provided that the daily TWA also is not exceeded. The "Immediately Dangerous to Life or Health" (IDLH) concentration represents a maximum level from which one could escape within 30 minutes without any impairing symptoms or any irreversible health effects. However, the 30-minute period is meant to represent a MARGIN OF SAFETY and is NOT meant to imply that any person should stay in the work environments any longer than necessary. In fact, every effort should be made to exit immediately. The concentrations are reported in either parts per million (ppm) or milligrams per cubic meter (mg/m^3).

Most U.S. specifications on permissible exposure limits in air have come from ACGIH[1] or NIOSH[2]. In the U.K. the Health and Safety Executive has set forth Occupational Exposure Limits[33]. In Germany the DFG has established Maximum Concentrations in the workplace[3]. This section also contains numerical values for allowable limits of various materials in ambient air[60] as assembled by the U.S. EPA. Where available, this field contains legally enforceable airborne Permissible Exposure Limits (PELs) from OSHA. It also contains recommended airborne exposure limits from NIOSH, ACGIH, and international sources and special warnings when a chemical substance is a Special Health Hazard Substance. Each is described below. TLVs have not been developed as legal standards and the ACGIH does not advocate their use as such. The TLV is defined as the time-weighted average (TWA) concentration for a normal 8-hour work-day and a 40-hour work-week, to which nearly all workers may be repeatedly exposed, day after day, without adverse effects. A ceiling value (TLV-C) is the concentration that should not be exceeded during any part of the working exposure. If instantaneous monitoring is not feasible, then the TLV-C can be assessed by sampling over a 15-minute period except for those substances that may cause immediate irritation when exposures are short. As some people become ill after exposure to concentrations lower than the exposure limits, this value cannot be used to define exactly what is a "safe" or "dangerous" concentration. ACGIH threshold limit values (TLVs) are reprinted with permission of the American Conference of Governmental Industrial Hygienists, Inc., from the booklet entitled, *Threshold Limit Values for Chemical Substances and Physical Agents and Biological Exposure Indices.* This booklet is revised on an annual basis. No entry appears when the chemical is a mixture; it is possible to calculate the TLV for a mixture only when the TLV for each component of the mixture is known and the composition of the mixture by weight is also known. According to ACGIH, "Documentation of the Threshold Limit Values and Biological Exposure Indices, 7th Edition" is necessary to fully interpret and implement the TLVs.

OSHA Permissible Exposure Limits (PELs) are found in Tables Z-1, Z-2, and Z-3 of OSHA, "General Industry Air Contaminants Standard (29CFR1910.1000)" that were effective on July 1, 2001 and which are currently enforced by OSHA.

Unless otherwise noted, PELs are the Time-Weighted Average (TWA) concentrations that must not be exceeded during any 8-hour shift of a 40-hour work-week. An OSHA ceiling concentration must not be exceeded during any part of the work-day; if instantaneous monitoring is not feasible, the ceiling must be assessed as a 15-minute TWA exposure. In addition there are a number of substances from Table Z-2 that have PEL ceiling values that must not be exceeded except for a maximum peak over a specified period (e.g., a 5- minute maximum peak in any 2 hours).

NIOSH Recommended Exposure Limits (RELs) are Time-Weighted Average (TWA) concentrations for up to a 10-hour work day during a 40-hour work week. A ceiling REL should not be exceeded at any time. Exposure limits are usually expressed in units of parts per million (ppm), i.e., the parts of vapor (gas) per million parts of contaminated air by volume at 25 °C/77 °F and one atmosphere pressure. For a chemical that forms a fine mist or dust, the concentration is given in milligrams per cubic meter (mg/m^3).

Protective Action Criteria (PAC) are emergency exposure limits developed by the U.S. Department of Energy (DOE) for 3387 chemicals in revision 27, published February 2012. These exposure limits can be used to estimate the consequences of the uncontrolled release of hazardous materials and to plan for emergency response. These PACs have been added to the 2nd edition because other well-established exposure limits in air are available for a only a limited number of chemicals from other governmental and advisory sources. PAC values are given in parts per million (ppm) for volatile liquids and gases; in milligrams per cubic meter (mg/m^3) for solids, particulates, solids, and nonvolatile liquids. Chemicals for which there are Acute Emergency Guideline Levels (AEGLs) and Emergency Response Planning Guidelines (ERPGs) have their values displayed in **bold** font. TEELs are intended for use until AEGLs or ERPGs are adopted for chemicals. For additional information see http://www.atlintl.com/DOE/teels/teel.html.

PAC Definitions:[SCAPA]

There are subtle difference in the definitions of AEGLs, ERPGs, and TEELs and major differences in how they are developed and issued. Differences in their definitions include:

AEGLs pertain to the "general population, including susceptible individuals," but ERPGs and TEELs pertain to "nearly all individuals."

AEGLs are defined as the level "above which" certain health effects are expected, while ERPGs and TEELs are defined as the level "below which" certain health effects are not expected.

Acute Emergency Guideline Levels (AEGLs) are defined as follows:

- *AEGL-1:* the airborne concentration (expressed as ppm or mg/m^3) of a substance above which it is predicted that the general population, including susceptible individuals, could experience notable discomfort, irritation, or certain asymptomatic, nonsensory effects. However, these effects are not disabling and are transient and reversible upon cessation of exposure.
- *AEGL-2:* the airborne concentration (expressed as ppm or mg/m^3) of a substance above which it is predicted that the general population, including susceptible individuals, could experience irreversible or other serious, long-lasting, adverse health effects or an impaired ability to escape.
- *AEGL-3:* the airborne concentration (expressed as ppm or mg/m^3) of a substance above which it is predicted that the general population, including susceptible individuals, could experience life-threatening adverse health effects or death.

Emergency Response Planning Guidelines (ERPGs) are defined as follows:

- *ERPG-1*: the maximum concentration in air below which it is believed nearly all individuals could be exposed for up to one hour without experiencing other than mild transient adverse health effects or perceiving a clearly defined objectionable odor.
- *ERPG-2*: the maximum concentration in air below which it is believed nearly all individuals could be exposed for up to one hour without experiencing or developing irreversible or other serious health effects or symptoms that could impair their abilities to take protective action.
- *ERPG-3*: the maximum concentration in air below which it is believed nearly all individuals could be exposed for up to one hour without experiencing or developing life-threatening health effects.

Temporary Emergency Exposure Limits (TEELs) are defined as follows:

- *TEEL-0*: the threshold concentration below which most people will experience no adverse health effects.
- *TEEL-1:* the airborne concentration (expressed as ppm or mg/m^3) of a substance above which it is predicted that the general population, including susceptible individuals, could experience notable discomfort, irritation, or certain asymptomatic, nonsensory effects. However, these effects are not disabling and are transient and reversible upon cessation of exposure.
- *TEEL-2:* the airborne concentration (expressed as ppm or mg/m^3) of a substance above which it is predicted that the general population, including susceptible individuals, could experience irreversible or other serious, long-lasting, adverse health effects or an impaired ability to escape.
- *TEEL-3:* the airborne concentration (expressed as ppm or mg/m^3) of a substance above which it is predicted that

the general population, including susceptible individuals, could experience life-threatening adverse health effects or death.

- TEELs are intended for use until AEGLs or ERPGs are adopted for chemicals.
- There are three levels of PAC value (1 to 3) where each successive value is associated with an increasingly severe effect from a higher level of exposure. Each level is defined as follows:
  PAC-1: Mild, transient health effects.
  PAC-2: Irreversible or other serious health effects that could impair the ability to take protective action.
  PAC-3: Life-threatening health effects.

Additional information on PAC values values, and links to other sources of information, can be found on the webpage for the *Subcommittee for Consequence Assessment and Protective Action (SCAPA)*: http://orise.orau.gov/emi/scapa/teels.htm.

The German MAK (DFG MAK values are conceived and applied as 8-hour time-weighted average (TWA) values[3].

Determination in Air: The citations to analytical methods are drawn from various sources, such as the *NIOSH Manual of Analytical Methods*[18]. In addition, methods have been cited in the latest U.S. Department of Health and Human Services publications including the *"NIOSH Pocket Guide to Chemical Hazards"* August, 2006

Permissible Concentrations in Water: The permissible concentrations in water are drawn from various sources, including: The National Academy of Sciences/National Research Council, Safe Drinking Water Committee Board on Toxicology and Environmental Health Hazards, *Drinking Water and Health*, 1980[16]. The priority toxic pollutant criteria published by U.S. EPA 1980[6]. The multimedia environmental goals for environmental assessment study conducted by EPA[32]. Values are cited from this source when not available from other sources. The U.S. EPA has come forth with a variety of allowable concentration levels: For allowable concentrations in "California List" wastes[38]. The California List consists of liquid hazardous wastes containing certain metals, free cyanides, polychlorinated biphenyls (PCBs), corrosives with a pH of less than or equal to 2.0, and liquid and nonliquid hazardous wastes containing halogenated organic compounds (HOCs). For regulatory levels in leachates from landfills[37]. For concentrations of various materials in effluents from the organic chemicals and plastics and synthetic fiber industries[51]. For contaminants in drinking water[36]. For National Primary and Secondary Drinking Water Regulations[62]. In the form of health advisories for 16 pesticides,[47] 25 organics,[48] and 7 inorganics[49]. For primary drinking water standards starting with a priority list of 8 Volatile Organic Chemicals[40]. State drinking water standards and guidelines[61] as assembled by the U.S. EPA.

Determination in Water: The sources of information in this field have been primarily U.S. EPA publications including the test procedures for priority pollutant analysis[25] and later modifications[42]. Octanol/water partition information is from various sources and it is controversial from the standpoint of reliability.

The octanol/water partition coefficient (commonly denoted K_{ow}) is a dimensionless concentration ratio (measurement) of the water-repulsing property of an organic compound. The higher the repulsion of a compound, the less soluble it is. The K_{ow} is used to estimated a substance's potential to harm the environment. Generally speaking, higher values have a greater chance of causing harm to the environment and accumulating in living tissue, especially values of 3.0 or higher. The U.S. EPA (2009) defines it as "A coefficient representing the ratio of the solubility of a compound in octanol (a non-polar solvent) to its solubility in water (a polar solvent). The higher to K_{OW}, the more non-polar the compound. Log K_{OW} is generally used as a relative indicator of the tendency of an organic compound to adsorb to soil. Log K_{OW} values are generally inversely related to aqueous solubility and directly proportional to molecular weight."

Routes of Entry: The toxicologically important routes of entry of each substance are listed. In other words, the way in which the people or experimental animals were exposed to the chemical is listed, e.g. eye contact, skin (or dermal) contact, inhalation, ingestion. Many of these are taken from the *NIOSH Pocket Guide*[2], and the NLM's *Hazardous Substance Data Bank*, but are drawn from other sources as well.

Harmful Effects and Symptoms: These are primarily drawn from NIOSH, EPA publications, data and state fact sheets and are supplemented by information from the draft criteria documents for priority toxic pollutants[26] and from other sources. The other sources include: EPA Chemical Hazard Information Profiles (CHIPS) cited under individual entries, NIOSH Information Profiles cited under individual entries, EPA Health and Environmental Effect Profiles cited under individual entries. Particular attention has been paid to cancer as a "harmful effect" and special effort has been expended to include current data on carcinogenicity. See also "Regulatory Authority and Advisory Bodies" section. See above.

Short Term Exposure: This section contains warnings and symptoms of exposure occurring over a short period of time, depending on route(s) of exposure: skin or eye contact, inhalation, or ingestion. This term is not to be confused with "Short-term Exposure Limit," which is a recommended exposure limit suggested by ACGIH and others and is defined as "maximum concentration to which workers can be exposed for a short period of time (15 minutes) for only four times throughout the day with at least one hour between exposures." This information can be found, if available, in the section entitled "Permissible Exposure Limits in Air." Also included under this heading is the LD_{50} for animals in mg/kg. The term LD50 (LD_{50}) signifies that about 50% of the animals given the specified dose will die. In most cases, the LD_{50} is for rat (or rabbit in fewer cases), administered orally and to the skin. Dangers extend fro Category I (most dangerous) to Category IV. See below:

Toxicity Categories				
Study	**Category I or 1**	**Category II or 2**	**Category III or 3**	**Category IV or 4**
Acute Oral	Up to & including 50 mg/kg	>50 thru 500 mg/kg	>500 thru 5000 mg/kg	>5000 mg/kg
Acute Dermal	Up to & including 200 mg/kg	>200 thru 2000 mg/kg	>2000 thru 5000 mg/kg	>5000 mg/kg

Source: 40 CFR156.64 (February 12, 2002)

Long Term Exposure: Where there is evidence that the chemical can cause cancer, mutagenic effects, teratogenic effects, or a delayed injury to vital organs such as the liver or kidney, a description of the effect is given.

Points of Attack: This category is based, in part, on the "Target Organs" in the *NIOSH Pocket Guide*[2] but the title has been changed as many of the points of attack are not organs (blood, for example). This is human data unless otherwise noted.

Medical Surveillance: This information is often drawn from various sources, including NIOSH publications[27], databases, and fact sheets, including *New Jersey State Fact Sheets*[70] on individual chemicals. Some time the information comes from a number of sources including databases and manufacturer's MSDSs. Where additional information is desired in areas of diagnosis, treatment and medical control, the reader is referred to a private publication[28] which is adapted from the products of the *NIOSH Standards Completion Program*.

First Aid: Guides and guidance to first aid found in this work should *NOT* be construed as authorization to emergency personnel to perform the procedures or activities indicated or implied. Care of persons exposed to toxic chemicals must be directed by a physician or other recognized professional or authority. Simple first aid procedures are listed for response to eye contact, skin contact, inhalation, and ingestion of the toxic substance as drawn to a large extent from the *NIOSH Pocket Guide*[2] but supplemented by information from recent commercially available volumes in the U.S.,[29] in the U.K., and in Japan[24] as well as from various state fact sheets and the *Emergency Response Guide* (ERG). They deal with exposure to the vapor (gas), liquid, or solid and include inhalation, ingestion (swallowing) and contact with eyes or skin. The instruction "Do NOT induce vomiting" is given if an unusual hazard is associated with the chemical being sucked into the lungs (aspiration) while the patient is vomiting. "*Seek medical attention*" or "*Call a doctor*" is recommended in those cases where only competent medical personnel can treat the injury properly. In all cases of human exposure, seek medical assistance as soon as possible. In many cases, medical advice has been included for guidance only.

Personal Protective Methods: This information is drawn heavily from NIOSH publications[2][77] and supplemented by information from the U.S.,[29] the U.K. and Japan[24]. There are indeed other "personal protective methods" which space limitations prohibit describing here in full. One of these involves limiting the quantities of carcinogens to which a worker is exposed in the laboratory. The items listed are those recommended by (a) NIOSH and/or OSHA, (b) manufacturers, either in technical bulletins or in material safety data sheets (MSDS), (c) the Chemical Manufacturers Association (CMA), or (d) the National Safety Council (NSC), for use by personnel while responding to fire or accidental discharge of the chemical. They are intended to protect the lungs, eyes, and skin.

Respirator Selection: The 2nd edition, like its predecessors, presents respirator selection with a full text description where available. For each line a maximum use concentration (in ppm, mg/m^3, μg/m^3, fibers/m^3, or mppcf), condition (e.g., escape) followed by the NIOSH code and full text related to respirator recommendations. All recommended respirators of a given class can be utilized at any concentration equal to or less than the class's listed maximum use concentration. Respirator selection should follow recommendations that provide the greatest degree of protection. Respirator codes found in the *NIOSH Pocket Guide* have been included to ease updating.

All respirators selected must be approved by NIOSH under the provisions of 42CFR84, 29CFR1910.134, or European Standard EN149. The current listing of NIOSH/MSHA certified respirators can be found in the *NIOSH Certified Equipment List*, which is available on www.cdc.gov/niosh/npptl/topics/respirators/cel. For firefighting, only self-contained breathing apparatuses with full facepieces operated in pressure-demand or other positive-pressure modes are recommended for all chemicals in the *NIOSH Pocket Guide*. In the case of pesticides that might be used as weapons of mass destruction, use only SCBA respirators certified by NIOSH for CBRN environments. CBRN stands for "Chemical, Biological, Radiological, and Nuclear."

Pesticides are not identified as such in the respirator selection tables. For those substances that are pesticides, the recommended air-purifying respirator must be specifically approved by NIOSH/MSHA. Specific information on choosing the appropriate respirator will be provided on pesticide labels. Approved respirators will carry a "TC" number prefix, which signifies they have been tested and certified for a specific level of protection. New respirators may carry a "TC-84A" prefix in compliance with 42 CFR 84 for testing and certifying non-powered, air-purifying, particulate-filter respirators. The new Part 84 respirators have passed a more demanding certification test than the old respirators (e.g., dust and mist [DM], dust, fume and mist [DFM], spray paint, pesticide, etc.) certified under 30 CFR 11.

Additionally, a complete respirator protection program should be implemented including all requirements in

29CFR1910.134 and 42CFR84. At a minimum, a respirator protection program should include regular training, fit-testing, periodic environmental monitoring, maintenance inspection, and cleaning. The selection of the actual respirator to be used within the classes of recommended respirators depends on the particular use situation, and should only be made by a knowledgeable person. Remember, air-purifying respirators will not protect from oxygen-deficient atmospheres. For firefighting, only self-contained breathing apparatuses with full facepieces operated in pressure-demand or other positive-pressure modes are recommended for all chemicals in the *NIOSH Pocket Guide*.

Storage: The 2nd edition now provides, as general guidance, a color-coded classification system similar to those often found in commerce and laboratories. It is the objective of any chemical storage classification system to prevent accidental combination of two (2) or more incompatible materials or conditions that might be stored or occur in the same space. To prevent an unwanted and possibly dangerous reaction, chemicals must be separated by space and/or physical barriers. Chemical storage areas should be appropriately labeled. Users must be careful to check the MSDS for both additional and specific information. Some chemical entries contain multiple storage codes because the chemical profile may fit more than a single category. This section is merely a guide and cannot replace the judgement of qualified personnel.

Code	**Hazard**
Red	Flammables (Flash point <100 °F)
Blue	Health Hazards/Toxics/Poisons
Yellow	Reactives/Oxidizers
White	Contact Hazards
Green*	General Storage

*Note**: For General Storage, the colors Gray and Orange may also be used by some facilities companies.

- Chemical containers that are not color-coded should contain hazard information on the label. Check the MSDS to learn what personal protective equipment is required when using the substance.
- *Red*: Flammability Hazard: Store in a flammable (liquid or materials) storage area or approved cabinet away from ignition sources and corrosive and reactive materials.
- Blue: Health Hazard/Toxics/Poisons: Store in a secure poison location.
- Yellow: Reactive Hazard; Store in a location separate from other materials, especially flammables and combustibles.
- White: Corrosive or Contact Hazard; Store separately in a corrosion-resistant location.
- Green (or Gray or Orange): General storage may be used. Generally, for flammability, health, and corrosivity with an NFPA rating of no higher than “2."
- Chemicals with labels that are colored and diagonally striped may react with other chemicals in the same hazard class. See MSDS for more information.
- Red Stripe: Flammability Hazard: Store separately from all other flammable materials. *Example:* sodium metal.
- Yellow Stripe: Reactivity Hazard; Store separately in a area isolated from flammables, combustibles, or other yellow coded materials. *Example*: reducing agents.
- White stripe: Contact Hazard; not compatible with materials in solid white category. Store separately. *Exampl*e: Bases.

Other data in this field are drawn from, or based on, various resources, including the NFPA,[17] from Japanese sources[24] and from publications such as the *Hazardous Substance Fact Sheets* published by the New Jersey Department of Health and Senior Services[70].

Shipping: The shipping guidance offered herein does not replace the training requirements of the Department of Transportation and in no way guarantees that you will be in full compliance with the Department of Transportation Regulations. *Labeling*: This section refers to the type label or placard required by regulation on any container or packaging of the subject compound being shipped. In some cases a material may require more than one hazardous materials label. *Quantity limitation:* This section lists quantities of material that may be shipped on passenger aircraft, rail, and cargo aircraft. Materials in certain hazard classes may be shipped under the small-quantities exception (see ***49 CFR 173.4***) with specific approval from the Associate Administrator for Hazardous Materials Safety, Department of Transportation. *Hazard class or division:* This number refers to the division number or hazard class that must appear on shipping papers. This information is drawn from DOT publications[19] as well as U.N. publications[20] and also NFPA publications[17], FEMA[78], CHRIS[86], HSDB[83]. The U.S. Department of Transportation[19] has published listings of chemical substances which give a hazard classification and required labels. The U.S. DOT listing now corresponds with the U.N. listing[20] and specifies first a hazard class of chemicals as defined in the following table, and then a packing group (I, II or III) within each of the classes. Where shown the packing group is for the active ingredient and not the formulation, especially those containing dangerous and flammable carriers and/or organic chemicals such as acetone, kerosene, naphthas, etc.

Spill Handling: Spill or leak information provided is intended to be used only as a guide. The term *Issue warning* is used when the chemical is a poison, has a high flammability, is a water contaminant, is an air contaminant (so as to be hazardous to life), is an oxidizing material, or is corrosive. *Restrict access* is used for those chemicals that are unusually and immediately hazardous to personnel unless they are protected properly by appropriate protective clothing, eye protection, and respiratory protection equipment, etc. *Evacuate area* is used primarily for unusually poisonous chemicals or those that ignite easily. *Mechanical containment* is used for water-insoluble chemicals that float and do not evaporate readily. *Should be removed* is used for chemicals that cannot be allowed to disperse because of potentially harmful effects on humans or on the ecological system in general. The term is not used unless there is a reasonable chance of preventing dispersal, after a discharge or leak, by chemical and physical treatment. *Chemical and physical treatment* is recommended for chemicals that can be removed by skimming, pumping, dredging, burning, neutralization, absorption, coagulation, or precipitation. The corrective response may also include the use of dispersing agents, sinking agents, and biological treatment. *Disperse and flush* is used for chemicals that can be made non-hazardous to humans by simple dilution with water. In a few cases the response is indicated even when the compound reacts with water because, when proper care is taken, dilution is still the most effective way of removing the primary hazard. This material safety data sheet information is drawn from a variety of sources including New Jersey Department of Health and Senior Services *Hazardous Substance Fact Sheets*[70] and EPA *Profiles on Extremely Hazardous Substances*[82].

Fire Extinguishing: Fire information provided is intended to be used only as a guide. Certain extinguishing agents should not to be used because the listed agents react with the chemical and have the potential to create an additional hazard. Many chemicals decompose or burn to give off toxic and irritating gases. Such gases may also be given off by chemicals that vaporize in the heat of a fire without either decomposing or burning. If no entry appears, the combustion products are thought to be similar to those formed by the burning of oil, gasoline, or alcohol; they include carbon monoxide (poisonous), carbon dioxide, and water vapor. Specific combustion products are usually not well known over the wide variety of conditions existing in fires; some may be hazardous. This information is drawn from NFPA publications[17], FEMA[78], CHRIS[86], HSDB[83], and other sources. The formation of flammable vapor clouds or dense smoke, the possibility of polymerization, and explosions is stated in this section and/or the incompatibility section.

Disposal Method Suggested: The disposal methods for various chemical substances have been drawn from various sources, including government documents[22][79].

References: The general bibliography for this volume follows the pesticide monographs. It includes both general reference sources and references dealing with analytical methods. The references at the end of individual chemical records are generally restricted to references dealing only with that particular compound; and references which, in turn, contain bibliographies giving references to the original literature.

Key to Abbreviations, Symbols, and Acronyms

Key to Abbreviations, Symbols, and Acronyms

α-	Greek letter alpha; used as a prefix to denote the carbon atom in a straight chain compound to which the principal group is attached.
as-	Prefix for asymmetric
ACGIH	American Conference of Governmental Industrial Hygienists
ANSI	American National Standards Institute
approx.	Approximately
ASTDR	Agency for Toxic Substances and Disease Registry
asym-	Prefix for asymmetric
@	at
atm.	Atmosphere
β	Greek letter beta
BP	Boiling point
C	Centigrade
[C]	Canceled (use registration)
CAA	Clean Air Act
CAAA	Clean Air Act Amendments of 1990
carc.	Carcinogen
CAS	Chemical Abstract Service
cc	Closed cup; cubic centimeter
CEPA	Canadian Environmental Protection Act
CERCLA	Comprehensive Environmental Response, Compensation, And Liability Act
CFR	Code of Federal Regulations
CHCL	Chronic Human Carcinogen Level
CHEMTREC	Chemical Manufacturers Association (CMA) Transportation Emergency Center
cis-	(Latin, on this side). Indicating one of two geometrical isomers in which certain atoms or groups are on the same side of a plane.
comp.	Compound
CWA	Clean Water Act
cyclo-	(Greek, circle). Cyclic, ring structure; as cyclohexane
Δ *or* δ	Greek letter delta
deriv.	Derivative
DFG	Deutsche Forschungsgemeinschaft
DOT	U.S. Department of Transportation
DOT ID	U.S. Department of Transportation Identification Numbers
Ed.	Editor(s)
EEC	European Economic Community
EHS	Extremely Hazardous Substances
EINECS	European Inventory of Existing Commercial Substances
EPA	U.S. Environmental Protection Agency
EPCRA	Emergency Planning and Community Right-to-Know Act
EXTOXNET	Extension Toxicology Network
F	Fahrenheit
FDA	U.S. Food and Drug Administration
FEMA	Federal Emergency Management Agency
FIFRA	Federal Insecticide, Fungicide, and Rodenticide Act
FR	Federal Register
GUP	General Use Pesticide
h	Hour(s)
HAPs	Hazardous Air Pollutants (CAA)
HCFC	Hydrochlorofluorocarbons
HCS	Hazard Communication Standard
HOC	Halogenated Organic Compounds
HSE	Health and Safety Executive (United Kingdom)
IARC	International Agency for Research on Cancer
ICSC	International Chemical Safety Cards
IDLH	Immediately Dangerous to Life or Health
IPCS	International Programme on Chemical Safety
iso-	(Greek, equal, alike). Usually denoting an isomer of a compound.
kg	Weight in kilograms (one thousand grams)
L or l	Liter(s)
lb	Weight in pound(s)
LEL	Lower explosive (flammable) limit in air, % by volume at room temperature or other temperature as noted
LEPC	Local Emergency Planning Committees
m-	An abbreviation for "*meta-*," a prefix used to distinguish between isomers or nearly related compounds
m^3	Cubic meter
MACT	Maximum Achievable Control Technology (CAA)
MAK	Airborne exposure limit used by the Deutsche Forschungsgemeinschaft (DFG)
MATC	Maximum Acceptable Toxicant Concentration
MCLs	Maximum Contaminant Levels (SDWA)
MCLGs	Maximum Contaminant Level Goals (SDWA)
m^3	Cubic meter
mg	Milligram
μ	Micro

µg	Microgram(s)
min	Time in minute(s)
mppcf	Million particles per cubic foot
MSDS	Material Safety Data Sheets
mbyp	Meat byproducts
n-	Abbreviation for "*normal*," referring to the arrangement of carbon atoms in a chemical molecule prefix for normal
N-	Symbol used in some chemical names, indicating that the next section of the name refers to a chemical group attached to a nitrogen atom. The bond to the nitrogen atom.
(N)	Neligible
NCEH	National Center for Environmental Health (CDC)
NCI	National Cancer Institute
NFPA	National Fire Protection Association
NIOSH	National Institute for Safety and Occupational Health
NOAEL	No-Adverse-Effect-Level
n.o.s.	Not otherwise specified
NPRI	National Pollutant Release Inventory (Canada)
NTP	National Toxicology Program (U.S.)
o-	Abbreviation for *ortho* -, a prefix used to distinguish between isomers or nearly related compounds.
o.c. or oc	Open cup
OPP	Office of Pesticides Programs (USEPA)
OSHA	Occupational Safety and Health Administration
Oxy	Oxidizer or oxidizing agent
p-	Abbreviation for for *para-*, a prefix used to distinguish between isomers or nearly related compounds.
PEL	Permissible Exposure Limit (OSHA)
post-h	Post harvest
pot. carc	Potential carcinogen
PPOTW	Publicly Owned Treatments Works
PP	Polypropylene
ppb	Parts per billion
PPE	Personal Protective Equipment
ppm	Parts per million
PQL	Practical Quantitation Limit (RCRA)
prim-	Prefix for primary
®	Symbol for a registered trademark or proprietary product
RED	Reregistration Eligibility Decision (EPA)
REL	Recommended Exposure Limits (NIOSH)
RQ	Reportable Quantity
RTECS®	Registry of Toxic Effects of Chemical Substances
RTK	Right-to -Know
RUP	Regulated Use Pesticide
SARA	Superfund Amendments and Reauthorization Act
SCBA	Self-contained breathing apparatus
SDWA	Safe Drinking Water Act
sec-	Prefix for secondary
SERC	State emergency response commissions
SMCL	Secondary Maximum Contaminant Levels (SDWA)
soln.	Solution
STEL	Short-Term Exposure Limit
sus. carc.	Suspected Carcinogen
sym-	Abbreviation for "*symmetrical*," referring to a particular arrangement of elements within a chemical molecule
t-	Prefix for tertiary
TRK	Technical Guiding Concentrations (DFG) for workplace control of carcinogens.
temp.	Temperature
tert-	Abbreviation for "*tertiary*," referring to a particular arrangement of elements within a chemical molecule
TLV®	Threshold Limit Value (ACGIH)
™	Symbol for trademark
TQ	Threshold Quantity
trans-	(Latin, across). Indicating one of two geometrical isomers in which certain atoms or groups are on opposite sides of a plane.
TRI	Toxics Release Inventory
TSCA	Toxic Substances Control Act
TWA	Time-Weighted Average
UEL	Upper explosive (flammable) limit in air, % by volume at room temperature or other temperature as noted
unsym-	Prefix for "*asymmetric*."
USDA	U.S. Department of Agriculture
USPHS	U.S. Public Health Service
VOCs	Volatile Organic Compounds
WHO	World Health Organization
>	Symbol for "greater than"
<	Symbol for "less than"
°	Degrees of temperature
%	Percent
§	Symbol for "section." Used in regulatory matters.
(S!)	Symbol for "Suspected."
(?)	Symbol for "Questionable."

A

Abamectin A:0010

Use Type: Acaricide, Miticide, Insecticide, Anthelmentic
CAS Number: 71751-41-2; 65195-55-3 (B_{1a}); 65195-56-4 (B_{1b}); 15555-91-8 (benzoate)
Formula: $C_{95}H_{142}O_{28}$; $C_{48}H_{72}O_{14}$ (B_{1a}); $C_{47}H_{70}O_{14}$ (B_{1b})
Synonyms: Avermectin; Avermectin B_{1a}; Avermectin B_{1a}+Avermectin B_{1b} mixture (80/20%)
Trade Names: ABACIDE®; AFFIRM®; AVID®, AVID-EC®; AVOMEC®; DYNAMEC®; INJECT-A-CIDE AV®; MK 936®(B_{1A}); BOVITIN®; DORATECT®; DUOMECTIN®; DUOTIN®; ENDECTO®; ENZEC®; L 676,863® (B_{1A}); MK 0936®; MK 936®; PARAFOIL®; VERTIMEC®, VERTIMIL®; VIVID®; ZECTIN®; ZEPHEYR®; ZEPHYR®
Chemical Class: Avermectins; Macrocyclic lactone
EPA/OPP PC Code: 122804
California DPR Chemical Code: 2254
HSDB Number: 6941
UN/NA&ERG Number: UN2811 (solid)/154
RTECS® Number: CL1203000
EC Number: [*Annex I Index No.* 606-143-00-0]
Uses: Used on fruit, vegetable and ornamental crops; pears, citrus fruits, and nut crops; to control mite and insect pests, and also to control household and lawn insects, including fire ants. Approved by the EPA for use in ash trees for control of emerald ash borer. A U.S. EPA restricted Use Pesticide (RUP).
Human toxicity (long-term)[101]: High–2.80 ppb, Health Advisory.
Fish toxicity (threshold)[101]: Extra High–0.00570 ppb, MATC (Maximum Acceptable Toxicant Concentration).
Correction and removal of text
Regulatory Authority and Advisory Information:
Carcinogenicity[83]: EPA Group E, evidence of non-carcinogenicity for humans
California Proposition 65 Chemical: Developmental toxin (12/3/2010)
Health Advisory: Nerve toxin (S!), Endocrine disruptor (S!)
Acute Oral Category: 1, DANGER-Poison. According to the EPA, most "formulated" products containing abamectin as an ingredient are of low toxicity to mammals.
EPCRA Section 313 Form R *de minimis* concentration reporting level: 1.0%
European/International Regulations: Hazard Symbol: T+, N; risk phrases: R26/28; R48/23/25; R50/53; R63; safety phrases: S2; S28; S36/37; S45; S60; S61.
Description: Abamectin is an off-white to yellow crystalline solid from methanol. A mixture of 80% B_{1a} and 20% B_{1b}. Odorless. Molecular weight = 887.11; Specific gravity (H_2O:1) = 1.158 @ 21 °C; Freezing/Melting point = 150–155 °C. Vapor pressure = negligible, 1.5×10^{-9} mmHg; Flash point = 135–150 °C. Hazard Identification (based on NFPA-704 M Rating System): Health 3; Flammability 1; Reactivity 0. Practically insoluble in water; solubility = 3.5×10^{-4} g/100 mL.
Incompatibilities: May react with strong oxidizers such as chlorates, peroxides, nitrates, etc.
Permissible Concentration in Water: Runoff from spills or fire control may cause water pollution. Highly toxic to aquatic organisms.
Routes of Entry: Inhalation, ingestion, dermal contact.
Harmful Effects and Symptoms
Short Term Exposure: Technical product: Contact with eyes or skin may cause irritation and/or injury. May be absorbed through the skin. Very toxic when swallowed: doses of 100 mg/kg or more may be fatal to humans. Inhalation should be avoided. Stimulates the release of γ-aminobutyric acid, an inhibitory neurotransmitter, resulting in paralysis. Very high doses may cause respiratory failure with possible death. LD_{50} (oral, rat) = 11 mg/kg.; LD_{50} (dermal, rat) = >330 mg/kg.
Long Term Exposure: Possible Reproductive Toxin. May be a neurotoxin[83]. Possible damage to the central nervous system.
Points of Attack: Skin, eyes, central nervous system, brain.
Medical Surveillance: In addition to comprehensive initial medical and work histories emphasizing reproductive experience and menstrual history, patient should have physical examination and testing of genito-urinary tract, sperm count, motility and morphology. If required, other tests, such as serum testosterone, serum follicle stimulating hormone (FSH), and serum lutenizing hormone (LH), may be indicated.
First Aid: If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least 15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately. If this chemical contacts the skin, remove contaminated clothing and wash immediately with soap and water. Seek medical attention immediately. If this chemical has been inhaled, remove from exposure, begin rescue breathing (using universal precautions) if breathing has stopped, and CPR if heart action has stopped. Transfer promptly to a medical facility. When this chemical has been swallowed, get medical attention. Give large quantities of water and induce vomiting. Do not make an unconscious person vomit.
Personal Protective Methods: Smoking, eating, and drinking before washing should be absolutely prohibited when any pesticide is being handled or used. Applicators and other handlers must wear: Coveralls worn over long-sleeved shirt and long pants; Chemical-resistant gloves such as DuPont™ Tychem® suit fabrics, barrier laminate, or Viton®; Chemical-resistant footwear plus socks;

Protective eye wear; Chemical-resistant headgear for overhead exposure; Chemical-resistant apron when cleaning equipment, mixing, or loading[83]. Agricultural Use/Engineering Controls: When handlers use closed systems, enclosed cabs, or aircraft in a manner that meets the requirements listed in the Worker Protection Standard (WPS) for agricultural pesticides, ***40 CFR 170.240(d)(4-6),*** the handler PPE requirements may be reduced or modified as specified in the Worker Protection Standard.

Respirator Selection: Reacts with the following absorbent materials: Cellulose-Based; Dirt/Earth[88]. Follow regulations in OSHA 29CFR1910.134 or European Standard EN149. Use a NIOSH/MSHA- or European Standard EN149-approved respirator; or use an approved supplied-air respirator with a full facepiece operated in the positive-pressure mode, or with a full facepiece, hood, or helmet in the continuous-flow mode; or use a NIOSH/MSHA- or European Standard EN149-approved self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive-pressure mode.

Storage: Color Code-Blue: Health Hazard/Poison (Toxic): Store in a secure, locked and cool, ventilated area. Prior to working with this chemical you should be trained on its proper handling and storage. Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: This compound requires a shipping label of "Toxic, solids, organic, n.o.s." It usually falls in Hazard Class 6.1(a). Technical name required.

Spill Handling: As an immediate precautionary measure, isolate spill or leak area in all directions for at least 50 meters/150 feet for liquids and at least 25 meters/75 feet for solids. Increase, in the downwind direction, as necessary, the isolation distance shown above. Eliminate all ignition sources (no smoking, flares, sparks or flames in immediate area). Do not touch damaged containers or spilled material unless wearing appropriate protective clothing. Stop leak if you can do it without risk. Prevent entry into waterways, sewers, basements or confined areas. Absorb or cover with dry earth, sand or other non-combustible material and transfer to containers. Do not get water inside containers.

Fire Extinguishing: Hazardous decomposition includes oxides of carbon. *Fire involving storage or vehicular tanks:* isolate for 800 meters/0.5 mile in all directions; also, consider initial evacuation for 800 meters/0.5 mile in all directions. *Small fire:* dry chemical, carbon dioxide or water spray. *Large fire:* dry chemical, carbon dioxide, alcohol-resistant foam or water spray. Move containers from fire area if you can do it without risk. Dike fire-control water for later disposal; do not scatter the material. *Fire involving tanks or car/trailer loads:* fight fire from maximum distance or use unmanned hose holders or monitor nozzles. Do not get water inside containers. Cool containers with flooding quantities of water until well after fire is out. Withdraw immediately in the event of rising sound from venting safety devices or discoloration of tank. Always stay away from tanks engulfed in fire. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies.

Disposal Method Suggested: Prior to implementing land disposal of waste residue (including waste sludge), consult with environmental regulatory agencies for guidance on acceptable disposal practices[83]. Abamectins are rapidly broken down in pond water from 4 days to 4 weeks in pond sediment. Abamectin breaks down in soil by the process of photo degradation. The process may take from 1 week to 2 months depending on its location, on the surface or under it.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- Pesticide Management Education Program, "Avermectin (Agri-Mek, Affirm) EPA Pesticide Fact Sheet 9/89," http://pmep.cce.cornell.edu/profiles/insect-mite/abamectin-bufencarb/avermectin/insect-prof-avermectin.html
- U.S. Environmental Protection Agency (U.S. EPA), Office of Pesticide Programs, Registration Div. *Pesticide Fact Sheet Number 89.2: Avermectin B1*,, Washington DC (July 1990)
- EXTOXNET, Extension Toxicology Network, "Pesticide Information Profile, Abamectin," Oregon State University, Corvallis, OR, (June 1996). http://extoxnet.orst.edu/pips/abamecti.htm
- Cornell University Cooperative Extension, Pesticide Management Education Program, Pesticide Information Profile: Abamectin, Ithaca, NY, (September 2007).

Acephate A:0080

Use Type: Insecticide

CAS Number: 30560-19-1

Formula: $C_4H_{10}NO_3PS$

Synonyms: Acetylphosphoramidothoic acid, *O,S*-dimethyl ester; ENT-27822; *O,S*-Dimethyl acetylphos-phoramidothioate; *O,S*-Dimethyl acetic phosphoramidothioate, *N*-[Methoxy (methylthio)phosphinoyl] acetamide; Phosphoramidothoic acid, *N*-acetyl-,*O,S*,-dimethyl ester

Trade Names: ACECAP SYSTEMIC INSECTICIDE IMPLANTS®; ACEFAL 75 PS®; ACEHERO®; ACEPHATE 97 EG®; ACEPHATE 75SP®; ACEPHATE PCO SP INSECTICIDE®; ACESUL®; ACE-TOX®; ACHERO®; ACIFAT®; ADDRESS®; AIMTHENE®; AMCOTHENE®; ASATAF®; ASIFY®; ATTACK®; CHEVRON RE 12420®; CLEAN CROP ACEPHATE 80 DF SEED PROTECTORANT®; DREXEL ACEPHATE 75 WSP®; DREXEL ACEPHATE PCO SP INSECTICIDE®; FATEL®; FORPHATE®, FORWARD®; KITRON®; KORANDA® (acephate+fenvelerate); LANCER®; ORCEPHATE®; ORTHENE®; ORTHENE 755®;

ORTHO 12420®; ORTRAN®; ORTRIL®; PACE®; PAYLOAD®; PILARTHENE®; PINPOINT®; PRECISE ACEPHATE®; RACET®; RE 12420®; SAPHATE®; 75 SP®; VALENT ORTHENE TECHNICAL®; VEGFRU TARGET®

Chemical Class: Organophosphate

EPA/OPP PC Code: 103301

California DPR Chemical Code: 1685

HSDB Number: 6549

UN/NA & ERG Number: UN2783 (solid)/152; UN3018 (liquid)/152

RTECS® Number: TB4760000

EC Number: 250-241-2 [*Annex I Index No.:* 015-079-00-7]

Uses: Acephate is a general use contact and systemic insecticide. Not approved for use in EU countries[115]. Actively registered in the U.S., homeowner use for lawns is discontinued except for treatment of fire ant mounds. Other indoor treatment has been discontinued. Used on green and lima beans, Brussels sprouts, cauliflower, celery, cotton, cottonseed, cranberries, head lettuce, macadamia nuts, peanuts, bell- and non-bell peppers, peppermint, spearmint, tobacco, and soybeans (Special Local Need Registration required in Mississippi and Texas only). Also used to control cockroach (spot treatment only) in residential and industrial buildings and insect control in forests, and on ornamental plants and to target armyworms, aphids, beetles, bollworms, borers, budworms, cankerworms, crickets, cutworms, fire ants, fleas, grasshoppers, leafhoppers, loopers, mealybugs, mites, moths, roaches, spiders, thirps, wasps, weevils, whiteflies, etc.

U.S. Maximum Allowable Residue Levels for Acephate and its cholinesterase-inhibiting metabolite O,S-dimethyl phosphoramidothioate in or on raw agricultural commodities as follows: [40 CFR 180.108(a)]: bean (succulent and dry form, of which not >1 ppm is *o,s*-dimethyl phosphoramidothioate) 3 ppm; brussels sprouts (of which not >0.5 ppm is *o,s*-dimethyl phosphoramidothioate) 3.0 ppm; cattle, fat 0.1 ppm; cattle, meat byproducts 0.1 ppm; cattle, meat 0.1 ppm; cauliflower (of which not >0.5 ppm is *o,s*-dimethyl phosphoramidothioate) 2.0 ppm; celery (of which not >1 ppm is *o,s*-dimethyl phosphoramidothioate) 10 ppm; cotton, undelinted seed 2 ppm; cotton, hulls 4 ppm; cotton, meal 8 ppm; cranberry (of which not >0.1 ppm is *o,s*-dimethyl phosphoramidothioate) 0.5 ppm; egg 0.1 ppm; goat, fat 0.1 ppm; goat, meat byproducts 0.1 ppm; goat, meat 0.1 ppm; hog, fat 0.1 ppm; hog, meat byproducts 0.1 ppm; hog, meat 0.1 ppm; horse, fat 0.1 ppm; horse, meat byproducts 0.1 ppm; horse, meat 0.1 ppm; lettuce, head (of which not >1 ppm is *o,s*-dimethyl phosphoramidothioate) 10 ppm; milk 0.1 ppm; mint hay (of which not >1 ppm is *o,s*-dimethyl phosphoramidothioate) 15.0 ppm; peanut 0.2 ppm; pepper (of which not >1 ppm is *o,s*-dimethyl phosphoramidothioate) 4.0 ppm; poultry, fat 0.1 ppm; poultry, meat byproducts 0.1 ppm; poultry, meat 0.1 ppm; sheep, fat 0.1 ppm; sheep, meat byproducts 0.1 ppm; sheep, meat 0.1 ppm; soybean, meal 4 ppm; soybean 1 ppm. ***[40 CFR 180.108(a)(2)]:*** in or on all food items (other than those already covered by a higher tolerance as a result of use on growing crops) in food handling establishments. The acephate may be present as a residue from applications of acephate in food handling establishments, including food service, manufacturing and processing establishments, such as restaurants, cafeterias, supermarkets, bakeries, breweries, dairies, meat slaughtering and packing plants, and canneries. ***[40 CFR 180.108(c)]:*** nut, macadamia 0.05 ppm.

Human toxicity (long-term)[101]: High–2.80 ppb, Health Advisory

Fish toxicity (threshold)[101]: Very low–2725.54621 ppb, MATC (Maximum Acceptable Toxicant Concentration)

Regulatory Authority and Advisory Information:

Carcinogenicity[83]: EPA Group C, Possible human carcinogen

Acute Oral Category: 3, CAUTION

Health Advisory: Nerve Toxin, Mutagen, Developmental/Reproductive Toxin

Potential Ground water Pollutant [California FAC Section 13145(d)/12811, active]

U.S. DOT 49CFR172.101, Inhalation Hazard Chemical as organophosphates.

European/International Regulations: Hazard Symbol: Xn; risk phrases: R22; safety phrases: S2; S36 (see Appendix 1)

WGK (German Aquatic Hazard Class): 2-Hazard to waters.

Description: Colorless crystalline solid (80% or more pure) or white powder (technical). Has an odor of rotten cabbage or mercaptans (like sulfur). Molecular weight = 183.17; Specific gravity (H_2O:1) = 1.347 @ 20 °C; Freezing/Melting point = 92-93 °C; 82–89 °C (technical grade 80 to 90% purity); Vapor pressure = 1.7×10^{-6} mmHg @ 25 °C. Hazard Identification (based on NFPA-704 M Rating System): Health 1, Flammability 0, Reactivity 0. Soluble in water; solubility = 800 mg/kg @20 °C.

Incompatibilities: May react with strong oxidizers such as chlorates, peroxides, nitrates, etc. Acephate emits toxic oxides of phosphorus, nitrogen, and sulfur when heated to decomposition. In the presence of strong reducing agents such as hydrides, organophosphates form highly toxic and flammable phosphine gas. Contact with oxidizers can cause the release of toxic oxides of phosphorus.

Determination in Air: OSHA versatile sampler-2; Toluene/Acetone; Gas chromatography/Flame ionization detection; NIOSH IV(18), Method #5600, Organophosphorus pesticides.

Determination in Water: NIOSH Method 1657. The determination of organophosphorus pesticides in municipal and industrial wastewater by gas chromatography. Detection limit = 6.0 ng/L. Log K_{ow} = <1.0. Unlikely to bioaccumulate in marine organisms.

Routes of Entry: Inhalation, ingestion, dermal contact, passes through the skin

Harmful Effects and Symptoms

Acephate can cause cholinesterase inhibition in humans–it can overstimulate the nervous system-causing nausea, dizziness, confusion, and, at very high exposures (e.g., accidents or major spills), respiratory paralysis and death[118].

Short Term Exposure: Poisonous; may be fatal if inhaled, swallowed, or absorbed through skin. Because this material has a low vapor pressure, significant inhalation of vapors is unlikely at ordinary temperatures. Contact may cause burns to skin and eyes. Eye pupils appear small; blurred vision; eye watering; runny nose; cough; shortness of breath; salivation; dizziness; nausea, stomach cramps, diarrhea, and vomiting; increased blood pressure; profuse sweating; hypermotility, hallucinations; irritability; tingling of the skin; drowsiness; slow heartbeat; convulsions; fluid in lungs; loss of consciousness; incontinence; breathing stops; death. Organophosphates inhibit the action of acetylcholinesterase enzymes, and alter the way in which nervous impulses are transmitted. The effects can last for hours, days, or much longer. The action of the enzymes is reestablished after new enzymes are formed. Delayed pulmonary edema may occur after inhalation. LD_{50} = (rat, oral) 1.4 g/kg[9]; LD_{50} (dermal, rat) = >2.5 g/kg[83].

Long Term Exposure: May cause cancer. Cholinesterase inhibitor; cumulative effect is possible. A neurotoxin. Organophosphates may damage the nervous system with repeated exposure, resulting in convulsions, respiratory failure. May cause liver damage. May cause skin sensitization; reproductive effects. A neurotoxin. May cause reproductive and fetal effects.

Points of Attack: Skin, respiratory system, central nervous system, cardiovascular system, blood cholinesterase. Reproductive cells.

Medical Surveillance: This chemical is a suspected or known human carcinogen. Exposed persons should contact a physician for advice regarding the possible long term health effects and advice for medical monitoring. Medical observation is recommended for 24 to 48 hours following breathing overexposure, as pulmonary edema may be delayed. Routine biological monitoring of pesticide applicators and field workers includes testing of plasma and red blood cell acetylcholinesterase levels (for enzyme poisoned by this chemical). These tests are normally accurate only if done within about two hours of exposure. If exposure stops, plasma levels return to normal in 1–2 weeks while red blood cell levels may be reduced for 1–3 months. When acetylcholinesterase enzyme levels are reduced by 25% or more below preemployment levels, risk of poisoning is increased, even if results are in lower ranges of "normal." Reassignment to work not involving organophosphate pesticides is recommended until enzyme levels recover. Do not drink any alcoholic beverages before or during use as it promotes absorption of organophosphates. Evaluation by a qualified allergist, including exposure history and testing, may help diagnose allergy.

First Aid: **Treatment for organophosphate poisoning consists of thorough decontamination, cardiorespiratory support, and administration of the antidotes atropine and pralidoxime. In cases of severe poisoning, diazepam, an anticonvulsant, should also be administered. Antidotes should be administered as prevention even if the diagnosis is in doubt**. Speed in removing material from eyes and skin is of extreme importance. *Eyes:* Contact can cause dangerous amounts of these chemicals to be quickly absorbed through the mucous membrane into the bloodstream. Immediately and gently flush eyes with plenty of warm or cold water (NO hot water) for at least 15 minutes, occasionally lifting the upper and lower eyelids. Get medical aid immediately. *Skin:* Get medical aid. Dermal contact can cause dangerous amounts of these chemicals to be absorbed into the bloodstream. Wearing the appropriate PPE equipment and respirator for organophosphate pesticides, immediately flush skin with plenty of soap and water for at least 15 minutes while removing contaminated clothing and shoes. Shampoo hair promptly if contaminated. The removed, contaminated clothing and shoes should be double-bagged and left in Hot Zone for later disposal by hazardous materials experts. Skin may also be decontaminated with diluted hypochlorite solution. *Inhalation:* Get medical aid. Do not contaminate yourself. Wearing the appropriate PPE equipment and respirator for organophosphate pesticides, immediately remove the victim from the contaminated area to fresh air. If the victim is not breathing, administer artificial respiration. Do not use mouth-to-mouth method if victim ingested or inhaled the substance; give artificial respiration with the aid of a pocket mask equipped with a one-way valve or other proper respiratory medical device. If breathing is difficult, administer oxygen through bag/mask apparatus until medical help arrives. Do not leave victim unattended. *Ingestion:* Call poison control. Loosen all clothing. Never give anything by mouth to an unconscious person. If victim is *unconscious or having convulsions,* do nothing except keep victim warm. Get medical aid. Transfer promptly to a medical facility. In cases of ingestion, **do not induce vomiting**. If the victim is alert and asymptomatic, administer a slurry of activated charcoal at a dose of 1 g/kg (infant, child, and adult dose). A soda can and straw may be of assistance when offering charcoal to a child. *In some cases you may be specifically instructed by poison control to induce vomiting by way of 2 tablespoons of syrup of ipecac (adult) washed down with a cup of water*. Do NOT give activated charcoal before or with ipecac syrup

Note to physician or authorized medical personnel: Treat cases of respiratory compromise, coma, or excessive pulmonary secretions with respiratory support using protocols and techniques available and within the scope of training. Some cases may necessitate procedures such as endotracheal intubation or cricothyrotomy by properly trained and equipped personnel. When possible, atropine (see *Antidotes*, below) should be given under medical supervision. Patients who are comatose, hypotensive, or having seizures or cardiac arrhythmias should be treated according to advanced life support protocols. *Antidotes:* Two antidotes are administered to treat organophosphate poisoning. Atropine is a competitive antagonist of acetylcholine at muscarinic receptors and is used to control the excessive bronchial secretions which are often responsible for death. Pralidoxime relieves both the nicotinic and muscarine effects of organophosphate poisoning by regenerating acetylcholinesterase and can reduce both the bronchial secretions and the muscle weakness associated with poisoning. The initial intravenous dose of atropine in adults should be determined by the severity of symptoms: An initial adult dose of 1.0 to 2.0 mg or pediatric dose of 0.01 mg/kg (minimum 0.01 mg) should be administered intravenously. If intravenous access cannot be established, atropine may also be given intramuscularly, subcutaneously or via endotracheal tube. Doses should be repeated every 15 minutes until excessive secretions and sweating have been controlled. Once bronchial secretion has been controlled, atropine administration should be repeated whenever the secretions begin to recur. In seriously poisoned patients, very large doses may be required. Alterations of pulse rate and pupillary size should not be used as indicators of treatment adequacy. Pralidoxime should be administered as early in poisoning as possible as its efficacy may diminish when given more than 24 to 36 hours after exposure. Doses are as follows: adult 1.0 g; pediatric 25 to 50 mg/kg. The drug should be administered intravenously over 30 to 60 minutes, but in a life-threatening situation, one-half of the total dose can be given per minute for a total administration time of 2 minutes. Treatment should begin to take effect within 40 minutes with a reduction in symptoms and the amount of atropine necessary to control bronchial secretion. The initial dose can be repeated in 1 hour and then every 8 to 12 hours until the patient is clinically well and no longer requires atropine. If intravenous access cannot be established, pralidoxime may also be given intramuscularly. Early administration of diazepam in addition to the combined atropine and pralidoxime treatment may help prevent the onset of seizures and potential brain and cardiac morphologic damage following high-level organophosphate poisoning. As first aid for pulmonary edema, a doctor or authorized paramedic might consider administering a corticosteroid spray.

Personal Protective Methods: Wear protective gloves and clothing to prevent any reasonable probability of dermal and/or eye contact. Safety equipment suppliers/manufacturers can provide recommendations on the most protective glove/clothing material for your operation. All protective clothing (suits, gloves, footwear, headgear) should be clean, available each day, and put on before work. Contact lenses should not be worn when working with this chemical. Wear dust-proof chemical goggles and face shield unless full facepiece respiratory protection is worn. Employees should wash immediately with soap when skin is wet or contaminated. Provide emergency showers and eyewash.

Respirator Selection: *At any detectable concentration:* SCBAF: Pd,Pp (APF = 10,000) (any NIOSH/MSHA- or European Standard EN 149-approved self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode); or SaF: Pd,Pp: ASCBA (APF = 10,000) (any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary, self-contained breathing apparatus operated in a pressure-demand or other positive-pressure mode). *Escape:* 100F (APF = 50) (any air-purifying, full facepiece respirator with an N100, R100, or P100 filter k-mounted organic vapor canister having a high-efficiency particulate filter); or SCBAE (any appropriate escape-type, self-contained breathing apparatus).

Storage: Color Code-Blue: Health Hazard/Poison. Store in a secure poison location. Prior to working with this pesticide, you should be trained on its proper handling and storage. Store in tightly closed containers in a cool, well-ventilated area away from strong bases. Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: Organophosphorus pesticides, solid or liquid require a “poisonous materials” label. This chemical falls in Hazard Class 6.1.

Spill Handling: Evacuate persons not wearing protective equipment from area of spill or leak until clean up is complete. Collect powdered material in the most convenient and safe manner and deposit in sealed containers. Ventilate area after clean up is complete. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable.

Fire Extinguishing: Hazardous decomposition includes oxides of phosphorus, sulfur, and nitrogen. Combustible material: may burn but does not ignite readily. Containers may explode when heated. Runoff may pollute waterways. *Fire involving storage or vehicular tanks:* isolate for 800 meters/0.5 mile in all directions; also, consider initial evacuation for 800 meters/0.5 mile in all directions. Highly toxic, may be fatal if inhaled, swallowed or absorbed through skin. Contact with molten substance may cause severe burns to skin and eyes. Avoid any skin contact. Effects of contact or inhalation may be delayed. Runoff from fire control or dilution water may be corrosive and/or toxic and cause pollution. *Small fire*: dry chemical, carbon dioxide or water spray. *Large fire*: dry chemical, carbon dioxide, or regular foam. Move containers from fire area if you can do it without risk. Dike fire-control water for later disposal; do not scatter the material. *Fire involving tanks or car/trailer loads*: fight fire from maximum distance or use unmanned hose holders or monitor nozzles. Do not get water inside containers. Cool containers with flooding quantities of water until well after fire is out. Withdraw immediately in the event of rising sound from venting safety devices or discoloration of tank. Always stay away from tanks engulfed in fire. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies.

Disposal Method Suggested: Alkaline hydrolysis or incineration. In accordance with 40CFR165, follow recommendations for the disposal of pesticides and pesticide containers. Containers must be disposed of properly by following package label directions or by contacting your local or federal environmental control agency, or by contacting your regional EPA office.

References:

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- USEPA, Office of Prevention, Pesticides and Toxic Substances, "Acephate Facts," September (2001)
- USEPA, Office of Pesticide Programs, Pesticide Residue Limits, "Acephate," 40 CFR 180.108. http://www.epa.gov/cgi-bin/oppsrch
- International Chemical Safety Card, "Acephate," NIOSH. http://www.cdc.gov/niosh/ipcsneng/neng0748.html
- USEPA, Office of Prevention, Pesticides and Toxic Substances, "Acetate Summary," February 2, 2000. http://www.epa.gov/pesticides/op/acephate/acephate_summ.htm
- Agency for Toxic Substances and Disease Registry, U.S. Department of Health and Human Services, Public Health Service, "Managing Hazardous Materials Incidents," Atlanta, GA (June 2003)
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- Christiansen, A.; Gervais, J.; Buhl, K.; Stone, D., *Acephate Technical Fact Sheet*; National Pesticide Information Center, Oregon State University Extension Services (2011)

Acetamiprid A:0145

Use Type: Insecticide
CAS Number: 135410-20-7
Formula: $C_{10}H_{11}ClN_4$
Synonyms: (1E)-*N*-[(6-chloro-3-pyridinyl)methyl]-*N*'-cyano-*N*-methylethanimidamide; *N*-cyano-*N*'-(2-chloro-5-pyridylmethyl)-*N*'-methylacetamidine; (1E)-*N*-[(6-chloro-3-pyridinyl)methyl]-*N*'-cyano-*N*-methylacetamidine; Ethanimidamide, *N*-((6-chloro-3-pyridinyl)methyl)-*N*'-cyano-*N*-methyl-,(E)-
Chemical Class: Neonicotinoid
EPA/OPP PC Code: 099050
California DPR Chemical Code: 5762
HSDB Number: 7274
UN/NA & ERG Number: UN2588 (Pesticide, solid, poisonous, n.o.s.)/151; UN2902 (Pesticide, liquid, poisonous, n.o.s.)/151
RTECS® Number: KJ4235200
EC Number: [*Annex I Index No.:* 608-032-00-2]
Uses: This class of pesticides are chemically related to nicotine and used on corn and soybean seeds and are used to control sucking and chewing insects, and soil insects including aphids, beetles, fruit moth, leaf-hoppers and -miners, thrips, whiteflies[83]. Also used to control fleas on domestic animals.

U.S. Maximum Allowable Residue Levels for residues of the insecticide Acetamiprid [40 CFR 180.578(a)(1)]: in or on the following commodities: canola, seed 0.010 ppm; citrus, dried pulp 1.20 ppm; cotton, gin byproducts 20.0 ppm; cotton, undelinted seed 0.60 ppm; fruit, citrus group 0.50 ppm; fruit, pome group 1.0 ppm; grape 0.20 ppm; mustard, seed 0.010 ppm; tomato, paste 0.40 ppm; vegetable, brassica, leafy, group 5, 1.20 ppm; vegetable, fruiting, group 8, 0.20 ppm; and vegetable, leafy, except brassica, group 4, 3.00 ppm. ***Tolerances are established for the combined residues of the insecticide acetamiprid N1-[(6-chloro-3-pyridyl)methyl]-N2-cyano-N1-methylacetamidine and N1-[(6-chloro-3-pyridyl)methyl]-N2-cyano-acetamidine in [40 CFR 180.578(a)(2)]:*** or on the following commodities: cattle, fat 0.10 ppm; cattle, meat 0.10 ppm; cattle, meat byproducts 0.20 ppm; egg 0.010 ppm; goat, fat 0.10 ppm; goat, meat 0.10 ppm; goat, meat byproducts 0.20 ppm; hog, fat 0.10 ppm; hog, meat 0.10 ppm; hog, meat byproducts 0.20 ppm; horse, fat 0.10 ppm; horse, meat 0.10 ppm; horse, meat byproducts 0.20 ppm; milk 0.10 ppm; poultry, fat 0.010 ppm; poultry, liver 0.050 ppm; poultry, meat 0.010 ppm; sheep, fat 0.10 ppm; sheep, meat 0.10 ppm; and sheep, meat byproducts 0.20 ppm.

Human toxicity (long-term)[101]: 490 ppb, Health Advisory.
Fish toxicity (threshold)[101]: 27,153 ppb, MATC (Maximum Acceptable Toxicant Concentration).
Regulatory Authority and Advisory Information:
Carcinogenicity[83]: EPA, Not likely to be carcinogenic to humans.
Acute Oral Category: 3, CAUTION
Potential Ground Water Pollutant (California)
USEPA/OPP Oral reference dose (RfD) = 0.01 mg/kg/day
European/International Regulations: Hazard Symbol: Xn, N; risk phrases: R22; R52/53; safety phrases: S2; S46; S61

Description: White crystalline solid or powder. Commercially available as an amber colored gel. Odorless. Molecular weight = 222.67; Specific gravity (H_2O:1) = 1.330 @ 20 °C; Boiling point = (decomposes); Freezing/Melting point = 99–103 °C; Vapor pressure = 4.4×10^{-5} mmHg @ 25 °C (est.)[83]; Henry's Law constant = 6.9×10^{-8} atm-m^3/mol @ 25 °C (est)[83]. Hazard Identification (based on NFPA-704 M Rating System): Health 3, Flammability 0, Reactivity 0. Solubility in water @ 25 °C = 3.48×10^3 mg/L @ pH5; 2.95×10^3 mg/L @ pH 7, 3.96×10^3 mg/L @ pH 9[83].

Incompatibilities: This material may be combustible; powder may form explosive mixture with air. Keep away from strong oxidizers, acids and alkaline media.

Permissible Concentration in Water: Federal Drinking Water Guidelines: 500 ppb[14]. State Drinking Water Guidelines: Maine 497 μg.

Determination in Water: Log K_{ow} = –0.9. @ 20 °C. Negative. Unlikely to bioaccumulate in marine organisms.

Routes of Entry: Inhalation, dermal and/or eye contact.

Harmful Effects and Symptoms

Short Term Exposure: Highly toxic. May be harmful if inhaled, ingested, or absorbed through the unbroken skin. Effects of inhalation or dermal contact may be delayed. May be fatal if inhaled. May cause irritation to the eyes. LD_{50} (oral, rat) = 146–450 mg/kg; LD_{50} (dermal, rabbit) = >2 g/kg.

Long Term Exposure: May cause liver and kidney problems.

Points of Attack: Liver, kidneys

Medical Surveillance: Liver and kidney function tests.

First Aid: If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least 15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately. Give artificial respiration if victim is not breathing. *Do not* use mouth-to-mouth method if victim ingested or inhaled the substance; give artificial respiration with the aid of a pocket mask equipped with a one-way valve or other proper respiratory medical device. Administer oxygen if breathing is difficult. Remove and isolate contaminated clothing and shoes. In the case of contact with substance, immediately flush skin or eyes with running water for at least 20 minutes. For minor skin contact, avoid spreading material on unaffected skin. Keep victim warm and quiet. Effects of exposure (inhalation, ingestion or skin contact) to substance may be delayed. Ensure that medical personnel are aware of the material(s) involved and take precautions to protect themselves.

Personal Protective Methods: Applicators and other handlers must wear: Coveralls worn over long-sleeved shirt and long pants; Chemical-resistant gloves such as DuPont™ Tychem® suit fabrics, barrier laminate, or Viton®; Chemical-resistant footwear plus socks; Protective eye wear; Chemical-resistant headgear for overhead exposure; Chemical-resistant apron when cleaning equipment, mixing, or loading[83]. Agricultural Use/Engineering Controls: When handlers use closed systems, enclosed cabs, or aircraft in a manner that meets the requirements listed in the Worker Protection Standard (WPS) for agricultural pesticides, ***40 CFR 170.240(d)(4-6),*** the handler PPE requirements may be reduced or modified as specified in the Worker Protection Standard. Firefighters should wear NIOSH-approved self-contained breathing apparatus and full protective clothing.

Respirator Selection: Where the neat (undiluted) test chemical is weighed and diluted, wear a NIOSH-approved half face respirator equipped with a combination filter cartridge, i.e. organic vapor/acid gas/HEPA (specific for organic vapors, HCl, acid gas, SO_2 and a high-efficiency particulate filter)[88].

Storage: Color Code-Blue: Health Hazard/Poison. Store in a tightly closed container in a dry, well-ventilated and secure poison location. Prior to working with this chemical you should be trained on its proper handling and storage. Where possible, automatically transfer material from other storage containers to process containers. Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: Pesticides, solid, toxic/poisonous, n.o.s require a shipping label of "poisonous materials" and fall in Hazard Class 6.1. Technical name required.

Spill Handling: Evacuate and restrict persons not wearing protective equipment from area of spill or leak until cleanup is complete. Ventilate area of spill or leak. Absorb liquids in vermiculite, dry sand, earth, peat, carbon, or a similar material and deposit in sealed containers. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable.

Fire Extinguishing: Hazardous decomposition includes oxides of nitrogen and carbon and hydrogen chloride gas. This chemical is combustible; it may burn but does not easily ignite. Use dry chemical powder extinguishers, water spray, foam, carbon dioxide. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies. From a secure, explosion-proof location, use water spray to cool exposed containers. If cooling streams are ineffective (venting sound increases in volume and pitch, tank discolors, or shows any signs of deforming), withdraw immediately to a secure position. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode.

Disposal Method Suggested: Containers must be disposed of properly by following package label directions or by contacting your local or federal environmental control agency, or by contacting your regional EPA office. If this material cannot be disposed of according to label instructions, it may be dissolved or mixed with a combustible solvent and burned in a chemical incinerator equipped with an afterburner and scrubber. In accordance with 40CFR165, follow recommendations for the disposal of pesticides and pesticide containers. Noncombustible containers should be compacted and buried under more than 16 inches/40 cm of soil[83].

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov

- USEPA/OPPTS; Pesticide Fact Sheet: Acetamiprid. (2002) Washington DC: Environmental Protection Agency, Off Prevent Pest Tox Sub, 2003
- Fishel, Frederick M., Document PI-80, Pesticide Information Office, Florida Cooperative Extension Service, Institute of Food and Agricultural Sciences, University of Florida, Gainesville, FL, October 2005; Revised February 2013

Acetic acid A:0160

Use Type: Herbicide, Fungicide, Microbiocide; Metabolite, Veterinary Medicine

CAS Number: 64-19-7

Formula: $C_2H_4O_2$

Synonyms: Acetic acid, glacial; Acido acetico (Spanish); Ethanoic acid; Ethylic acid; Glacial acetic acid (pure compound); Methane carboxylic acid; Mixed acid etch (5-2-2); Mixed acidetch (6-1-1); Vinegar (4–6% solution in water); Vinegar acid

Trade Names: ACETUM®; ACI-JEL®; ECOCLEAR®; NATURAL WEED SPRAY® No. One; VOSOL®

Chemical Class: Unclassified

EPA/OPP PC Code: 044001

California DPR Chemical Code: 933

HSDB Number: 40

UN/NA & ERG Number: UN2789 (glacial or >80% acid, by mass)/132; UN2790 (10–80% acid, by mass)/153

RTECS® Number: AF1225000

EC Number: 200-580-7 [*Annex I Index No.:* 607-002-00-6]

Uses: A herbicide used to control grasses, woody plants and broad-leaf weeds on hard surface and in areas where crops are not normally grown; as a veterinary medicine.

U.S. Maximum Allowable Residue Levels for Acetic acid [40 CFR 180.1001(c)]: Residues of acetic acid are exempted from the requirement of a tolerance when used as a catalyst in accordance with good agricultural practices as inert (or occasionally active) ingredients in pesticide formulations applied to growing crops or to raw agricultural commodities after harvest. ***[40 CFR 180.1001(e)]:*** Residues are exempted from the requirement of a tolerance when used as a catalyst (Limit: not more than 0.5% of pesticide formulation) in accordance with good agricultural practices as inert (or occasionally active) ingredients in pesticide formulations applied to animals.

Human toxicity (long-term)[101]: Very low–50,000 ppb, Health Advisory.

Fish toxicity (threshold)[101]: Low–510 ppb, MATC (Maximum Acceptable Toxicant Concentration).

Regulatory Authority and Advisory Information:

U.S. EPA Gene-Tox Program, Negative: Histidine reversion Ames test

Health Advisory: Mutagen, Developmental/Reproductive Toxin, Skin irritant/sensitizer

Acute Oral Category: 4, Caution

Clean Water Act: 40CFR116.4 Hazardous Substances; RQ 40CFR117.3 (same as CERCLA)

Superfund/EPCRA 40CFR302.4, Appendix A, Reportable Quantity (RQ): 5000 lb (2270 kg)

European/International Regulations: Hazard Symbol: C; risk phrases: R10; R35; safety phrases: S1/2; S23; S26; S45 (see Appendix 1).

WGK (German Aquatic Hazard Class): 1-Low hazard to waters.

Description: Acetic acid is a colorless liquid or crystals. Sour, vinegar-like odor. Pure compound is a solid below 17 °C. The commercial agricultural product is available as an emulsifiable concentrate; often used in an aqueous solution for spraying. Odor threshold = 0.016 ppm. Glacial acetic acid contains 99% acid. Molecular weight = 60.08; Specific gravity (H_2O:1) = 1.051@ 20 °C; Boiling point = 117.9 °C[A2]; Melting/Freezing point = 16.611 °C[88]; Electrical conductivity = 6×10^5 pS/m; Critical pressure = 57.1 atm; Heat of combustion = –3136 cal/g[A2]; Vapor pressure = 11 mmHg @ 20 °C[A2]; Flash point = 39 °C[17] (glacial); Autoignition temperature = 463 °C (glacial)[17]; 516.11 °C[88]. Explosive limits: LEL = 4.0%; UEL = 19.9%. Hazard Identification (based on NFPA-704 M Rating System): (glacial) Health 3, Flammability 2, Reactivity 0. Freely soluble in water; may produce some heat and an irritating odor.

Potential Exposure: Acetic acid is widely used as a chemical feedstock for the production of vinyl plastics, acetic anhydride, acetone, acetanilide, acetyl chloride, ethyl alcohol, ketene, methyl ethyl ketone, acetate esters, and cellulose acetates. It is also used alone in the dye, rubber, pharmaceutical, food preserving, textile, and laundry industries. It is utilized, too, in the manufacture of Paris green, white lead, tint rinse, photographic chemicals, stain removers, insecticides and plastics.

Incompatibilities: Vapor forms explosive mixture with air. Violent reaction with oxidizers, organic amines, and bases, such as hydroxides and carbonates. Incompatible with strong acids; aliphatic amines; alkanolamines, isocyanates, alkylene oxides; epichlorohydrin, acetaldehyde, 2-aminoethanol, ammonia, ammonium nitrate, chlorosulfonic acid, chromic acid; ethylene diamine, ethyleneimine, halides, peroxides, perchlorates, perchloric acid, permanganates, phosphorus isocyanate, phosphorus trichloride, potassium *tert*-butoxide, and xylene. Attacks cast iron, stainless steel, and other metals, forming flammable/explosive hydrogen gas. Will attack many forms of rubber or plastic.

Permissible Exposure Limits in Air: Conversion factor: 1 ppm = 2.46 mg/m^3 @ 25 °C & 1 atm

OSHA PEL: 10 ppm/25 mg/m^3 TWA

NIOSH REL: 10 ppm/25 mg/m^3 TWA; 15 ppm/37 mg/m^3 STEL

ACGIH TLV®[1]: 10 ppm/25 mg/m^3 TWA; 15 ppm/37 mg/m^3 ppm STEL

Protective Action Criteria (PAC) Ver. 27[89]

PAC-1: $\mathbf{5}_\mathbf{E}$ ppm
PAC-2: $\mathbf{35}_\mathbf{E}$ ppm
PAC-3: $\mathbf{250}_\mathbf{E}$ ppm

Subscript "E" corresponding to ERPGs (Emergency Response Planning Guideline) are in **bold face**.

DFG MAK: 10 ppm/25 mg/m^3 TWA; Peak Limitation Category I(2)
NIOSH IDLH: 50 ppm.

Determination in Air: Use NIOSH Analytical Method (IV) #1603, OSHA Analytical Method 186SG.

Permissible Concentration in Water: No U.S. limit has been established. However, EPA·[32] has proposed an ambient environmental goal of 345 μg/L based on health effects.

Determination in Water: Acetic acid in water may be determined by titration. Harmful to aquatic life. Octanol-water coefficient: Unlikely to bioaccumulate in marine organisms. –0.2 to –0.31. The following wastewater treatment technologies have been investigated for acetic acid: activated carbon; reverse osmosis[83].

Routes of Entry: Inhalation, skin and/or eye contact.

Harmful Effects and Symptoms

Short Term Exposure: Can cause severe irritation, burns, and permanent eye damage. Skin contact can cause severe irritation and burns. Breathing can cause irritation of the mouth, nose, and throat; coughing, and shortness of breath. Higher exposures can cause bronchopneumonia and pulmonary edema, a medical emergency. LD_{50} (oral, rat) = 3300 –3530 mg/kg; LD_{50} (dermal, rabbit) = 1060 mg/kg.

Long Term Exposure: Repeated exposure may cause bronchitis to develop, with cough, phlegm, and/or shortness of breath. Repeated skin exposure can cause thickening and cracking of the skin, particularly the skin of the hands. Chronic exposure may result in pharyngitis and catarrhal bronchitis. Ingestion, though not likely to occur in industry, may result in penetration of the esophagus, bloody vomiting, diarrhea, shock, hemolysis; and hemoglobinuria which is followed by anuria. Repeated or prolonged exposure to acetic acid may cause darkening, irritation of the skin, erosion of the exposed front teeth, and chronic inflammation of the nose, throat and bronchi.

Points of Attack: Respiratory system, skin, eyes, teeth.

Medical Surveillance: lung function tests. Consider chest x-ray following acute overexposure. Consideration should be given to the skin, eyes, teeth, and respiratory tract in placement or periodic examinations.

First Aid: If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least 30 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately. If this chemical contacts the skin, remove contaminated clothing and wash with soap immediately. When this chemical has been swallowed, get medical attention. If victim is conscious, administer water or milk. Do not induce vomiting. If this chemical has been inhaled, remove from exposure, begin rescue breathing (using universal precautions, including resuscitation mask) if breathing has stopped and CPR if heart action has stopped. If swallowed, do not induce vomiting. Transfer promptly to a medical facility. Medical observation recommended for 24 to 48 hours following inhalation overexposure, as pulmonary edema may be delayed.

Personal Protective Methods: Contact lenses should not be worn when working with acetic acid. Prevent skin contact; **8 hr** (More than 8 hours of resistance to breakthrough >0.1 micron>g/cm^2/min): Butyl rubber (gloves, suits, boots), Teflon™ gloves, suits, boots; Viton™, 4H™, and Silver Shield™ gloves, Responder™ suits; Trychem 1000™ suits; **4 hr** (At least 4 but <8 hours of resistance to breakthrough >0.1 micron>g/cm^2/min.) Neoprene™, Barricade®. Remove clothing immediately if wet or contaminated with liquids containing 50% and promptly remove if liquid contains 10–49% acetic acid. Provide emergency eyewash if liquids containing >5% acetic acid are involved, drench if >50% acetic acid is involved.

Respirator Selection: SCBA >5 ppm. NIOSH/OSHA: *50 ppm:* Sa:Cf$^{£}$ (APF = 25) (any supplied-air respirator operated in a continuous-flow mode); or PaprOv$^{£}$ (APF = 25) [any powered, air-purifying respirator with organic vapor cartridge(s)]; CcrFOv (APF = 50) [any air-purifying, full facepiece respirator (gas mask) with a chin-style, front-or back-mounted acid gas canister]; or GmFOv (APF = 50) [any air-purifying, full facepiece respirator (gas mask) with a chin-style, front-or back-mounted organic vapor canister]; or SCBAF (APF = 50) (any self-contained breathing apparatus with a full facepiece); or SaF (APF = 50) (any supplied-air respirator with a full facepiece). *Emergency or planned entry into unknown concentrations or IDLH conditions:* SCBAF:Pd,Pp (APF = 10,000) (any self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode); or SaF:Pd,Pp:ASCBA (APF = 10,000) (any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary self-contained breathing apparatus operated in a pressure-demand or other positive-pressure mode). *Escape:* GmFOv (APF = 50) [any air-purifying, full facepiece respirator (gas mask) with a chin-style, front-or back-mounted organic vapor canister] or SCBAE (any appropriate escape-type, self-contained breathing apparatus). *Note*$^{£}$: Substance causes eye irritation or damage; eye protection needed.

Storage: (1) Color Code-Red: Flammability Hazard: Store in a flammable liquid storage area or approved cabinet away from ignition sources and corrosive and reactive materials. (2) Color Code-White: Corrosive or Contact Hazard; Store separately in a corrosion resistant location. Prior to working with this chemical you should be trained on its proper handling and storage. Before entering confined space where this chemical may be present, check to make sure that an explosive concentration does not exist. Should be stored in cool dry place away from heat and incompatible substances listed above. If this material contains a flammable carrier, sources of ignition, such as smoking and open flames, are prohibited where this chemical is used, handled, or stored in a manner that could create a potential fire or explosion hazard. Metal containers involving the transfer of this chemical should be grounded and bonded. Drums must be equipped with self-closing valves, pressure vacuum bungs, and flame arresters. Use only non-sparking tools and equipment, especially when opening and closing containers of this chemical. Store pesticides in original containers, complete with labels listing ingredients, use

directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: *Acetic acid >80%:* Should be labeled "CORROSIVE, FLAMMABLE LIQUID." Hazard Class 8, 3. *Acetic acid 10-80%:* Should be labeled "CORROSIVE," shipped in glass and polyethylene carboys, metal drums, aluminum tank cars and wooden barrels. It falls in Hazard Class 8. Do not transport with human food or animal feedstuffs.

Spill Handling: Warn other workers of spill. Evacuate persons not wearing protective equipment from area of spill or leak until clean up is complete. Establish forced ventilation to keep levels below explosive limit. Absorb liquids in vermiculite, dry sand, or similar material and deposit in sealed containers, and transport to outdoor location. With expert help, cautiously neutralize spilled liquid with lime or sodium bicarbonate. Wash away remainder with plenty of water (extra personal protection: chemical protection suit including self-contained breathing apparatus). Alternatively cover with soda ash and then flush to sewer with water[24]. Ventilate area after clean up is complete. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable.

Fire Extinguishing: Hazardous decomposition includes oxides of carbon. As an immediate precautionary measure, isolate spill or leak area in all directions for at least 50 meters/150 feet for liquids and at least for solids. *If tank, rail car or tank truck is involved in a fire*, *isolate* for 800 meters/0.5 mile in all directions; also, consider initial evacuation for 800 meters (0.5 mile) in all directions. *On a small fire:* use dry chemical, CO_2, water spray or alcohol-resistant foam. Vapors are heavier than air and will collect in low areas. Vapors in confined areas may explode when exposed to fire. *On a large fire:* use water spray, fog or regular foam. Do not scatter spilled material with high-pressure streams of water. Move containers from fire area if you can do it without risk. Dike fire-control water for later disposal. *Fire involving tanks:* from a secure, explosion-proof location, use water spray to cool exposed containers. If cooling streams are ineffective (venting sound increases in volume and pitch, tank discolors, or shows any signs of deforming), withdraw immediately to a secure position. Always stay away from tanks engulfed in fire. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode.

Disposal Method Suggested: Dissolve or mix the material with a combustible solvent and burn in a chemical incinerator equipped with an afterburner and scrubber. All federal, state, and local environmental regulations must be observed.

References

- University of Herfordshire, PPDB, Hatfield, Herts. (2013)
- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- Sax, N. I., Ed., *Dangerous Properties of Industrial Materials Report*, 1, No. 4, 23-25 (1981), and 3, No. 6, 31-35 (Nov./Dec. 1983)
- New Jersey Dept. of Health and Senior Services, *Hazardous Substances Fact Sheet:* Acetic Acid, Trenton, NJ (June 1998)
- New York State Dept. of Health, Bureau of Toxic Substances Assessment Chemical Fact Sheet: Acetic Acid, Albany, NY (March 1986)

Acetochlor A:0175

Use Type: Herbicide

CAS Number: 34256-82-1

Formula: $C_{14}H_{20}ClNO_2$

Synonyms: Acetamide, 2-chloro-*N*-(ethoxymethyl)-*N*- (2-ethyl-6-methylphenyl)-; *O*-Acetotoluidide, 2-chloro- *N*-(ethoxymethyl)-6'-ethyl-; Azetochlor; 2-chloro-*N*-(ethoxymethyl)-6'-ethyl-*O*-acetotoluidide; 2-Chloro-*N*-(ethoxymethyl)-*N*-(2-ethyl-6-methylphenyl) acetamide; 2'-Ethyl-6'-methyl-*N*-(ethoxymethyl)-2-chloroacetanilide

Trade Names: ACENIT®; CP 55097®; DEGREE®; ERUNIT®; FULTIME®; GUARDIAN®; HARNESS®; KEYSTONE LA®; MG 02®; MON 097®; MON 58420®; NEVIREX®; RELAY®; SACEMID®; SURPASS®; TOPHAND®; TOPNOTCH®; TROPHEE®; TROPHY®; WINNER®

Chemical Class: Chloroacetanilide; Chloroacetamide

EPA/OPP PC Code: 121601

California DPR Chemical Code: 2349

HSDB Number: 6550

UN/NA & ERG Number: UN3082 (liquid)/171

RTECS® Number: AB5457000

EC Number: 251-899-3 [*Annex I Index No.:* 616-037-006]

Uses: A U.S. EPA restricted Use Pesticide (RUP). Approval pending in the EU. A pre-emergence herbicide for control of annual grasses and broadleaf weeds. It is used on cabbage, citrus cops, coffee, all types of corn, cotton, green peas, maize, onion, peanuts, potatoes, vineyards, sugar cane, and sugar beets, among others. It is compatible with most other pesticides.

U.S. Maximum Allowable Residue Levels for Acetochlor including its metabolites and degradates, in or on the commodities listed below. Compliance

with the tolerance levels specified below is to be determined by measuring only acetochlor and its metabolites containing the ethyl methyl aniline (EMA) moiety and the hydroxyethyl methyl aniline (HEMA) moiety. Both parent and the named metabolites shall be determined as ethyl methyl aniline (EMA) and hydroxyethyl methyl aniline (HEMA), and calculated as the stoichiometric equivalents of acetochlor, in or on the following commodities [40CFR180.470(a)]: corn, field, forage 4.5 ppm; corn, field, grain 0.05 ppm; corn, field, stover 2.5 ppm; corn, pop, grain 0.05 ppm; corn, pop, stover 2.5 ppm; corn, sweet, forage 1.5 ppm; corn, sweet, kernels plus cob with husks removed 0.05 ppm; corn, sweet, stover 1.0 ppm; cotton, gin byproducts 4.0 ppm; cotton, undelinted seed 0.6 pmp; sorghum, grain, forage 1.6 pmp; sorghum, grain, grain 0.05 ppm; sorghum, grain, stover 1.7 pmp; soybean, meal 1.2 pmp; soybean, seed 1.0 ppm.

Tolerances are established for indirect or inadvertent residues of acetochlor, including its metabolites and degradates, in or on the raw agricultural commodities in this section when present therein as a result of application of acetochlor to the growing crops listed above of this section. Compliance with the tolerance levels specified below is to be determined by measuring only acetochlor and its metabolites containing the ethyl methyl aniline (EMA) moiety and the hydroxyethyl methyl aniline (HEMA) moiety. Both parent and the named metabolites shall be determined as ethyl methyl aniline (EMA) and hydroxyethyl methyl aniline (HEMA), and calculated as the stoichiometric equivalents of acetochlor, in or on the following commodities[40CFR180.470(d)]: animal feed, nongrass, group 18, forage 1.3 pmp; animal feed, nongrass, group 18, hay 3.5 ppm; beet, sugar, root 0.05 ppm; beet, sugar, tops 0.05 ppm; grain, cereal, forage, fodder and straw, group 16, except corn, grain sorghum, rice and wheat, forage 0.5 ppm; grain, cereal, forage, fodder and straw, group 16, except corn, grain sorghum, rice and wheat, hay 2.0 ppm; grain, cereal, forage, fodder and straw, group 16, except corn, grain sorghum, rice and wheat, stover 0.1 ppm; grain, cereal, forage, fodder and straw, group 16, except corn, grain sorghum, rice and wheat, straw 0.3 pmp; grain, cereal, group 15, except corn, grain sorghum, rice, and wheat, grain 0.05 ppm; pea and bean, dried shelled, except soybean, subgroup 6C, 0.05 ppm; potato 0.05 ppm; soybean, forage 0.7 pmp; soybean, hay 1.0 ppm; sunflower, seed 0.05 ppm; wheat, forage 0.5 ppm; wheat, grain 0.02 wheat, hay 2.0 ppm; wheat, straw 0.1 ppm.

Human toxicity (long-term)[101]: Intermediate–20.71006 ppb, CHCL (Chronic Human Carcinogen Level)

Fish toxicity (threshold)[101]: Low–187.34840 ppb, MATC (Maximum Acceptable Toxicant Concentration)

Regulatory Authority and Advisory Information:

Carcinogenicity[83]: EPA, Likely to be carcinogenic to humans; IARC Group 2b, probable carcinogen

California Proposition 65 Chemical: Carcinogen (1/1/1989)

Acute Oral Category: 3, CAUTION

Health Advisory: Skin irritant/sensitizer, Endocrine disruptor (S!)

European/International Regulations: Hazard Symbol: Xn, Xi, N; risk phrases: R20; R37/8; R43; R50/53; safety phrases: S2; S36/37; S60; S61 (see Appendix 1)

Description: Acetochlor is a thick, oily, amber, blue or purplish liquid. Sweet, aromatic odor. Molecular weight = 269.77; Specific gravity (H_2O:1) = 1.1 gm/ml @ 25 °C; Boiling point = 171 °C; Freezing/Melting point = 1 °C; Vapor pressure = 3.4×10^{-8} mmHg @ 25 °C; Flash point = >93 °C; 160 °C. Hazard Identification (based on NFPA-704 M Rating System): Health 3, Flammability 1, Reactivity 1. Moderately soluble in water; solubility = 233 mg/L; 400 ppm @ 25 °C. Physical and toxicological properties may be affected by carrier solvents in commercial formulations.

Incompatibilities: Oxidizers (chlorates, nitrates, peroxides, permanganates, perchlorates, chlorine, bromine, fluorine, etc). Hydrolyzed by strong acids; strong alkalies; bases; alkaline reagents. Slowly hydrolyzes in water, releasing ammonia and forming acetate salts. Slightly corrosive to some steels. May attack some forms of plastic, rubber, and coatings.

Permissible Concentration in Water: Federal Drinking Water Guidelines: 10 ppb[14].

Determination in Water: Log K_{ow} = >3.5. Values at or above 3.0 are likely to bioaccumulate in marine organisms.

Routes of Entry: Inhalation, ingestion, dermal contact; absorbed through the intact skin.

Harmful Effects and Symptoms

Short Term Exposure: May cause skin sensitization. Attacks central nervous system. May cause apprehension, anxiety, confusion, nervous excitation; dizziness; headache; numbness and weakness in limbs; muscle twitching, tremors; nausea and vomiting; slow, shallow respiration, bluish face; convulsions; loss of consciousness; breathing stops; death. LD_{50} (oral, rabbit) = 600 mg/kg; LD_{50} (dermal, rabbit) = >2 g/kg.

Long Term Exposure: A potential human carcinogen. May cause skin sensitization.

Medical Surveillance: This chemical is a suspected or known human carcinogen. Exposed persons should contact a physician for advice regarding the possible long term health effects and advice for medical monitoring. Employees shall be counseled by the physician to ensure that each employee is aware that this chemical has been implicated in the production of effects on the reproductive system. Preliminary medical exam to detect chronic diseases of central nervous system, liver, heart, kidneys, lung and skin, as well as endocrinological or immunological disturbances, should protect susceptible individuals. Periodical medical exams of internal organs, skin and eyes are important to avoid chronic occupational intoxications. They should include lab and patch tests when necessary[83]. Medical observation is recommended for 24 to 48 hours following breathing overexposure, as pulmonary edema may be delayed. Cigarette smoking may exacerbate pulmonary injury and should be discouraged for at least 72 hours following exposure. Evaluation by a qualified allergist, including exposure history and testing, may help diagnose allergy.

First Aid: Speed in removing material from eyes and skin is of extreme importance. *Eyes:* Eye contact can cause dangerous amounts of these chemicals to be quickly absorbed through the mucous membrane into the bloodstream. Directly, irrigate with large amounts of plain, tepid water or saline for 20 minutes, occasionally lifting the lower and upper lids. During this time, remove contact lenses, if easily removable without additional trauma to the eye. Get medical aid immediately. Have physician check for possible delayed damage. Skin: Get medical aid. Dermal contact can cause dangerous amounts of these chemicals to be absorbed into the bloodstream. Wearing the appropriate PPE equipment and respirator for organochlorine pesticides, immediately flush exposed skin, hair, and under nails with plain, running, tepid water for 20 minutes, then wash twice with mild soap. Shampoo hair promptly if contaminated; protect eyes. Do not scrub skin or hair, since this can increase absorption through the skin. Rinse thoroughly with water. Victims who are able and cooperative may assist with their own decontamination. Remove and double-bag contaminated clothing and personal belongings. Leather absorbs many organochlorines; therefore, items such as leather shoes, gloves, and belts should be discarded. If the skin is swollen or inflamed, cool affected areas with cold compresses. *Ingestion:* Call poison control. Loosen all clothing. Never give anything by mouth to an unconscious person. Get medical aid. Do NOT induce vomiting. The patient is at risk of central nervous system depression or seizures, which may lead to pulmonary aspiration during vomiting. If the victim is conscious and able to swallow, *administer an aqueous slurry of activated charcoal at 1 gm/kg (usual adult dose 60–90 g, child dose 25–50 g). A soda can and straw may be of assistance when offering charcoal to a child. The efficacy of activated charcoal for some organochlorine poisoning (such as chlordane) is uncertain. If victim is *unconscious or having convulsions,* do nothing except keep victim warm. **In some cases you may be specifically instructed by Poison Control to induce vomiting by way of 2 tablespoons of syrup of ipecac (adult) washed down with a cup of water*. Do NOT give activated charcoal before or with ipecac syrup. *Inhalation:* Get medical aid. Do not contaminate yourself. Wearing the appropriate PPE equipment and respirator for organochlorine pesticides, immediately remove the victim from the contaminated area to fresh air. For inhalation exposures, monitor for respiratory distress. If the victim is not breathing, administer artificial respiration. Do not use mouth-to-mouth method if victim ingested or inhaled the substance; give artificial respiration with the aid of a pocket mask equipped with a one-way valve or other proper respiratory medical device. If cough or breathing difficulty develops, evaluate for respiratory tract irritation, bronchitis, or pneumonitis. If breathing is difficult, administer 100% humidified supplemental oxygen through bag/mask apparatus until medical help arrives. Do not leave victim unattended. As first aid for pulmonary edema, a doctor or authorized paramedic might consider administering a corticosteroid spray.

Respirator Selection: *At any detectable concentration:* SCBAF: Pd,Pp (APF = 10,000) (any NIOSH/MSHA-or European Standard EN 149-approved self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode); or SaF: Pd,Pp: ASCBA (APF = 10,000) (any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary, self-contained breathing apparatus operated in a pressure-demand or other positive-pressure mode). *Escape:* 100 F (APF = 50) (any air-purifying, full facepiece respirator with and N100, R100, or P100 filter k-mounted organic vapor canister having a high-efficiency particulate filter); or SCBAE (any appropriate escape-type, self-contained breathing apparatus).

Spill Handling: First, remove all sources of ignition. For liquids, isolate spill or leak area in all directions for at least 50 meters /150 feet. Increase, in the downwind direction, as necessary. Do not touch damaged containers or spilled material unless wearing appropriate protective clothing. Stop leak if you can do it without risk. Prevent entry into waterways, sewers, basements or confined areas. Cover with plastic sheet to prevent spreading. Absorb or cover with dry earth, sand or other non-combustible material and transfer to containers. Do not allow water to get inside containers.

Storage: Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: Environmentally hazardous substances, solid or liquid, usually fall in Hazard Class 9.

Fire Extinguishing: Hazardous decomposition includes oxides of nitrogen and carbon and hydrogen chloride gas. As an immediate precautionary measure, isolate spill or leak area in all directions for at least 50 meters/150 feet for liquids and at least 25 meters/75 feet for solids. *Fire involving storage or vehicular tanks:* isolate for 800 meters/0.5 mile in all directions; also, consider initial evacuation for 800 meters/0.5 mile in all directions. *On a small fire:* use dry chemical, CO_2, water spray or regular foam. *On a large fire:* use water spray, fog or regular foam. Do not scatter spilled material with high-pressure streams of water. Move containers from fire area if you can do it without risk. Dike fire-control water for later disposal. *Fire involving tanks:* from a secure, explosion-proof location, use water spray to cool exposed containers. If cooling streams are ineffective (venting sound increases in volume and pitch, tank discolors, or shows any signs of deforming), withdraw immediately to a secure position. Always stay away from tanks engulfed in fire. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies. If employees are

expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode.

Disposal Method Suggested: Do not discharge into drains or sewers. Dispose of waste material as hazardous waste using a licensed disposal contractor to an approved landfill. Consult with environmental regulatory agencies for guidance on acceptable disposal practices. If allowed, incineration with effluent gas scrubbing is recommended. Containers must be disposed of properly by following package label directions or by contacting your local or federal environmental control agency, or by contacting your regional EPA office.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- EXTOXNET, Extension Toxicology Network, “Pesticide Information Profile, Acetochlor,” Oregon State University, Corvallis, OR. http://extoxnet.orst.edu/pips/acetochl.htm
- USEPA, Office of Pesticide Programs, Pesticide Residue Limits, “Acetochlor”, 40 CFR 180.470. http://www.epa.gov/pesticides/food/viewtols.htm

Acifluorfen A:0360

Use Type: Herbicide

CAS Number: 50594-66-6; 62476-59-9 (sodium salt)

Formula: $C_{14}H_7ClF_3NO_5$; $F_3C\text{-}C_6H_3(Cl)\text{-}O\text{-}C_6H_3(NO_2)(COOH)$

Synonyms: Acifluorfene; Benzoic acid, 5-(2-chloro-4-(trifluoromethyl)phenoxy)-2-nitro-; 5-(2-Chloro-4-(trifluoromethyl)phenoxy)-2-nitrobenzoic acid; 5-(2-Chloro-α-α-α-trifluoro-*p*-tolyloxy)-2-nitrobenzoic acid; Sodium acifluorfen

Trade Names: ASIF®; BLAZER®; CARBOFUORFEN®; KLEENUP® Grass and Weed Killer; RH-6201; SCEPTER O.T. HERBICIDE®; STATUS®; STORM®; ULTRA BLAZER®

Chemical Cass: Nitrophenyl ether (diphenolic ether)

EPA/OPP PC Code: 114401; sodium salt: 114402, 209800

California DPR Chemical Code: 2218 as sodium salt

HSDB Number: 6551 (sodium salt)

UN/NA & ERG Number: UN3077(solid)/171

RTECS® Number: DG5643200

EC Number: 256-634-5 [*Annex I Index No.:* 604-041-00-0]; 263-560-7 [*Annex I Index No.:* 604-041-00-0] (sodium salt)

Uses: Used to control pre-emergent and post-emergent broadleaf weeds and grasses in soybean, peanut, pea and rice crops. It is also registered for use by homeowners as a spot treatment on driveways, sidewalks, and patios. It should not be mixed with oils, surfactants, liquid fertilizers, and other pesticides. Not approved for use in EU countries[115].

U.S. Maximum Allowable Residue Levels for Aacifluorfen, sodium and its metabolites (the corresponding acid, methyl ester, and amino analogues) [40CFR180.383]: in or on the following raw agricultural commodities: Peanut 0.1 ppm; Rice, grain 0.1 ppm; Rice, straw 0.2 ppm; Soybean, seed 0.1 ppm; Strawberry 0.05 ppm.

Human toxicity (long-term)[101]: (Na salt) High–10 ppb, Health Advisory.

Fish toxicity (threshold)[101]: (Na salt) Very low–1500 ppb, MATC (Maximum Acceptable Toxicant Concentration).

Regulatory Authority and Advisory Information:

Carcinogenicity[83]: EPA, Likely to be carcinogenic to humans at high doses; Not likely to be carcinogenic to humans at Low Doses; IARC:[12] Animal Sufficient Evidence, Human Inadequate Evidence, *possibly carcinogenic to humans*, Group 2b.

California Proposition 65 Chemical: Cancer (1/1/90) (CAS: 62476-59-9, *sodium salt*)

Health Advisory: Mutagen (sodium salt), Developmental/Reproductive Toxin

SARA 313: Form R *de minimis* Concentration Reporting Level: 1.0% (sodium salt)

European/International Regulations (*includes sodium*): Hazard Symbol: Xn, Xi, N; risk phrases: R22; R38; R41; R50/53; safety phrases: S2; S24; S39; S60; S61 (see Appendix 1)

Description: Acifluorfen is a combustible, off-white to light tan solid. The sodium salt is a white or brown crystalline powder. Molecular weight = 361.65; Specific gravity $(H_2O{:}1) = 1.647$ @ 20 °C; Freezing/Melting point = 152–157 °C [23]; 124–125 °C (sodium salt)[88]; Flash point = >200 °C;. Vapor pressure = 6.8×10^{-8} mmHg @ 25 °C. Highly soluble in water. The sodium salt is also soluble in water.

Incompatibilities: Strong oxidizers. Avoid contact with all sources of ignition.

Permissible Exposure Limits in Air: Not established

Permissible Concentration in Water: State Drinking Water Guidelines: Maine 3.5 μg/L; Florida 1 μg/L.

Determination in Water: Method: USGS-NWQL O-1131-95; Procedure: high-performance liquid chromatography using ultraviolet spectrometry; Analyte: acifluorfen-sodium; Matrix: filtered natural-water; Detection limit: 0.008 μg/L.

Routes of Entry: Inhalation, dermal contact, ingestion

Harmful Effects and Symptoms

Short Term Exposure: Acifluorfen is a moderate dermal and eye irritant.

Long Term Exposure: A known animal carcinogen. Similar chlorinated diphenyl ethers have caused liver damage in laboratory animals. LD_{50} (oral, male rat) = 2025 mg/kg; (oral, femal rat) = 1370 mg/kg.

Points of Attack: Fluorides may cause bone disease (pain and tenderness of the bones); mottled teeth in children. May cause skin and liver effects.

Medical Surveillance: The sodium salt of this chemical is a suspected or known human carcinogen. Exposed persons should contact a physician for advice regarding the possible long term health effects and advice for medical monitoring. Liver function tests.

First Aid: If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least 15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately. If this chemical contacts the skin, remove contaminated clothing and wash immediately with soap and water. Seek medical attention immediately. If this chemical has been inhaled, remove from exposure, begin rescue breathing (using universal precautions) if breathing has stopped, and CPR if heart action has stopped. Transfer promptly to a medical facility. When this chemical has been swallowed, get medical attention. Give large quantities of water and induce vomiting. Do not make an unconscious person vomit. Do not induce vomiting when formulations containing petroleum solvents are ingested

Personal Protective Methods: Incompatible with Cellulose-Based and Expanded Polymeric Absorbents[88]. Smoking, eating, and drinking before washing should be absolutely prohibited when any pesticide is being handled or used. Applicators and other handlers must wear: Coveralls worn over long-sleeved shirt and long pants; Chemical-resistant gloves such as DuPont™ Tychem® suit fabrics, barrier laminate, or Viton®; Chemical-resistant footwear plus socks; Protective eye wear; Chemical-resistant headgear for overhead exposure; Chemical-resistant apron when cleaning equipment, mixing, or loading[83]. Agricultural Use/Engineering Controls: When handlers use closed systems, enclosed cabs, or aircraft in a manner that meets the requirements listed in the Worker Protection Standard (WPS) for agricultural pesticides, ***40 CFR 170.240(d)(4-6),*** the handler PPE requirements may be reduced or modified as specified in the Worker Protection Standard.

Respirator Selection: Wherever and whenever workplace conditions warrant respirator use, a respiratory protection program must be followed that meets one or more of the following government standards: OSHA's 29 CFR 1910.134, ANSI Z88.2, or European Standard EN 149.

Storage: Color Code-Blue: Health Hazard/Poison: Store in a tightly closed container in a dry, well-ventilated and secure poison location. Prior to working with this chemical you should be trained on its proper handling and storage. Where possible, automatically transfer material from other storage containers to process containers. Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: Environmentally hazardous substances, solid or liquid, usually fall in Hazard Class 9.

Spill Handling: Do not touch or walk through spilled material. Stop leak if you can do it without risk. Prevent dust cloud. Avoid inhalation of asbestos dust. *Small Dry Spill:* With clean shovel place material into clean, dry container and cover loosely; move containers from spill area. *Small Spill:* Take up with sand or other non-combustible absorbent material and place into containers for later disposal. *Large Spill*: Dike far ahead of liquid spill for later disposal. Cover powder spill with plastic sheet or tarp to minimize spreading. Prevent entry into waterways, sewers, basements or confined areas.

Fire Extinguishing: This chemical is a combustible solid. Hazardous decomposition includes oxides of nitrogen and carbon and hydrogen fluoride and hydrogen chloride gas. As an immediate precautionary measure, isolate spill or leak area in all directions for at least 50 meters/150 feet for liquids and at least 25 meters/75 feet for solids. *Fire involving storage or vehicular tanks:* isolate for 800 meters/0.5 mile in all directions; also, consider initial evacuation for 800 meters/0.5 mile in all directions. *On a small fire:* use dry chemical, CO_2, water spray or regular foam. *On a large fire:* use water spray, fog or regular foam. Do not scatter spilled material with high-pressurestreams of water. Move containers from fire area if you can do it without risk. Dike fire-control water for later disposal. *Fire involving tanks:* from a secure explosion-proof location, use water spray to cool exposed containers. If cooling streams are ineffective (venting sound increases in volume and pitch, tank discolors, or shows any signs of deforming), withdraw immediately to a secure position. Always stay away from tanks engulfed in fire. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode.

Disposal Method Suggested: It is the responsibility of chemical waste generators to determine the toxicity and physical properties of a discarded chemical and to properly identify its classification and certification as a hazardous waste and to determine the disposal method. U.S. EPA guidelines for the classification determination are listed in 40 CFR Parts 261.3. Additionally, waste generators must consult and follow all regional, national, state and local hazardous waste laws to ensure complete and accurate classification and disposal methods.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- USEPA, “Health Advisory: Acifluorfen,” Washington DC, Office of Drinking Water (August 1987)
- “Sodium Acifluorfen Usage, Benefits, and Alternatives,” EPA Office of Prevention, Pesticides and Toxic Substances, letter, December 6, 2001. http://www.epa.gov/oppsrrd1/reregistration/acifluorfen
- USEPA, “Tolerance Reassessment & Registration”, 40 CFR 180.383; FR April 12, 2002. http://www.epa.gov/oppsrrd1/reregistration/acifluorfen

Alachlor A:0480

Use Type: Herbicide
CAS Number: 15972-60-8; 15972-50-8
Formula: $C_{14}H_{20}ClNO_2$
Synonyms: Al3-51506; Acetamide, 2-chloro-*N*-(2,6-diethylphenyl)-*N*-(Methoxymethyl)-; Acetanilide, 2-chloro-2',6'-diethyl-*N*-methoxymethyl)-; Alachlore; α-Chloro-2',6'-diethyl-*N*-(methoxymethyl)acetanilide; 2-Chloro-*N*-(2,6-diethylphenyl)-*N*-(methoxymethyl) acetamide; Metachlor; Methachlor; *N*-(Methoxymethyl)2,6-diethylchloro acetamide
Trade Names: AGIMIX® Araclor; ALAGAM®; ALAGAN®; ALANEX®; ALAPAZ®, suspended; ALAZINE®; ALATOX 480®; ALCLOR 48 LE®; CHIMICHLOR®; LARIAT®; LASAGRIN®; LASSAGRIN®; LASSO®; LASSO MICRO-TECH®; METACHLOR®; PARTNER® Arachlor; PILLARZO®; SANACHLOR®
Chemical Class: Chloroacetanilide; Chloroacetamide
EPA/OPP PC Code: 090501
California DPR Chemical Code: 678
HSDB Number: 1014
UN/NA & ERG Number: UN2588 (Pesticide, solid, poisonous, n.o.s.)/151; UN2902 (Pesticide, liquid, poisonous, n.o.s.)/151
RTECS® Number: AE1225000
EC Number: 240-110-8 [*Annex I Index No.:* 616-015-00-6]
Uses: A pre-emergence herbicide for corn, soybeans, and peanuts, and other field crops. It is a selective systemic herbicide, absorbed by germinating shoots and by roots. It works by interfering with a plant's ability to produce protein and by interfering with root elongation. It is available as granules or emulsifiable concentrate. Alachlor is used in mixed formulations with atrazine, glyphosate, trifluralin, and imaquin. Not approved for use in the EU. A U.S. EPA restricted Use Pesticide (RUP).
U.S. Maximum Allowable Residue Levels for Alaclor and its metabolites calculated as alachlor (40 CFR 180.249): in or on bean, dry, seed 0.1 ppm; bean, forage 0.2 ppm; bean, hay 0.2 ppm; bean, lima, succulent 0.1 ppm; cattle, fat 0.02 ppm; cattle, meat byproducts 0.02 ppm; cattle, meat 0.02 ppm; corn, forage 0.2 ppm; corn, fresh, kernel plus cob with husks removed 0.05 ppm; corn, grain 0.2 ppm; corn, stover 0.2 ppm; Egg 0.02 ppm; goat, fat 0.02 ppm; goat, meat byproducts 0.02 ppm; goat, meat 0.02 ppm; Hog, fat 0.02 ppm; hog, meat byproducts 0.02 ppm; hog, meat 0.02 ppm; horse, fat 0.02 ppm; horse, meat byproducts 0.02 ppm; horse, meat 0.02 ppm; milk 0.02 ppm; peanut 0.05 ppm; poultry, fat 0.02 ppm; poultry, meat byproducts 0.02 ppm; poultry, meat 0.02 ppm; sheep, fat 0.02 ppm; sheep, meat byproducts 0.02 ppm; sheep, meat 0.02 ppm; sorghum, forage 2.0 ppm; sorghum, grain (milo) 0.1 ppm; sorghum, grain, stover 1.0 ppm; soybean 0.2 ppm.
Human toxicity (long-term)[101]: High–2.00 ppb, MCL (Maximum Contaminant Level)
Fish toxicity (threshold)[101]: Intermediate–26.19584 ppb, MATC (Maximum Acceptable Toxicant Concentration)
Regulatory Authority and Advisory Information:
Carcinogenicity[83]: EPA, Likely to be carcinogenic to humans (in high doses); Not likely to be carcinogenic to humans (low doses); EU GHS Category 2: Suspected human carcinogen; ACGIH: A3, Confirmed animal carcinogen with unknown relevance to humans.
California Proposition 65 Chemical: Cancer (1/1/1989)
Acute Oral Category: 3, CAUTION
Health Advisory: Mutagen, Endocrine disruptor (S!)
Potential Ground water Pollutant [California FAC Section 13145(d)/12811, active]
Safe Drinking Water Act, MCL, 0.002 mg/L; MGLC, zero; Regulated chemical (47 FR 9352)
Superfund/EPCRA 40CFR302.4, Appendix A, Reportable Quantity (RQ): 1 lb (0.454 kg), SARA 313: Form R *de minimis* Concentration Reporting Level: 1.0%
European/International Regulations: Hazard Symbol: Xn, Xi, N; risk phrases: R22; R40; R43; R50/53; safety phrases: S2; S36/37; S46; S60; S61 (see Appendix 1)
WGK (German Aquatic Hazard Class): 3-Severe hazard to waters
Description: Alachlor is a white to cream-colored solid. Molecular weight = 269.79; Specific gravity (H_2O:1) = 1.1 g/cm^3; Boiling point = 399 °C; Freezing/Melting point = 40–41 °C[88]; Vapor pressure = 1.5×10^{-6} mmHg @ 25 °C; Flash point = 137 °C (cc). Hazard Identification (based on NFPA-704 M Rating System): Health 2, Flammability 0, Reactivity 0. Low solubility in water; solubility = 250 mg/L @ 25 °C.
Incompatibilities: Hydrolyzed on contact with acid or alkaline media. May react with strong oxidizers such as chlorates, peroxides, nitrates, etc. Corrosive to iron and steel. Decomposes in temperatures >100 °C.
Permissible Exposure Limits in Air: ACGIH TLV®[1]: 1 mg/m^3 TWA (inhalable fraction and vapor; sensitization). Excursion Limit Recommendation: Excursions in worker exposure levels may exceed 3 times the TLV-TWA for no more than a total of 30 minutes during a work day, and under no circumstances should they exceed 5 times the TLV-TWA, provided that the TLV-TWA is not exeeded A3: Confirmed animal carcinogen with unknown relevance to humans. A3, confirmed animal carcinogen with unknown relevance to humans.
Determination in Air: OSHA PV2035; Procedure: high-performance liquid chromatography; Detection limit: 0.005 mg/m^3; NIOSH 5602, Issue 1; Procedure: gas chromatography with electron capture detector; Detection limit: 0.05 μg/sample; NIOSH 9200, Issue 1; Procedure: gas chromatography with electron capture detector; Detection limit: 0.01 μg/mL; NIOSH 9201, Issue 1; Procedure: gas chromatography with electron capture detector; Detection limit: 0.0025 μg/mL.
Permissible Exposure Limits in water: Federal Drinking Water Standards: EPA 2 μg/L; State Drinking Water Guidelines: Minnesota 5 μg/L; Arizona 0.15 μg/L; Maine 7 μg/L; Minnesota (Alachlor-oxanilic acid) 70 μg/L; Minnesota (Alachlor-ethane sulfonic acid) 70 μg/L. MCLG = 0; MCL = 2 ppb.

Determination in Water: May be accomplished by liquid-liquid extraction gas chromatographic procedure[47]. Log K_{ow} = >3.0. Values at or above 3.0 are likely to bioaccumulate in marine organisms.

Routes of Entry: Ingestion, inhalation, dermal and/or eye contact.

Harmful Effects and Symptoms: No effects found in human studies[47]. Exhibits relatively low acute oral toxicity. However, alachlor feeding studies have demonstrated oncogenic effects including lung tumors in mice, and stomach, thyroid and nasal turbinate tumors in rats.

Short Term Exposure: Toxic by dermal contact, ingestion, and inhalation. Eye contact may cause severe irritation or permanent injury. Dermal contact may irritate and burn skin. May cause skin sensitization and alergic skin reaction. LD_{50} (oral, rat) = 930 mg/kg; LD_{50} (dermal, rabbit) = >1200 mg/kg.

Long Term Exposure: Repeated or prolonged contact may cause skin sensitization. May cause liver damage. A suspected endocrine disruptor and carcinogen; developmental toxin. A possible lung, kidney and liver toxin. Mutagen; human mutation data reported. May cause tumors.

Points of Attack: Liver, skin, lungs, kidneys, DNA.

Medical Surveillance: This chemical is a suspected or known human carcinogen. Exposed persons should contact a physician for advice regarding the possible long term health effects and advice for medical monitoring. Lung, liver and kidney function tests. Evaluation by a qualified allergist, including exposure history and testing, may help diagnose allergy. In addition to comprehensive initial medical and work histories emphasizing reproductive experience and menstrual history, patient should have physical examination and testing of genito-urinary tract, sperm count, motility and morphology. If required, other tests, such as serum testosterone, serum follicle stimulating hormone (FSH), and serum lutenizing hormone (LH), may be indicated.

First Aid: If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least 15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately. Give artificial respiration if victim is not breathing. *Do not* use mouth-to-mouth method if victim ingested or inhaled the substance; give artificial respiration with the aid of a pocket mask equipped with a one-way valve or other proper respiratory medical device. Administer oxygen if breathing is difficult. Remove and isolate contaminated clothing and shoes. In the event of contact with substance, immediately flush skin or eyes with running water for at least 20 minutes. For minor skin contact, avoid spreading material on unaffected skin. Keep victim warm and quiet. Effects of exposure (inhalation, ingestion or skin contact) to substance may be delayed. Ensure that medical personnel are aware of the material(s) involved and take precautions to protect themselves.

Personal Protective Methods: Smoking, eating, and drinking before washing should be absolutely prohibited when any pesticide is being handled or used. Applicators and other handlers must wear: Coveralls worn over long-sleeved shirt and long pants; Chemical-resistant gloves such as DuPont Tychem® suit fabrics, barrier laminate, or Viton®; Chemical-resistant footwear plus socks; Protective eye wear; Chemical-resistant headgear for overhead exposure; Chemical-resistant apron when cleaning equipment, mixing, or loading[83]. Agricultural Use/Engineering Controls: When handlers use closed systems, enclosed cabs, or aircraft in a manner that meets the requirements listed in the Worker Protection Standard (WPS) for agricultural pesticides, ***40 CFR 170.240(d)(4-6),*** the handler PPE requirements may be reduced or modified as specified in the Worker Protection Standard.

Respirator Selection: Wherever and whenever workplace conditions warrant respirator use, a respiratory protection program must be followed that meets one or more of the following government standards: OSHA's 29 CFR 1910.134, ANSI Z88.2, or European Standard EN 149.

Storage: Color Code-White: Corrosive or Contact Hazard; Store separately in a corrosion-resistant location. Prior to working with this chemical you should be trained on its proper handling and storage. Store in tightly closed containers in a cool, well-ventilated area. Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: Pesticides, solid, toxic/poisonous, n.o.s require a shipping label of "poisonous materials" and fall in Hazard Class 6.1. Technical name required. IMO Pollution Category B.

Spill Handling: First, remove all sources of ignition. Evacuate persons not wearing protective equipment from area of spill or leak until clean up is complete. Ventilate area of spill or leak. Use water spray to reduce vapors. Take up with diatomite, clay, expanded mineral, foamed glass, or synthetic treated absorbent material and deposit in sealed containers for later disposal. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable. For *large spills* seek professional environmental engineering assistance from the U.S. EPA Environmental Response Team at (908) 548-8730 (24-hour response line).

Fire Extinguishing: Hazardous decomposition includes nitrogen oxides and hydrogen chloride. This chemical is not flammable, but may support combustion. Stay upwind of fire. Use dry chemical, carbon dioxide; water spray; or foam extinguishers. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies. From a secure, explosion-proof location, use water spray to cool exposed containers. If cooling streams are ineffective (venting sound increases in volume and pitch, tank discolors, or shows any signs of deforming), withdraw immediately to a secure position. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode.

Disposal Method Suggested: This compound is hydrolyzed under strongly acid or alkaline conditions, to chloroacetic acid, methanol, formaldehyde and 2,6-diethylanilne. Incineration is recommended as a disposal procedure. Do not discharge into drains or sewers. Dispose of waste material as hazardous waste using a licensed disposal contractor to an approved landfill. Contact a licensed disposal facility about surplus and non-recyclable solutions. Burn in a chemical incinerator equipped with an afterburner and scrubber. Extra care must be exercised as the material in an organic solvent is highly flammable. Consult with environmental regulatory agencies for guidance on acceptable disposal practices. Generators of waste containing this contaminant (≥100 kg/mo) must conform with EPA regulations governing storage, transportation, treatment, and waste disposal. Incineration with effluent gas scrubbing is recommended. Techniques for alachlor removal from potable water have been reviewed by EPA[47] but the data revealed no superior method. Improper disposal of pesticides is a violation of federal law. Dispose in accordance with 40CFR165, follow recommendations for the disposal of pesticides and pesticide containers. Containers must be disposed of properly by following package label directions or by contacting your local or federal environmental control agency, or by contacting your regional EPA office.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- USEPA, "Alachlor: Notice of Intent to Cancel Registrations; Conclusion of Special Review," Federal Register 52, No. 251, pp.49480-49504 incl. (December 31, 1987)
- USEPA, Office of Pesticide Programs, Pesticide Residue Limits, "Alachlor," 40 CFR 180.249. http://www.epa.gov/pesticides/food/viewtols.htm
- EXTOXNET, Extension Toxicology Network, "Pesticide Information Profile, Alachlor," Oregon State University, Corvallis, OR (June 1996). http://ace.ace.orst.edu/info/extoxnet/pips/alachlor.htm
- Waxman, M. F. and Kammel, D.W., A Guidebook for the Safe Use of Hazardous Agricultural Farm Chemicals and Pesticides, North Central Regional Publication 402, Madison, WI (1991)
- USEPA, *R.E.D. Facts Alachlor*, EPA 738-R-98-018, Washington DC (September 1998)

Aldicarb A:0490

Use Type: Insecticide, Nematicide, Acaricide
CAS Number: 116-06-3
Formula: $C_7H_{14}N_2O_2S$; $CH_3SC(CH_3)_2CH{=}NOCONHCH_3$; $C_7H_{14}N_2O_2S$
Synonyms: A13-27093; Aldecarb; Aldecarb (ISO); Carbamic acid, methyl-,*O*-[(2-methyl-2-(methylthio)propylidene)amino]derivative; Carbanolate; Caswell No. 011A; ENT 27093; NCI 08640; 2-Methyl-2-(methylthio) propanal *O*-[(methylamino)carbonyl]oxime; 2-Methyl-2-(methylthio)propanaldehyde *O*-(methylcarbamoyl)oxime; Propionaldehyde, 2-methyl-2-(methylthio)-,*O*-(methylcarbamoyl)oxime; Propanal, 2-methyl-2-(methythio)-,*O*-[(methylamino)carbonyl]oxime; Sulfone aldoxycarb
Trade Names: TEMIC®; TEMIK®; OMS 771®; TERNIC®; TEMIK 10 G®
Chemical Class: Carbamate (*N*-methyl)
EPA/OPP PC Code: 098301
California DPR Chemical Code: 00575
HSDB Number: 1510
UN/NA & ERG Number: UN2757 (solid)/151
RTECS® Number: UE2275000
EC Number: 204-123-2; [*Annex I Index No.:* 006-017-00-X]
Uses: A U.S. EPA restricted Use Pesticide (RUP). Not approved for use in EU countries[115].

U.S. Maximum Allowable Residue Levels for Aldicarb and its cholinesterase-inhibiting metabolites 2-methyl 2-methylsulfinyl)propionaldehyde O-(methylcarbamoyl)oxime & 2-methyl-2-(methylsulfonyl)propionaldehyde O-(methylcarbamoyl) oxime [(40 CFR 180.269 (a)]: in or on the following food commodities: beans (dry) 0.1 ppm; beets, sugar 0.05 ppm; beets, sugar, tops 1 ppm; cattle, fat 0.01 ppm; cattle, meat byproducts 0.01 ppm; cattle, meat 0.01 ppm; citrus pulp, dried 0.6 ppm; coffee beans 0.1 ppm; cottonseed 0.1 ppm; cotton, hulls 0.3 ppm; goat, fat 0.01 ppm; goat, meat byproducts 0.01 ppm; goat, meat 0.01 ppm; grapefruit 0.3 ppm; hog, fat 0.01 ppm; hog, meat byproducts 0.01 ppm; hog, meat 0.01 ppm; horse, fat 0.01 ppm; horse, meat byproducts 0.01 ppm; horse, meat 0.01 ppm; lemon 0.3 ppm; lime 0.3 ppm; milk 0.002 ppm; oranges 0.3 ppm; peanuts 0.05 ppm; pecans 0.5 ppm; potato 1 ppm; sheep, fat 0.01 ppm; sheep, meat byproducts 0.01 ppm; sheep, meat 0.01 ppm; sorghum, bran 0.5 ppm; sorghum, fodder 0.5 ppm; sorghum, grain 0.2 ppm; soybeans 0.02 ppm; sugarcane 0.02 ppm; sugarcane, fodder 0.1 ppm; sugarcane, forage 0.1 ppm; sweet potato 0.1 ppm.

Human toxicity (long-term)[101]: High–7.00 ppb, MCL (Maximum Contaminant Level)
Fish toxicity (threshold)[101]: High–3.75027 ppb, MATC (Maximum Acceptable Toxicant Concentration)
Regulatory Authority and Advisory Information:
Carcinogenicity[83]: EPA Group E, evidence of non-carcinogenicity for humans; IARC Group 3, unclassifiable as to its carcinogenicity in humans, 1991

Acute Oral Category: 1, DANGER–POISON
Health Advisory: Nerve Toxin, Mutagen, Endocrine disruptor (S!)
Potential Ground water Pollutant [California FAC Section 13145(d)/12811, active]
U.S. EPA Hazardous waste number (RCRA No.): P070
RCRA 40CFR261, Appendix 8; 40CFR261.11 Hazardous Constituents
RCRA Land Ban Waste Restrictions
Safe Drinking Water Act, MCL, 0.003 mg/L; MCLG 0.001 mg/L; Regulated chemical (47 FR 9352). CERCLA/SARA 40CFR302, Extremely Hazardous Substances: TPQ = 100 /10,000 lb (45.4/4540 kg)
Superfund/EPCRA 40CFR302.4, Appendix A, Reportable Quantity (RQ): CERCLA 1 lb (0.454 kg), SARA 313: Form R *de minimis* Concentration Reporting Level: 1.0%
US DOT Regulated Marine Pollutant (49CFR172.101, appendix B)
European/International Regulations: Hazard Symbol: T+, N; risk phrases: R24; R26/28; R50/53; safety phrases: S1/2; S22; S36/37; S45; S60; S61 (see Appendix 1).
WGK (German Aquatic Hazard Class): No value assigned.

Description: Aldicarb is a noncombustible, white crystalline solid with a slight sulfurous odor. Molecular weight = 190.28; Specific gravity (H_2O:1) = 1.195 @ 20 °C; Boiling point = (decomposes); Freezing/Melting point = 98–101.1 °C; Vapor pressure = 3.5×10^{-5} mmHg @ 20 °C. Relative vapor density (air = 1) = 6.59. Hazard Identification (based on NFPA-704 M Rating System): Health 3, Flammability 1, Reactivity 0. Slightly soluble in water; solubility = 0.6% @ 20 °C.

Incompatibilities: Carbamates are incompatible with strong oxidizing acids, peroxides, and hydro-peroxides; strong reducing agents such as hydrides; strong acids and bases. Contact with nitrides or chemically active metals (aluminum, copper, magnesium, neptunium, sodium, tin, titanium, zinc, etc.) causes the release of potentially explosive hydrogen gas and a metal salt. Rapidly hydrolyzed in acid and alkaline media.

Permissible Exposure Limits in Air: The American Industrial Hygiene Association (AIHA/WEEL) recommends a TWA level of 0.07 mg/m^3, and warns that aldicarb can be absorbed through the skin, thereby increasing exposure.

Protective Action Criteria (PAC) Ver. 27[89]
PAC-1: 0.027 mg/m^3
PAC-2: 0.3 mg/m^3
PAC-3: 9.5 mg/m^3

Permissible Concentration in Water: Federal Drinking Water Guidelines: EPA 7 μg/L (includes sulfoxide and sulfone); State Drinking Water Standards: Illinois 2 μg/L (includes sulfone), 4 μg/L (sulfoxide); New York 3 μg/L; 2 μg/L (sulfone), 4 μg/L (sulfoxide); State Drinking Water Guidelines: Arizona 9 μg/L; Maine 7 μg/L (sulfone); California 7 μg/L; Minnesota 1 μg/L; Wisconsin 10 μg/L; Massachusetts 3 μg/L, *2* ∝g/L (sulfone), 4 μg/L (sulfoxide). Canadian Drinking Water Standards (MAC): 0.009 mg/L.

Determination in Water: Aldicarb may be determined in water by gas-liquid chromatography with flame photometric detection after oxidation to the sulfone (aldoxycarb) by peracetic acid or 3-chloro-perbenzoic acid. Colorimetric methods have also been used based on hydrolysis to hydroxyl-amine, which is oxidized to nitrous acid, the latter used to diazotize sulfanilic acid which is then coupled to give a dye[23]. Log K_{ow} = <1.5. Although this chemical is an environmental hazard, it is unlikely to bioaccumulate in marine organisms.

Routes of Entry: Ingestion, dermal and/or eye contact.

Harmful Effects and Symptoms

Short Term Exposure: This chemical is one of the most highly toxic pesticides. It can be harmful or fatal if swallowed, inhaled or absorbed through the skin. Exposure can cause rapid severe poisoning with headache, blurred vision, sweating, nausea, abdominal pain, vomiting, diarrhea, loss of coordination, and death. In severe cases, unconsciousness and convulsions may occur. The probable oral lethal dose for humans is <5 mg/kg, or a taste (<7 drops) for a 150-lb person; it is extremely toxic by both oral and dermal routes. Carbamate insecticides inhibit the cholinesterase activity of enzymes, causing accumulation of acetylcholine at synapses and altering the way in which nervous impulses are transmitted. However, within several hours carbamates spontaneously detach from the enzymes. LD_{50} (oral, rat) = 650–930 μg/kg; (dermal, rabbit) = >5–20 mg/kg. The lethal dose for the sulfoxide is similar.

Long Term Exposure: May affect the immune system. Aldicarb is a questionable carcinogen with no firm human evidence. May cause reproductive and fetal effects. A neurotoxin. May cause tumors.

Points of Attack: Skin, lungs, immune system; Reproductive cells. Central nervous system.

Medical Surveillance: Routine biological monitoring of pesticide applicators and field workers includes testing of plasma and red blood cell acetylcholinesterase levels (for enzyme poisoned by this chemical). These tests are normally accurate only if done within about two hours of exposure. If exposure stops, plasma levels return to normal in 1–2 weeks while red blood cell levels may be reduced for 1–3 months. When acetylcholinesterase enzyme levels are reduced by 25% or more below preemployment levels, risk of poisoning is increased, even if results are in lower ranges of "normal." Reassignment to work not involving carbamate pesticides is recommended until enzyme levels recover. In addition to comprehensive initial medical and work histories emphasizing reproductive experience and menstrual history, patient should have physical examination and testing of genito-urinary tract, sperm count, motility and morphology. If required, other tests, such as serum testosterone, serum follicle stimulating hormone (FSH), and serum lutenizing hormone (LH), may be indicated.

First Aid: Speed in removing material from eyes and skin is of extreme importance. *Eyes:* Eye contact can cause dangerous amounts of these chemicals to be quickly absorbed through the mucous membrane into the bloodstream. Immediately and gently flush eyes with plenty of warm or cold water (NO hot water) for at least 15 minutes, occasionally lifting the upper and lower eyelids. Get medical aid immediately. *Skin:* Get medical aid. Dermal contact can cause dangerous amounts of these chemicals to be absorbed into the bloodstream. Wearing the appropriate PPE equipment and respirator for carbamate pesticides, immediately flush skin with plenty of soap and water for at least 15 minutes while removing contaminated clothing and shoes. Shampoo hair promptly if contaminated; protect eyes. *Ingestion:* Call poison control. Loosen all clothing. Never give anything by mouth to an unconscious person. Get medical aid. Do NOT induce vomiting. * If conscious, alert, and able to swallow, rinse mouth and have victim drink 4 to 8 ounces of water. Check to see if poison control instructs you to use ipecac syrup, otherwise administer slurry of activated charcoal (2 oz in 8 oz of water). If victim is *UNCONSCIOUS OR HAVING CONVULSIONS,* do nothing except keep victim warm. **In some cases you may be specifically instructed by poison control to induce vomiting by way of 2 tablespoons of syrup of ipecac (adult) washed down with a cup of water.* Do NOT give activated charcoal before or with ipecac syrup. *Inhalation:* Get medical aid. Do not contaminate yourself. Wearing the appropriate PPE equipment and respirator for carbamate pesticides, immediately remove the victim from the contaminated area to fresh air. If the victim is not breathing, administer artificial respiration. Do not use mouth-to-mouth method if victim ingested or inhaled the substance; give artificial respiration with the aid of a pocket mask equipped with a one-way valve or other proper respiratory medical device. If breathing is difficult, administer oxygen through bag/mask apparatus until medical help arrives. Do not leave victim unattended.

Note to physician or authorized medical personnel. Administer atropine, 2 mg (1/30 gr) intramuscularly or intravenously as soon as any local or systemic signs or symptoms of an intoxication are noted; repeat the administration of atropine every 3 to 8 minutes until signs of atropinization (mydriasis, dry mouth, rapid pulse, hot and dry skin) occur; initiate treatment in children with 0.05 mg/kg of atropine; repeat at 5 to 10 minute intervals. Watch respiration, and remove bronchial secretions if they appear to be obstructing the airway; intubate if necessary. *Medical note:* 2-PAMCI may be contraindicated in the case of some carbamate poisonings.

Personal Protective Methods: Wear protective gloves and clothing to prevent any reasonable probability of dermal and/or eye contact. Safety equipment suppliers/manufacturers can provide recommendations on the most protective glove/clothing material for your operation. DuPont™ Tychem® suit fabrics[88]. All protective clothing (suits, gloves, footwear, headgear) should be clean, available each day, and put on before work. Contact lenses should not be worn when working with this chemical. Wear dust-proof chemical goggles and face shield unless full facepiece respiratory protection is worn. Employees should wash immediately with soap when skin is wet or contaminated. Provide emergency showers and eyewash.

Respirator Selection: *SCBA* > 0.027 mg/m^3. *At concentrations above the NIOSH REL, or where there is no REL, at any detectable concentration:* SCBAF:Pd,Pp (APF = 10,000): (any self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode); or SaF:Pd,Pp:ASCBA (APF = 10,000) (any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary self-contained positive-pressure breathing apparatus). *Escape*: GmFOv100 (APF = 50) [any air-purifying, full facepiece respirator (gas mask) with a chin-style, front- or back-mounted organic vapor canister having an N100, R100, or P100 filter]; or SCBAE (any appropriate escape-type, self-contained breathing apparatus).

Storage: Color Code-Blue: Health Hazard/Poison. Store in a secure poison location. Prior to working with this chemical you should be trained on its proper handling and storage. A regulated, marked area should be established where aldicarb is handled, used, or stored. Store in tightly closed containers in a cool, well-ventilated area away from strong alkalis (such as sodium hydroxide, sodium bicarbonate, etc.). Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: This is a solid toxic carbamate and should be labeled “poisonous materials.” It falls into Hazard Class 6.1.

Spill Handling: For solids, isolate spill or leak area in all directions for at least 25 meters/75 feet. Increase, in the downwind direction, as necessary. Do not touch damaged containers or spilled material unless wearing appropriate protective clothing. Stop leak if you can do it without risk. Prevent entry into waterways, sewers, basements or confined areas. Cover with plastic sheet to prevent spreading. Absorb or cover with dry earth, sand or other non-combustible material and transfer to containers. Do not allow water to get inside containers.

Fire Extinguishing: Hazardous decomposition includes oxides of nitrogen, sulfur, and carbon. *On small fire*, use dry chemical powder, carbon dioxide, water spray, or foam. *On large fire*, use water spray, fog or alcohol resistant foam. Do not scatter material using straight water jet streams. Dike fire-control water for later disposal; do not scatter the material. Move containers from fire area if you can do it without risk. *Fire involving storage or vehicular tanks:* isolate for 800 meters/0.5 mile in all directions; also, consider initial evacuation for 800 meters/0.5 mile in all directions. Fight fire from maximum distance or use unmanned hose holders or monitor nozzles. Do not allow water to get inside containers. Cool containers with flooding quantities of water until well after fire is out. Withdraw immediately in the case of rising sound from venting safety devices or discoloration of tank. *Always* stay away from tanks engulfed in fire. For massive fire, use unmanned hose holders or monitor nozzles; if this is impossible, withdraw from area and let fire burn.

Disposal Method Suggested: Do not discharge into drains or sewers. Dispose of waste material as hazardous waste using a licensed disposal contractor to an approved landfill. Consult with environmental regulatory agencies for guidance on acceptable disposal practices. Generators of waste containing this contaminant (≥100 kg/mo) must conform with EPA regulations governing storage, transportation, treatment, and waste disposal. Incineration with effluent gas scrubbing is recommended. Containers must be disposed of properly by following package label directions or by contacting your local or federal environmental control agency, or by contacting your regional EPA office.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- Sax, N. I., Ed., Dangerous Properties of Industrial Materials Report, 4, No. 2, 37-41 (1984)
- American Bird Conservancy. http://www.abcbirds.org/pesticides/Profiles/aldicarb.htm
- USEPA, "Chemical Profile: Aldicarb," Washington DC, Chemical Emergency Preparedness Program (November 30, 1987)
- USEPA, Office of Pesticide Programs, "Pesticide Residue Limits, Aldicarb," 40 CFR 180.269. http://www.epa.gov/pesticides/food/viewtols.htm
- New Jersey Department of Health and Senior Services, "Hazardous Substance Fact Sheet: Aldicarb," Trenton, NJ (January 2001). http://www.state.nj.us/health/eoh/rtkweb/rtkhsfs.htm

Aldoxycarb A:0505

Use Type: Insecticide, Acaricide, Nematicide

CAS Number: 1646-88-4

Formula: $C_7H_{14}N_2O_4S$

Synonyms: Aldicarb sulfone; Carbamic acid, methyl-, *O*-[(2-methyl-2-(methylsulfonyl)propylidene)amino] derivative; ENT AI 3-29261; 2-Methyl-2-(methylsulfonyl)propanal-*O*-[(methylamino)carbonyl]oxime; 2-Methyl-2-(methylsulfonyl)propionaldehyde-*O*-(methylcarbamoyl)oxime; Propanal, 2-methyl-2-(methylsulfonyl)-, *O*-[(methylamino)carbonyl]oxime

Trade Names: ALDICARB SULFONE®; TEMIK SULFONE®; SULFOCARB®; STANDAK®; UC-21865®

Chemical Class: Carbamate (*N-methyl*)

EPA/OPP PC Code: 110801; 216900

California DPR Chemical Code: 2265

UN/NA & ERG Number: UN2757 (solid)/151

RTECS® Number: UE2080000

EC Number: 216-710-0

Uses: Used to control honey locust, gall midge and other insects and mites on cotton, potatoes, sugar beets and ornamentals. Applied to the soil by soluble mixture or spikes. Not listed for use in EU countries[115].

Human toxicity (long-term)[101]: High–7.00 ppb, MCL (Maximum Contaminant Level)

Fish toxicity (threshold)[101]: Very low–7683.76758 ppb, MATC (Maximum Acceptable Toxicant Concentration)

Regulatory Authority and Advisory Information: Acute Oral Category: 1, DANGER–POISON

Health Advisory: Nerve Toxin[103]

U.S. EPA Hazardous waste number (RCRA No.): P203

Description: Aldecarb sulfone is a white, crystalline solid. Slight sulfur odor. Molecular weight = 222.27; Freezing/Melting point = 141 °C; Vapor pressure = 12 mmHg @ 25 °C; 1.0×10^{-4} mmHg. Highly soluble in water; solubility = 1000 ppm @ 20 °C.

Incompatibilities: Carbamates are incompatible with reducing agents, strong acids, oxidizing acids, peroxides, and bases. Contact with active metals or nitrides causes the release of flammable, and potentially explosive, hydrogen gas. May react violently with bromine, ketones. Incompatible with azo dyes, caustics, ammonia, amines, boranes, hydrazines, strong oxidizers.

Permissible Concentration in Water: Federal Drinking Water Guidelines: EPA 7 μg/L; State Drinking Water Standards: Illinois 2 μg/L; New York 2 μg/L; Maine 7 μg/L; Massachusetts23 μg/L Runoff from spills or fire control may cause water pollution.

Determination in Water: Log K_{ow} = –0.6. Negative. Unlikely to bioaccumulate in marine organisms.

Harmful Effects and Symptoms

Short Term Exposure: Eye pupils are small; blurred vision; eye watering; runny nose; cough; shortness of breath; salivation; nausea, stomach cramps, diarrhea, and vomiting; increased blood pressure; profuse sweating; hypermotility, hallucinations; agitation; tingling of the skin; slow heartbeat; convulsions; fluid in lungs; loss of consciousness; incontinence; breathing stops; death. Carbamate insecticides inhibit the cholinesterase activity of enzymes, causing accumulation of acetylcholine at synapses and altering the way in which nervous impulses are transmitted. However, within several hours carbamates spontaneously detach from the enzymes. LD_{50} (oral, rat) = 20 mg/kg; LD_{50} (dermal, rat) = >1000 mg/kg[83].

Long Term Exposure: A potent acetylcholinesterase (AChE) inhibitor; cumulative effect is possible. This chemical may damage the nervous system with repeated exposure, resulting in convulsions, respiratory failure. May cause liver damage.

Points of Attack: Respiratory system, central nervous system, cardiovascular system, skin, eyes, plasma and red blood cell cholinesterase

Medical Surveillance: Medical observation is recommended for 24 to 48 hours following breathing overexposure, as pulmonary edema may be delayed. Cigarette smoking may exacerbate pulmonary injury and should be discouraged for at least 72 hours following exposure. Routine biological monitoring of pesticide applicators and field workers includes testing of plasma and red blood cell acetylcholinesterase levels (for enzyme poisoned by this chemical). These tests are normally accurate only if done within about two hours of exposure. If exposure stops, plasma levels return to normal in 1–2 weeks while red blood cell levels may be reduced for 1–3 months. When acetylcholinesterase enzyme levels are reduced by 25% or more below preemployment levels, risk of poisoning is increased, even if results are in lower ranges of "normal." Reassignment to work not involving carbamate pesticides is recommended until enzyme levels recover.

First Aid: Speed in removing material from eyes and skin is of extreme importance. *Eyes:* Eye contact can cause dangerous amounts of these chemicals to be quickly absorbed through the mucous membrane into the bloodstream. Immediately and gently flush eyes with plenty of warm or cold water (NO hot water) for at least 15 minutes, occasionally lifting the upper and lower eyelids. Get medical aid immediately. *Skin:* Get medical aid. Dermal contact can cause dangerous amounts of these chemicals to be absorbed into the bloodstream. Wearing the appropriate PPE equipment and respirator for carbamate pesticides, immediately flush skin with plenty of soap and water for at least 15 minutes while removing contaminated clothing and shoes. Shampoo hair promptly if contaminated; protect eyes. *Ingestion:* Call poison control. Loosen all clothing. Never give anything by mouth to an unconscious person. Get medical aid. Do NOT induce vomiting. *If conscious, alert, and able to swallow, rinse mouth and have victim drink 4 to 8 ounces of water. Check to see if poison control instructs you to use ipecac syrup, otherwise administer slurry of activated charcoal (2 oz in 8 oz of water). If victim is *UNCONSCIOUS OR HAVING CONVULSIONS,* do nothing except keep victim warm. **In some cases you may be specifically instructed by poison control to induce vomiting by way of 2 tablespoons of syrup of ipecac (adult) washed down with a cup of water.* Do NOT give activated charcoal before or with ipecac syrup. *Inhalation:* Get medical aid. Do not contaminate yourself. Wearing the appropriate PPE equipment and respirator for carbamate pesticides, immediately remove the victim from the contaminated area to fresh air. If the victim is not breathing, administer artificial respiration. Do not use mouth-to-mouth method if victim ingested or inhaled the substance; give artificial respiration with the aid of a pocket mask equipped with a one-way valve or other proper respiratory medical device. If breathing is difficult, administer oxygen through bag/mask apparatus until medical help arrives. Do not leave victim unattended.

Note to physician or authorized medical personnel. Administer atropine, 2 mg (1/30 gr) intramuscularly or intravenously as soon as any local or systemic signs or symptoms of an intoxication are noted; repeat the administration of atropine every 3 to 8 minutes until signs of atropinization (mydriasis, dry mouth, rapid pulse, hot and dry skin) occur; initiate treatment in children with 0.05 mg/kg of atropine; repeat at 5 to 10 minute intervals. Watch respiration, and remove bronchial secretions if they appear to be obstructing the airway; intubate if necessary. *Medical note:* 2-PAMCI may be contraindicated in the case of some carbamate poisonings. As first aid for pulmonary edema, a doctor or authorized paramedic might consider administering a corticosteroid spray.

Personal Protective Methods: Wear protective gloves and clothing to prevent any reasonable probability of dermal and/or eye contact. Safety equipment suppliers/manufacturers can provide recommendations on the most protective glove/clothing material for your operation. DuPont™ Tychem® suit fabrics[88]. All protective clothing (suits, gloves, footwear, headgear) should be clean, available each day, and put on before work. Contact lenses should not be worn when working with this chemical. Wear dust-proof chemical goggles and face shield unless full facepiece respiratory protection is worn. Employees should wash immediately with soap when skin is wet or contaminated. Provide emergency showers and eyewash.

Respirator Selection: *At concentrations above the NIOSH REL, or where there is no REL, at any detectable concentration:* SCBAF:Pd,Pp (APF = 10,000): (any self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode); or SaF:Pd,Pp:ASCBA (APF = 10,000) (any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary self-contained positive-pressure breathing apparatus). *Escape*: GmFOv100 (APF = 50) [any air-purifying, full facepiece respirator (gas mask) with a chin-style, front- or back-mounted organic vapor canister having an N100, R100, or P100 filter]; or SCBAE (any appropriate escape-type, self-contained breathing apparatus).

Storage: Color Code-Blue: Health Hazard/Poison. Store in a secure poison location. Prior to working with this chemical you should be trained on its proper handling and storage. Store in tightly closed containers in a cool, well-ventilated area away from strong alkalis (such as sodium hydroxide, sodium bicarbonate, etc.). Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: This is a solid toxic carbamate and should be labeled "poisonous materials." It falls into Hazard Class 6.1.

Spill Handling: For solids, isolate spill or leak area in all directions for at least 25 meters/75 feet. Increase, in the downwind direction, as necessary. Do not touch damaged containers or spilled material unless wearing appropriate protective clothing. Stop leak if you can do it without risk. Prevent entry into waterways, sewers, basements or confined areas. Cover with plastic sheet to prevent spreading. Absorb or cover with dry earth, sand or other non-combustible material and transfer to containers. Do not allow water to get inside containers.

Fire Extinguishing: Hazardous decomposition includes oxides of nitrogen, sulfur, and carbon. *On small fire*, use dry chemical powder, carbon dioxide, water spray, or foam. *On large fire*, use water spray, fog or alcohol-resistant foam. Do not scatter material using straight water jet streams. Dike fire-control water for later disposal; do not scatter the material. Move containers from fire area if you can do it without risk. *Fire involving storage or vehicular tanks:* isolate for 800 meters/0.5 mile in all directions; also, consider initial evacuation for 800 meters/0.5 mile in all directions. Fight fire from maximum distance or use unmanned hose holders or monitor nozzles. Do not allow water to get inside containers. Cool containers with flooding quantities of water until well after fire is out. Withdraw immediately in the case of rising sound from venting safety devices or discoloration of tank. *Always* stay away from tanks engulfed in fire. For massive fire, use unmanned hose holders or monitor nozzles; if this is impossible, withdraw from area and let fire burn.

Disposal Method Suggested: Do not discharge into drains or sewers. Dispose of waste material as hazardous waste using a licensed disposal contractor to an approved landfill. Consult with environmental regulatory agencies for guidance on acceptable disposal practices. Generators of waste containing this contaminant (≥100 kg/mo) must conform with EPA regulations governing storage, transportation, treatment, and waste disposal. Incineration with effluent gas scrubbing is recommended. Containers must be disposed of properly by following package label directions or by contacting your local or federal environmental control agency, or by contacting your regional EPA office.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- Pesticide Management Education Program, "Aldoxycarb (Standak) EPA Pesticide Fact Sheet 1/86," Cornell University, Ithaca, NY (January 1986). http://pmep.cce.cornell.edu/profiles/insect-mite/abamectin-bufencarb/aldoxycarb/insect-prof-aldoxycarb.html

Allethrin A:0520

Use Type: Insecticide

CAS Number: 584-79-2 (I); 497-92-7 (II); 23031-36-9 (Prallethrin); 28434-00-6 (*S*-Bioallethrin); 28057-48-9 (Bioallethrin)

Formula: $C_{19}H_{26}O_3$ (I); $C_{10}H_{26}O_5$ (II)

Synonyms: Allethrolone ester of chrysanthemum dicarboxylic acid monomethyl ester (II); (+)-Allelrethonyl; (+)-*cis,trans*-chrysanthemate; *d*-Allethrin; Allethrin I; Allyl cinerin; Allyl homolog of cinerin I; *d*, l-2-allyl-4-hydroxy-3-methyl-2-cyclopenten-1-one-*dl*-chrysanthemum monocarboxylate; 3-Allyl-4-keto-2-methylcyclopentenyl chrysanthemummonocarboxylate 3; 3-Allyl-2-methyl-4-*oxo*-2-cyclopenten-1-yl chrysanthemate; *d1*-3-allyl-2-methyl-4-oxocyclopent-2-enyl *dl-cis trans* chrysanthemate; Allylrethronyl *dl-cis*-trans-chrysanthemate; Bioaltrina; Cinerin I allyl homolog; *d*-Cisallethrin; (±)-*cis,trans*-Chrysanthemumic acidester of (±) allethrolone; Depallethrin; EBT; ENT 17,510 (II); FDA 1446; 3-(3-Methoxy-2-methyl-3-*oxo*-1-propenyl)-2,2-dimethylcyclopropanecarboxylic acid 2 methyl-4-*oxo*-3-(2-propenyl)-2-cyclopenten-1-yl ester (II); Necarboxylic acid

Trade Names: BIOALLETHRIN®; BIOALLETHRIN TECHNICAL®; *d*-CISALLETHRIN®; ESBIOTHRIN®; EXTHRIN® FMC 249®; NIA 249®; OMS 468®; PYNAMIN®; PYNAMIN-FORTE®; PYRESIN®; PYRESYN®; PYREXCEL®; PYROCIDE®; SBP 1382/BIOALLETHRIN CONCENTRATE®

Chemical Class: Pyrethroid

EPA/OPP PC Code: 004001 (Allethrin); 004002 (Allethrin Coil); 004003 [Bioallethrin (a mixture of *d-cis-trans*-Allethrin and *S*-Bioallethrin)]; 004004 (*S*-Bioallethrin); 004005 (*d-cis-trans*-Allethrin); 128722 (Prallethrin)

California DPR Chemical Code: 12 (Allethrin); 90012 (Allethrin, other related)

HSDB Number: 1511 for allethrins

UN/NA & ERG Number: UN3352 (liquid)/151

RTECS® Number: GZ1925000; GZ1472000 (*S*-Bio-allethrin)

EC Number: 209-542-4 [*Annex I Index No.:* 006-025-00-3] (I)

Uses: Allethrin is used almost exclusively to control flying and crawling insects in homes and industrial locations. Used extensively in pet animal shampoos, to treat lice in humans and in home and industrial sprays for flying insects, mosquitos, etc. It is available as mosquito coils, mats, oil formulations and as an aerosol spray. It may be hazardous to the environment; special attention should be given to fish and honey bees. Not currently registered in the U.S. Not approved for use in EU countries[115]. Depending on CAS registry number there are probably >100 global suppliers[97].

Human toxicity (long-term)[101]: 3.5 ppb, Health Advisory.

Fish toxicity (threshold)[101]: 0.18 ppb, MATC (Maximum Acceptable Toxicant Concentration)

Regulatory Authority and Advisory Information:

Acute Oral Category: 2, WARNING

Health Advisory: Nerve Toxin (S!), Endocrine disruptor (S!)

European/International Regulations [584-79-2 (I)]: Hazard Symbol: Xn, N; risk phrases: R20/22; R50/53; safety phrases: S2; S36; S46; S60; S61

WGK (German Aquatic Hazard Class): No value assigned

Description: Allethrins are synthetic analogs of naturally occurring insecticides. Clear, yellow to amber, oily liquids which is also available as wettable powder or granules. Sprays may be dissolved in xylene or kerosene. Slight aromatic odor. Practically insoluble in water (I & II). Molecular weight = 302.39 (*S*-bioallethrin); Specific gravity (H_2O:1) = 1.02 @ 20 °C; Boiling point = 282 °C; Flash point = 85 °C. Henry's Law constant = 1×10^{-7} atm-m^3/mol @ 25 °C (est)[83]. Hazard Identification (based on NFPA-704 M Rating System): Health 1, Flammability 1, Reactivity 0.

Incompatibilities: Strong alkalies and oxidizers. Unstable in light, UV, air, and in alkaline conditions.

Permissible Exposure Limits in Air: Conversion factor:
1 mg/m^3 = 0.081 ppm @ 25 °C
NIOSH[2] IDLH = 5,000 ppm
OSHA PEL: 5 mg/m^3 TWA
NIOSH REL: 5 mg/m^3 TWA
ACGIH TLV®[1]: 5 mg/m^3 TWA
STEL set by HSE(33) = 10 mg/m^3

Determination in Air: Collection by impinger or fritted bubbler, analysis by gas liquid chromatography/ultraviolet. See NIOSH IV, Method #5008(18), as pyrethroid.

Permissible Concentration in Water: Acceptable Daily Intake (ADI) =0.02 mg/kg as pyrethroid.

Determination in Water: Log K_{ow} = >4.0. Values at or above 3.0 are likely to bioaccumulate in marine organisms.

Routes of Entry: Inhalation, dermal and/or eye contact.

Harmful Effects and Symptoms

Short Term Exposure: Skin and eye contact causes irritation and burns. Inhalation can cause respiratory tract irritation with coughing and wheezing, tearing and runny nose. High exposure may cause dizziness, shaking, irritability, seizures, and unconsciousness. Allethrin may cause effects on the nervous system. LD_{50} (oral, rat) = 700–1100 mg/kg; LD_{50} (dermal, rabbit) = >2 g/kg.

Long Term Exposure: May cause skin allergy. If the allergy develops, very low future exposure can cause itching and skin rash. Allethrin may cause an asthma-like allergy. Future exposure can cause asthma attacks with shortness of breath, wheezing, cough and/or chest tightness. Allethrin can cause bronchitis to develop with cough, phlegm, and/or shortness of breath. This chemical may cause liver and kidney damage. There is no evidence that allethrin affects reproduction[2]. See also pyrethrins. Potential mutagen.

Points of Attack: Skin, lungs, liver, and kidneys

Medical Surveillance: Before beginning employment and at regular times after that, the following are recommended: Employees should be screened for history of certain medical conditions which might place the employee at increased risk from pyrethroid exposure. Chronic respiratory disease: In persons with chronic respiratory disease, especially asthma, the inhalation of pyrethroids might cause exacerbation of symptoms due to its sensitizing properties. Lung function tests. These may be normal if the person is not having an attack at the time of the test. Consider chest x-ray if lung symptoms are present. Skin disease: Pyrethroids can cause dermatitis which may be allergic in nature. Persons with pre-existing skin disorders may be more susceptible to the effects of this agent. Evaluation by a qualified allergist, including exposure history and testing, may help diagnose allergy. Any employee developing the above-listed conditions should be referred for further medical examination[9]. Liver and kidney function tests. Comprehensive physical examination with emphasis on the genito-urinary tract analysis to include sperm count, motility and morphology. Other tests, such as serum testosterone, serum follicle stimulating hormone (FSH), and serum lutenizing hormone (LH), may be carried out if, in the opinion of a physician, they are indicated.

First Aid: If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least 15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately. If this chemical contacts the skin, remove contaminated clothing and wash immediately with soap and water. Seek medical attention immediately. If this chemical has been inhaled, remove from exposure, begin rescue breathing (using universal precautions) if breathing has stopped, and CPR if heart action has stopped. Transfer promptly to a medical facility. When this chemical has been swallowed, get medical attention. Give large quantities of water and induce vomiting. Do not make an unconscious person vomit.

Personal Protective Methods: Wear protective gloves and clothing to prevent any reasonable probability of dermal and/or eye contact. Safety equipment suppliers/manufacturers can provide recommendations on the most protective glove/clothing material for your operation. All protective clothing (suits, gloves, footwear, headgear) should be clean, available each day, and put on before work. Contact lenses should not be worn when working with this chemical. Wear splash-proof chemical goggles and face shield unless full facepiece respiratory protection is worn. Employees should wash immediately with soap when skin is wet or contaminated. Remove nonimpervious clothing immediately if wet or contaminated. Provide emergency showers and eyewash.

Respirator Selection: NIOSH/OSHA *for pyrethrum*: *50 mg/m^3:* CcrOv95 (APF = 10) [any air-purifying half-mask respirator equipped with an organic vapor cartridge(s) in combination with an N95, R95, or P95 filter. The following filters may also be used: N99, R99, P99, N100, R100, P100]; or Sa (APF = 10) (any supplied-air respirator). *125 mg/m^3:* Sa:Cf (APF = 25) (any supplied-air respirator operated in a continuous-flow mode); or PaprOvHie (APF = 25) (any air-purifying full facepiece respirator equipped with an organic vapor cartridge in combination with a high-efficiency particulate filter). *250 mg/m^3:* CcrFOv100 (APF = 50) [any air-purifying full facepiece respirator equipped with organic vapor cartridge(s) in combination with an N100, R100, or P100 filter]; or PaprTOvHie (APF = 50) [any powered, air-purifying respirator with a tight-fitting face-piece and organic vapor cartridge(s) in combination with a high-efficiency particulate filter]; or SCBAF (APF = 50) (any self-contained breathing apparatus with full facepiece); or SaF (APF = 50) (any supplied-air respirator with a full facepiece). *5000 mg/m^3:* SaF:Pd,Pp (APF = 2000) (any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode). *Emergency or planned entry into unknown concentrations or IDLH conditions:* SCBAF:Pd,Pp (APF = 10,000) (any self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode); or SaF:Pd,Pp:ASCBA (APF = 10,000) (any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary self-contained breathing apparatus operated in a pressure-demand or other positive-pressure mode). *Escape:* GmFOv100 (APF = 50) [any air-purifying, full facepiece respirator (gas mask) with a chin-style, front- or back-mounted organic vapor canister having an N100, R100, or P100 filter]; or SCBAE (any appropriate escape-type, self-contained breathing apparatus). *Note:* Substance reported to cause eye irritation or damage; may require eye protection.

Storage: Color Code-Blue: Health Hazard/Poison. Store in a secure poison location at temperature <35 °C and away from alkaline materials. Prior to working with this chemical you should be trained on its proper handling and storage. Store in tightly closed containers in a cool, well-ventilated area. Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: Allethrin is a liquid toxic pesticide and should be labeled "poisonous materials." It falls into Hazard Class 6.1. PG III. STN: 49-411-12

Spill Handling: First, remove all sources of ignition. Evacuate persons not wearing protective equipment from area of spill or leak until clean up is complete. Ventilate area of spill or leak. Use water spray to reduce vapor. Absorb liquids in vermiculite, dry sand, earth, or a similar material and deposit in sealed containers. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable.

Fire Extinguishing: Hazardous decomposition includes oxides of carbon. Use dry chemical, carbon dioxide, or alcohol-resistant foam extinguishers. Vapors are heavier than air and will collect in low areas. Vapors may travel long distances to ignition sources and flashback. Vapors in confined areas may explode when exposed to fire. Storage containers and parts of containers may rocket great distances, in many directions. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies. From a secure, explosion-proof location, use water spray to cool exposed containers. If cooling streams are ineffective (venting sound increases in volume and pitch, tank discolors, or shows any signs of deforming), withdraw immediately to a secure position. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode.

Disposal Method Suggested: Incineration would be an effective disposal procedure where permitted. If an efficient incinerator is not available, the product should be mixed with large amounts of combustible material and contact with the smoke should be avoided. In accordance with 40CFR165, follow recommendations for the disposal of pesticides and pesticide containers.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- New Jersey Department of Health and Senior Services, Hazardous Substance Fact Sheet, "Allethrin," Trenton, NJ (December, 1998). http://www.state.nj.us/health/eoh/rtkweb/2102.pdf
- USEPA, Office of Pesticide Programs, Pesticide Residue Limits, "Allethrin", 40 CFR 180.113 et sec. http://www.epa.gov/cgi-bin/oppsrch

Aluminum phosphide A:0710

Use Type: Fumigant, Fungicide, Rodenticide, Insecticide

CAS Number: 20859-73-8; 1302-45-0; 71751-04-7

Formula: AlP

Alert: Metallic phosphides on clothes, skin, or hair can react with water or moisture to generate phosphine gas. Vomitus containing phosphides can also off-gas phosphine. Phosphine is extremely flammable and explosive; it may ignite spontaneously on contact, with air.

Synonyms: AIP; Aluminum monophosphide; Caswell No. 031; Fosfuro aluminico (Spanish)

Trade Names: AL-PHOS®; CELPHIDE®; CELPHOS®; DELICIA®; DETIA®; DETIA-EX-B®; DETIA GAS EX®; DETIA-GAS-EX-B®; DELICIA GASTOXIN; FARMOZ®; FUMITOXIN®; PHOSTOXIN®; PHOSTOXIN-A®; QUICKPHOS®; QUICK TOX®; RENTOKIL GASTION®

Chemical Class: Inorganic toxic metals; Inorganic phosphide

EPA/OPP PC Code: 066501

California DPR Chemical Code: 484

HSDB Number: 6035

UN/NA & ERG Number: UN3048 (aluminum phosphide pesticides)/157

RTECS® Number: BD1400000

EC Number: 244-088-0 [*Annex I Index No.:* 015-004-00-8]

Uses: Used as an insecticidal fumigant for grain, peanuts, processed food, animal feed, leaf tobacco, cottonseed, and as space fumigant for flour mills, warehouses and railcars. It is also used in baits for rodent and mole control in crops. Used as a source of phosphine; in semiconductor research. Zinc phosphide is often mixed with bait food such as cornmeal, which can be a danger to pets and children. When phosphides are ingested or exposed to moisture, they release phosphine gas. A U.S. EPA restricted Use Pesticide (RUP). Metallic phosphides on clothes, skin, or hair can react with water or moisture to generate phosphine gas.

U.S. Maximum Allowable Residue Levels for Aluminum Phosphide [40 CFR 180.225(a)(1)]: Note: The following residue limits are for phosphine compounds that produce phosphine gas: almond 0.1 ppm; animal feed 0.1 ppm; avocado 0.01 ppm; banana (incl. plantains) 0.01 ppm; barley, grain 0.1 ppm; brazil nuts 0.1 ppm; cabbage, chinese, bok choy 0.01 ppm; cacao bean, dried 0.1 ppm; cashew 0.1 ppm; citron, citrus 0.01 ppm; coffee, bean 0.1 ppm; corn, field, grain 0.1 ppm; corn, pop, grain 0.1 ppm; cotton, undelinted seed 0.1 ppm; date, dried 0.1 ppm; dill, seed 0.01 ppm; eggplant 0.01 ppm; endive 0.01 ppm; filbert 0.1 ppm; grapefruit 0.01 ppm; kumquat 0.01 ppm; lemon 0.01 ppm; lettuce 0.01 ppm; lime 0.01 ppm; mango 0.01 ppm; millet, grain 0.1 ppm; mushroom 0.01 ppm; oat, grain 0.1 ppm; okra 0.01 ppm; orange 0.01 ppm; papaya 0.01 ppm; peanut 0.1 ppm; pecan 0.1 ppm; pepper, black, post-harvest 0.01 ppm; pepper, red, post-harvest 0.01 ppm; pepper, white, post-harvest 0.01 ppm; persimmon 0.01 ppm; pimentos 0.01 ppm; pistachio 0.1 ppm; processed food 0.01 ppm; raw agricultural commodities 0.01 ppm; rice, grain 0.1 ppm; rye, grain 0.1 ppm; safflower, seed 0.1 ppm; salsify, tops 0.01 ppm; sesame, post-harvest 0.1 ppm; sorghum, grain, grain 0.1 ppm; soybean, seed 0.1 ppm; sunflower, seed 0.1 ppm; sweet potato 0.01 ppm; tangelo 0.01 ppm; tangerine 0.01 ppm; tomato 0.01 ppm; vegetable, legume ppm; (crop group 6), exc soybeans 0.01 ppm; walnut 0.1 ppm; wheat, grain 0.1 ppm. ***[40 CFR 180.225(a)(2)]:*** Tolerances are established for residues of the fumigant in or on all RACs resulting from preharvest treatment of pest burrows in agricultural and non-crop land areas. All raw agricultural commodities resulting from preharvest treatment of pest burrows, 0.01 ppm. ***[40 CFR 180.225(a)(3)]*** Residues resulting from fumigation of processed foods: Processed foods, 0.01 ppm. ***[40 CFR 180.225(a)(4)]*** Residues resulting from fumigation of animal feed: Animal feed, 0.1 ppm. ***[40 CFR 180.225(a)(5)]*** To ensure safe use of this pesticide, it must be used in compliance with the labeling conforming to that registered by the U.S. Environmental Protection Agency (EPA) under FIFRA. Labeling shall bear a restriction to aerate the finished food/feed for 48 hours before it is offered to the consumer, unless EPA specifically determines that a different time period is appropriate. Where appropriate, a warning shall state that under no condition should any formulation containing aluminum or magnesium phosphide be used so that it will come in contact with any processed food, except processed brewer's rice, malt, and corn grits stored in breweries for use in the manufacture of beer.

Regulatory Authority and Advisory Information

Carcinogenicity[83]: ACGIH A4, not classified as a human carcinogen

Department of Homeland Security Screening Threshold Quantity (pounds): Sabotage/Contamination Hazard: A placarded amount (commercial grade)

Acute Oral Category: 1, DANGER–POISON

US DOT 49CFR172.101, Inhalation Hazardous Chemical

U.S. EPA Hazardous Waste Number (RCRA No.): P006[5]

Superfund/EPCRA 302 Extremely Hazardous Substances: TPQ = 500 lb (228 kg)

CERCLA Reportable Quantity (RQ): 100 lb (45.4 kg)

EPCRA Section 313 Form R *de minimis* concentration reporting level: 1.0%

European/International Regulations: Hazard Symbol: F, T+, H, N; risk phrases: R15/29; R28; R32; R50; safety phrases: S1/2; S3/9/14; S28, S30; S36/37; S43; S45; S61 (see Appendix 1)

WGK (German Aquatic Hazard Class): 2-Hazard to waters

Description: Aluminum phosphide is a pyrophoric, dark gray or dark yellow crystalline solid. Molecular weight = 57.96; Specific gravity (H_2O:1) = 2.85 @ 25 °C; Freezing/Melting point ≥ 1000 °C; Decomposes in water, forming poisonous and flammable (potentially explosive) phosphine gas. NFPA-704 Hazard Identification (based on NFPA-704 M Rating System): Health 4, Flammability 4, Reactivity 2, Water–violently reactive; dangerous when wet.

Incompatibilities: A strong reducing agent. Forms toxic and potentially explosive phosphine gas with moist air and water. Reacts violently with oxidizers, water, carbon dioxide, and foam fire extinguishers; generates high heat. Contact with water and bases rapidly releases highly toxic and flammable phosphine gas and heat. Contact with steam and acids may be violent. Pyrophoric; aluminum alkyls can ignite spontaneously in moist air. Contact with metals may release flammable hydrogen gas.

Permissible Exposure Limits in Air: OSHA PEL: None

NIOSH REL: 2 mg[Al]/m^3 soluble salts and alkyls

ACGIH TLV: 2 mg[Al]/m^3, respirable fraction; A4, not classified as a human carcinogen. Excursion Limit Recommendation: Excursions in worker exposure levels may exceed 3 times the TLV-TWA for no more than a total of 30 minutes during a work day, and under no circumstances should they exceed 5 times the TLV-TWA, provided that the TLV-TWA is not exceeded.

Protective Action Criteria (PAC) Ver. 27[89]

PAC-1: 0.42 ppm
PAC-2: $\mathbf{2.0}_A$ ppm
PAC-3: $\mathbf{3.6}_A$ ppm

Subscript "**A**" signifies 60-minute AEGL (Acute Emergency Guideline Level) values.

OSHA PEL: None

NIOSH REL: 2 mg/m^3 aluminum, soluble salts

The NIOSH[2] recommended airborne exposure limit for soluble aluminum salts (measured as aluminum) is 2 mg/m^3 TWA for a 10-hour workshift. ACGIH recommends the same criterion for an 8-hour workshift[1]. *Note:* Metallic phosphides on clothes, skin, or hair can react with water or moisture to generate phosphine gas (colorless gas; odor of garlic or decaying fish). *Warning*: Highly toxic phosphine gas may evolve from vomitus and feces of victim. For *phosphine*: OSHA PEL = 0.3 ppm (averaged over an 8-hour workshift) NIOSH[2] IDLH (immediately dangerous to life or health) = 50 ppm ERPG-2 (Emergency Response Planning Guideline) (maximum airborne concentration below which it is believed nearly all individuals could be exposed for up to 1 hour without experiencing or developing irreversible or other serious adverse health effects or symptoms that could impair an individuals's ability to take protective action) = 0.5 ppm.

Permissible Concentration in Water: Federal Drinking Water Guidelines: EPA 50-200[Al]μg/L; State Drinking Water Standards: California 1000[Al]μg/L; State Drinking Water Guidelines: Arizona 73 [Al]μg/L; Maine 1430 [Al]μg/L; California 200 [Al]μg/L. EU Drinking Water Guidelines (MAC) = 200 [Al]μg/L.

Routes of Entry: Inhalation, ingestion, dermal and/or eye contact.

Harmful Effects and Symptoms

Short Term Exposure: A severe health hazard. Irritates the eye, skin and respiratory tract. Inhalation can cause lung irritation with coughing, wheezing, and shortness of breath. Affects metabolism and the central nervous system; exposure can lead to death. Higher exposures can cause pulmonary edema, a medical emergency that can be delayed for several hours. This can cause death. Acute toxicity occurs primarily by the inhalation route when aluminum phosphide decomposes into the toxic gas phosphine. The human median lethal dose for aluminum phosphide has been reported to be 20 mg/kg. Symptoms of phosphine gas poisoning include restlessness, headache, dizziness, fatigue, nausea, vomiting, coma, convulsions; lowered blood pressure, pulmonary edema, respiratory failure, and disorders of the kidney, liver, heart, and brain may be observed. LD_{50} (oral, rat) = 8.7–14 mg/kg; LD_{50} (dermal, rat) = >450 mg/kg.

Long Term Exposure: This chemical may cause lung, kidney, and liver damage. It may be able to cause skin rash or eczema.

Points of Attack: Central nervous system, liver, kidney, lungs.

Medical Surveillance: Lung, liver, kidney, and nervous system function tests. Evaluation by a qualified allergist, including exposure history and testing, may help diagnose allergy.

First Aid: If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least 15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately. If this chemical contacts the skin, remove contaminated clothing and wash immediately with soap and water. Seek medical attention immediately. If this chemical has been inhaled, remove from exposure, begin rescue breathing (using universal precautions) if breathing has stopped, and CPR if heart action has stopped. Transfer promptly to a medical facility. When this chemical has been swallowed, get medical attention. Give large quantities of water and induce vomiting. Do not make an unconscious person vomitMedical observation is recommended for 24 to 48 hours following breathing overexposure, as pulmonary edema may be delayed. As first aid for pulmonary edema, a doctor or authorized paramedic may consider administering a corticosteroid spray.

Note to physician or authorized medical personnel (Advanced Treatment for phosphine exposure): In cases of respiratory compromise secure airway and respiration via endotracheal intubation. If not possible, perform cricothyroidotomy if equipped and trained to do so. Treat patients who have bronchospasm with aerosolized bronchodilators. The use of bronchial sensitizing agents in situations of multiple chemical exposures may pose additional risks. Consider the health of the myocardium before choosing which type of bronchodilator should be administered. Cardiac sensitizing agents may be appropriate; however, the use of cardiac sensitizing agents after exposure to certain chemicals may pose enhanced risk of cardiac arrhythmias (especially in the elderly). Consider racemic epinephrine aerosol for children who develop stridor. Dose 0.25–0.75 mL of 2.25% racemic epinephrine solution in 2.5 cc water, repeat every 20 minutes as needed, cautioning for myocardial variability. Patients who are comatose, hypotensive, or having seizures or cardiac arrhythmias should be treated according to advanced life support protocols. If evidence of shock or hypotension is observed begin fluid administration. For adults, bolus 1000 mL/hour intravenous saline or lactated Ringer's solution if blood pressure is under 80 mmHg; if systolic pressure is over 90 mmHg, an infusion rate of 150 to 200 mL/hour is sufficient. For children with compromised perfusion administer a 20 mL/kg bolus of normal saline over 10 to 20 minutes, then infuse at 2 to 3 mL/kg/hour.

Personal Protective Methods: Wear protective gloves and clothing to prevent any reasonable probability of dermal and/or eye contact. Safety equipment suppliers/manufacturers can provide recommendations on the most protective glove/clothing material for your operation. All protective clothing (suits, gloves, footwear, headgear) should be clean, available each day, and put on before work. Contact lenses should not be worn when working with this chemical. Wear dust-proof chemical goggles and face shield unless full facepiece respiratory protection is worn. Employees should wash immediately with soap when skin is wet or contaminated. Provide emergency showers and eyewash.

Respirator Selection: SCBA >0.442 ppm. Where potential exists for exposures over 2 mg/m^3 (aluminum), use a NIOSH/MSHA- or European Standard EN149-approved respirator equipped with particulate (dust/fume/mist) filters. Particulate filters must be checked every day before work for physical damage, such as rips or tears, and replaced as needed, or where any potential for exposures to phosphine gas exist, use a NIOSH/MSHA- or European Standard EN149-approved gas mask (Approval number TC-14-98) equipped with a canister offering protection against phosphine, chlorine, hydrogen sulfide, organic vapors, acid gases, and dusts and mists. If the potential for exposure to more than 15 ppm of phosphine gas exists, use a NIOSH/MSHA- or European Standard EN149-approved supplied-air respirator with a full facepiece operated in the positive-pressure mode, or with a full facepiece, hood, or helmet in the continuous-flow mode; or use a NIOSH/MSHA- or European Standard EN149-approved self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive-pressure mode. See phosphine entry.

Storage: (1) Color Code-Yellow Stripe (*strong reducing agent*): Reactivity Hazard; Store separately in a area isolated from flammables, combustibles, or other yellow-coded materials. (2) Color Code-Red: Flammability Hazard: Store in a flammable materials storage area. (2) Color Code-Blue: Health Hazard/Poison. Store in a secure poison location. Prior to working with this chemical you should be trained on its proper handling and storage. Store in a noncombustible, non-sprinklered building or location, in tightly closed containers in a cool well-ventilated area away from all forms of moisture and strong acids. Aluminum phosphide decomposes in water, forming phosphine gas. Consult the entry on phosphine for more information. Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: Aluminum phosphide requires a shipping label of "DANGEROUS WHEN WET, POISONOUS/TOXIC MATERIALS." It usually falls in Hazard Class 4.3 and 6.1 (subsidiary), and usually Packing Group I. Highly dangerous. STN: 49-163-05.

Spill Handling: Decomposes in moist air and in water, releasing toxic gaseous phosphine, which may ignite. It is included as a water reactive despite the fact that the coating applied to the particles in the pesticide application is likely to slow the hydrolysis. Based on a scenario where the chemical is spilled into an excess of water (at least 5 fold excess of water), half of the maximum theoretical yield of phosphine gas will be created in 15 minutes. Shut off ignition; no flares, smoking, or flames in hazard area. Do not touch spilled material. Do not get water on spilled material or inside container. Dike spill for later disposal. Blanket release with dry sand, clay, or ground limestone. Shovel small spill into clean, dry container, and cover. Move containers from spill area. Avoid breathing dust. Wear appropriate protective clothing and use appropriate respiratory protection. Cover large powder spill with plastic sheet or tarp to minimize spreading. Clean up only under supervision of an expert. DOT warns that this chemical is spilled in water: Dangerous from 0.5 to 10 km (0.3–6.0 miles) downwind. Clean up and disposal must be supervised by a specialist. For spills, clean up and emergency situations, wear a positive-pressure, pressure-demand, full facepiece self-contained breathing apparatus (SCBA) or pressure-demand supplied-air respirator with escape SCBA and a fully encapsulating, chemical-resistant suit. DuPont™ Tychem® has been suggested in the literature. Eliminate all ignition sources. Avoid touching or walking through spilled material. Stop leak if you can do it without risk. Avoid getting water on spilled substance or inside containers. Use water spray to reduce vapors or divert vapor cloud drift. Avoid allowing water runoff to contact spilled material. Cover small spill non-combustible and DRY materials such as lime, earth, sand or soda ash followed with plastic sheet to minimize spreading or contact with rain. Dike for later disposal; do not apply water unless directed to do so[ERG].

Small spills (From a small package or a small leak from a large package)

when spilled in water:

First: isolate in all directions (feet/meters) 300/100
Then: Protect persons downwind (miles/kilometers)
Day 0.3/0.5
Night 1.2/1.9

Large spills (From a large package or from many small packages)

First: isolate in all directions (feet/meters) 2000/600
Then: Protect persons downwind (miles/kilometers)
Day 3.6/5.8
Night 7.0+/11.0+

Fire Extinguishing: This chemical is a combustible solid. Hazardous decomposition includes deadly phosphine, and oxides of phosphorus and aluminum. Keep unnecessary people away; isolate hazard area and deny entry. Stay upwind; keep out of low areas. Move container from fire area if you can do so without risk[ERG]. Violent reaction with extinguishing agents such as water, halogenated agents, water-based foams, and carbon dioxide. On small fires, use dry chemical, soda ash or lime. Do not use any agent with an acid reaction (i. e., carbon dioxide or halogenated agents); toxic and flammable phosphine gas will be released[83]. Small fires can be extinguished with dry chemical, soda ash; clay, or ground limestone, or use an approved Class D extinguisher *Large fires:* withdraw from area and let fire burn. Wear protective suits, gloves, boots, and self-contained breathing apparatus when fighting fires involving zinc phosphide. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode. Wear self-contained breathing apparatus when fighting fires involving this material. If contact with the material is anticipated, wear full protective clothing. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156.

Disposal Method Suggested: Must be supervised and handled by a specialist. Consult with environmental regulatory agencies for guidance on acceptable disposal practices. Generators of waste containing this contaminant (≥100 kg/mo) must conform with EPA regulations governing storage, transportation, treatment, and waste disposal. Allow to react slowly with moisture in the open, being sure that phosphine gas evolved is dissipated. Alternatively, mix with dry diluent and incinerate at temperature above 1000 °C with effluent gas scrubbing. Must be disposed of properly by following package label directions or by contacting your local or federal environmental control agency, or by contacting your regional EPA office.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov

- USEPA, Office of Pesticide Programs, Pesticide Residue Limits, “Phosphine Compounds that Produce Phosphine Gas”, 40 CFR 180.225. http://www.epa.gov/pesticides/food/viewtols.htm
- USEPA, Reregistration Eligibility Decision (RED) Facts, Aluminum and Magnesium Phosphide, EPA-738-F-98-015, Washington DC (December, 1998)
- USEPA, “Chemical Profile: Aluminum Phosphide,” Washington DC, Chemical Emergency Preparedness Program (November 30, 1987)
- Agency for Toxic Substances and Disease Registry, U.S. Department of Health and Human Services, Public Health Service, “Managing Hazardous Materials Incidents,” Atlanta, GA (June 2003)
- New Jersey Department of Health and Senior Services, “Hazardous Substance Fact Sheet: Aluminum Phosphide,” Trenton, NJ (April 1998). http://www.state.nj.us/health/eoh/rtkweb/0063.pdf

Ametryn A:0740

Use Type: Herbicide
CAS Number: 834-12-8
Formula: $C_9H_{17}N_5S$
Synonyms: A 1093; AI3-60365; Amyphyt; Cemerim; 2-Ethylamino-4-isopropylamino-6-methylmercarpo-*S*-triazine; Caswell No. 431; 2 Ethylamino- 4-isopropylamino-6-methylthio-*S*-triazine; 2-Ethylamino-4-isopropylamino-6-methylthio-1, 3, 5-triazine;2-(Ethylamino)-4-(isopropylamino)-6-(methylthio)-1,3,5-triazine; 2-(Ethylamino)-4-(isopropylamino)-6-(methylmercapto)-*S*-triazine; 2-(Ethylamino)-4-(isopropylamino)-6-(methylthio)-*S*-triazine; *N*-Ethyl-*N*-isopropyl-6-methylthio-1,3,5-triazine-2,4-diamine; N^2-Ethyl-N^4-isopropyl-6-methylthio-1,3,5-triazine-2,4-diamine; *N*-Ethyl-*N*'-isopropyl-6-methylthio-1,3,5-triazine-2,4-diyldiamine; *N*-Ethyl-*N*'-(1-methylethyl)-6-(methylthio)-1,3,5,-triazine-2,4-diamine; *N*-Ethyl-*N*'-(1-methylethyl)-6-(methylthio)-1,3,5-triazine-2,4-diamine; 2-Methylmercapto- 4-ethylamino-6-isopropylamino-*S*-triazine; 2-Methylmercapto- 4-isopropylamino-6-ethylamino-*S*-triazine; 2-Methylthio-4-ethylamino- 6-isopropylamino-*S*-triazine; NSC 163044; 2-Triazine, 2-ethylamino-4- isopropylamino-6-methylthio-; 1,3,5-Triazine-2, 4-diamine, *N*-ethyl-*N*'-(1-methylethyl)-6-(methylthio)-; *S*-Triazine, 2-(ethylamino)-4-(isopropylamino)-6-(methylthio)-; *S*-Triazine, 2-ethylamino-4-isopropylamino-6-methylthio-
Trade Names: AMESIP®; AMERTREX®; AMETREX; AMETRON SC®; AMETRYNE TECHNICAL®; AMIGAN®; AMULEX; CRISATRINE®; CRISATRINA®; DORUPLANT®; EVIK®; G-34162®; GESAPAX®; HERBIPAK®; KRISMAT®; OXON PRIMATOL Z 80®; SANCOPAX®; TRINATOX-D®
Chemical Class: Triazine
EPA/OPP PC Code: 080801
California DPR Chemical Code: 18
HSDB Number: 1710
UN/NA & ERG Number: UN2763/151
RTECS® Number: XY91000000
EC Number: 212-634-7 [*Annex I Index No.:* 613-010-00-0]
Uses: Ametryn is a herbicide which inhibits photosynthesis and other enzymatic processes. It is used to control broadleaf weeds and annual grasses in pineapple, sugarcane and bananas. Uses are being supported in the U.S. only for the following agricultural crops: field corn, popcorn, sugarcane, and pineapple (EPA, 2005). Used in premixes with atrazine, diuron, simazine, and terbutryn. Not approved for use in the EU.
U.S. Maximum Allowable Residue Levels for Ametryn: [40CFR180258(a)]: banana 0.25 ppm; corn, forage 0.5 ppm; corn, fresh, kernel plus cob with husks removed 0.25 ppm; corn, grain 0.25 ppm; corn, stover 0.5 ppm; pineapple 0.25 ppm; pineapple, fodder 0.25 ppm; pineapple, forage 0.25 ppm; sugarcane, cane 0.25 ppm; sugarcane, fodder 0.25 ppm; sugarcane, forage 0.25 ppm; tanier 0.25 ppm; yams, true, tuber 0.25 ppm. ***[40CFR180258(c)]*** cassava, root 0.1 ppm.
Human toxicity (long-term)[101]: Low–60.00 ppb, Health Advisory
Fish toxicity (threshold)[101]: Very low–989.94257 ppb, MATC (Maximum Acceptable Toxicant Concentration)
Regulatory Authority and Advisory Information:
Carcinogenicity[83]: EPA, Data are inadequate for an assessment of human carcinogenic potential
Health Advisory: Nerve Toxin (S!), Mutagen, Developmental/Reproductive Toxin
Acute Oral Category: 3, CAUTION
Superfund/EPCRA 40CFR302.4, Appendix A, Reportable Quantity (RQ): 100 lb (45.5 kg), 40CFR372.65: Form R *de minimis* Concentration Reporting Level: 1.0%
European/International Regulations: Hazard Symbol: Xn, N; risk phrases: R22; R50/53; safety phrases: S2; S36; S60; S61 (see Appendix 1)
Description: Ametryn is a white crystalline powder. Ametryn is available as an 80% emulsifiable concentrate, flowable wettable powder and a wettable powder. Molecular weight = 227.32; Freezing/Melting point = 88–89 °C[88]; Specific gravity (H_2O:1) = 1.19 @ 20 °C; Vapor pressure = 2.5×10^{-6} mmHg. Hazard Identification (based on NFPA-704 M Rating System): Health 1, Flammability 1, Reactivity 0. Soluble in water; solubility = 200 mg/l @ 20 °C.
Incompatibilities: Incompatible with oxidizers, acids, acid chlorides, acid halides, isocyanates, halogenated organics, peroxides, phenols (acidic), epoxides, anhydrides. Contact with strong reducing agents such as halides may generate a flammable gas. Organosulfides are incompatible with acids, diazo and azo compounds, halocarbons, isocyanates, aldehydes, alkali metals, nitrides, hydrides, and other strong reducing agents. Reactions with these materials generate heat and in many cases hydrogen gas. Many of these compounds may liberate hydrogen sulfide upon decomposition or reaction with an acid. Amines are chemical bases. They neutralize acids to form salts plus water. These acid-base reactions are exothermic. The amount of

heat that is evolved per mole of amine in a neutralization is largely independent of the strength of the amine as a base.

Permissible Concentration in Water: Federal Drinking Water Guidelines: EPA 60μg/L; State Drinking Water Guidelines: Maine 60μg/L; Florida 60μg/L.

Determination in Water: Extraction with methylene chloride may be followed by gas chromatography using a nitrogen phosphorus detector. The detection limits are in the range of 0.1 to 2.0μg/L. Log K_{ow} = ~ 3.0. Values at or above 3.0 are likely to bioaccumulate in marine organisms.

Routes of Entry: Ingestion, dermal and/or eye contact

Harmful Effects and Symptoms

Short Term Exposure: Ametryn is an eye and skin irritant. It is mildly toxic by dermal and/or eye contact. Harmful if swallowed or inhaled. LD_{50} (oral, rat) = 550–1600 mg/kg[83]; LD_{50} (dermal, rabbit) = >2000 mg/kg[83].

Long Term Exposure: It may cause liver degeneration.

Points of Attack: Liver

Medical Surveillance: Herbicides: Preliminary medical exam to detect chronic diseases of central nervous system, liver, heart, kidneys, lung and skin, as well as endocrinological or immunological disturbances, should protect susceptible individuals. Periodical medical exams of internal organs, skin and eyes are important to avoid chronic occupational intoxications. They should include lab and patch tests when necessary[83].

First Aid: If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least 15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately. If this chemical contacts the skin, remove contaminated clothing and wash immediately with soap and water. Seek medical attention immediately. If this chemical has been inhaled, remove from exposure, begin rescue breathing (using universal precautions) if breathing has stopped, and CPR if heart action has stopped. Transfer promptly to a medical facility. When this chemical has been swallowed, get medical attention. Give large quantities of water and induce vomiting. Do not make an unconscious person vomit.

Personal Protective Methods: Reacts with the following absorbent materials: Cellulose-Based; Mineral- and Clay-Based[88]. Applicators and other handlers must wear: Coveralls worn over long-sleeved shirt and long pants; Chemical-resistant gloves such as DuPont™ Tychem® suit fabrics, barrier laminate, or Viton®; Chemical-resistant footwear plus socks; Protective eye wear; Chemical-resistant headgear for overhead exposure; Chemical-resistant apron when cleaning equipment, mixing, or loading[83]. Agricultural Use/Engineering Controls: When handlers use closed systems, enclosed cabs, or aircraft in a manner that meets the requirements listed in the Worker Protection Standard (WPS) for agricultural pesticides, ***40 CFR 170.240(d)(4-6),*** the handler PPE requirements may be reduced or modified as specified in the Worker Protection Standard. Firefighters should wear NIOSH-approved self-contained breathing apparatus and full protective clothing.

Respirator Selection: Wherever and whenever workplace conditions warrant respirator use, a respiratory protection program must be followed that meets one or more of the following government standards: OSHA's 29 CFR 1910.134, ANSI Z88.2, or European Standard EN 149.

Storage: Color Code-Blue: Health Hazard/Poison. Store in a secure poison location. Prior to working with this chemical you should be trained on its proper handling and storage. Store in tightly closed containers in a cool, well-ventilated area away from strong acids. Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: Triazine pesticides, solid, toxic, n. o. s. require a label of "poisonous materials." They fall in Hazard Class 6.1 and in Packing Group III.

Spill Handling: Evacuate and restrict persons not wearing protective equipment from area of spill or leak until clean up is complete. Avoid inhalation of dust; wear respirator. Do not touch damaged containers or spilled material unless wearing appropriate protective clothing. Stop leak if you can do it without risk. Prevent entry into waterways, sewers, basements or confined areas. Cover with plastic sheet to prevent spreading. Absorb or cover with dry earth, sand or other non-combustible material and transfer to containers. Do not allow water to get inside containers. (ERG, 2012) Ventilate area of spill or leak after clean up is complete. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable. Granular activated carbon will remove ametryn from water. Soil Adsorption Index (K_{oc}) = 300.

Fire Extinguishing: Hazardous decomposition includes oxides of nitrogen, carbon and sulfur. Wear positive-pressure self-contained breathing apparatus when fighting fires involving this herbicide. Avoid breathing dusts and fumes from burning material. Keep upwind. *On a small fire:* use dry chemical, CO_2 or water spray. *On a large fire*: use water spray, fog or regular foam. Move containers from fire area if you can do it without risk. Dike fire-control water for later disposal; do not scatter the material. Use water spray or fog; do not use straight streams. *Fire involving storage or vehicular tanks:* isolate for 800 meters/0.5 mile in all directions; also, consider initial evacuation for 800 meters/0.5 mile in all directions. Fight fire from maximum distance or use unmanned hose holders or monitor nozzles. Do not get water inside containers. Cool containers with flooding quantities of water until well after fire is out. Withdraw immediately in the case of rising sound from venting safety devices or discoloration of tank. ALWAYS stay away from tanks engulfed in fire. For massive fire, use unmanned hose holders or monitor nozzles; if this is impossible, withdraw from area and let fire burn. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode.

Disposal Method Suggested: In accordance with 40CFR165, follow recommendations for the disposal of pesticides and pesticide containers.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- USEPA, "Health Advisory: Ametryn," Washington DC, Office of Drinking Water (August 1987)
- EXTOXNET, Pesticide Information Profiles, "Ametryn," Oregon State University (September 1995). http://ace.orst.edu/cgi-bin/mfs/01/pips/ametryn.htm?33#mfs
- USEPA, Office of Pesticide Programs, Pesticide Residue Limits, "Ametryn,", 40 CFR 180.258. http://www.epa.gov/pesticides/food/viewtols.htm
- USEPA, *R.E.D. Facts, Ametryn*, EPA 738-F-05-007, Washington DC (September 2005)

Aminocyclopyrachlor A:0745

Use Type: Herbicide

CAS Number: 858956-08-8; 858954-83-3 (methyl ester); 858956-35-1 (potassium salt)

Formula: $C_8H_8ClN_3O_2$

Synonyms: 6-Amino-5-chloro-2-cyclopropyl-4-pyrimidinecarboxylic acid; 6-Amino-5-chloro-2-cyclopropylpyrimidine-4-carboxylic acid

Trade names: IMPRELlIS®; Ortho MAT28; SG Herbicide; DPX-MAT28; VIEWPOINT HERBICIDE; STREAMLINE HERBICIDE; WEED & FEED

Chemical Class: Pyralid

EPA/OPP PC Code: 288008

California DPR Chemical Code: 5998

HSDB Number: 7981

UN/NA & ERG Number: UN3077 (solid)/171; UN3082 (liquid)/171

Uses: In August 2010, EPA conditionally registered the active ingredient aminocyclopyrachlor for pesticide applications. In August 2011, the EPA issued a Stop Sale, Use or Removal Order for the herbicide Imprelis (which contains the active ingredient aminocyclopyrachlor), which may be causing injury to certain species of evergreen trees, particularly Norway spruce and white pine[83]. Aminocyclopyrachlor is being registered for uses of general weed and brush control on private, public and military lands including sod farms, uncultivated non-agricultural areas such as airports, highways, railroads, golf courses, lumber yards, wildlife habitats, multi-family residential complexes, recreation areas, utility rights of way, with residential use specified for lawn/turf[83]. For control of weeds in cool-season lawn grasses, especially bluegrass. Not listed for use in EU countries[115].

Regulatory Authority and Advisory Information:

Description: Cream to light tan granules or brown liquid with a vinegar-like odor. Molecular weight = 213.62; Specific gravity (H_2O:1) = @ 20 °C; Dissociation constant (pKa) = 4.65 @ 20 °C[83]; Vapor pressure = 3.7×10^{-8} mmHg @ 25 °C[83]. Henry's Law constant = 3.4×10^{-12} atm-m^3/mol @ 25 °C (est)[83]. Soluble in water. Physical and toxicological properties may be affected by carrier solvents in commercial formulations.

Incompatibilities: Dust may form explosive mixture with air. Keep away from strong oxidizers, heat and flame. *Methyl ester*: May react with acids to liberate heat along with alcohols and acids. Strong oxidizing acids may cause a vigorous reaction that is sufficiently exothermic to ignite the reaction products. Heat is also generated by the interaction of esters with caustic solutions. Flammable hydrogen is generated by mixing esters with alkali metals and hydrides. As an ester, it will hydrolyze to form sulfur dioxide and alcohols; reaction is more rapid under basic conditions. It may react exothermically with acids to generate alcohols. Heat will be generated by interaction with basic or caustic solutions. Flammable hydrogen is generated by mixing with alkali metals and hydrides.

Permissible Exposure Limits in Air: AEL*: 5 mg/m^3 8 & 12 hr. TWA (respirable dust)

AEL*: 10 mg/m^3 8 & 12 hr. TWA (total dust)

Determination in Air: See Analytic Laboratory Methods in the Hazardous Substance Data Bank Number 7981.

*AEL = DuPont™'s (AEL) Acceptable Exposure Limit. Where governmentally imposed occupational exposure limits which are lower than the AEL are in effect, such limits shall take precedence.

Permissible Concentration in Water: Runoff from spills or fire control may cause water pollution.

Determination in Water: Log K_{ow} = –2.5. Negative. Unlikely to bioaccumulate in marine organisms.

Routes of Entry: Inhalation, dermal and/or eye contact.

Harmful Effects and Symptoms

Short Term Exposure: May cause irritation of the skin, eyes, and respiratory tract. LD_{50} (oral, rat) = >5 g/kg.; LD_{50} (dermal, rat) = >5 g/kg[83].

Long Term Exposure: Unknown. Potential health effects of pyralid herbicide contaminants in foods have not been fully investigated.

First Aid: Eyes: First check the victim for contact lenses and remove if present. Flush victim's eyes with water or normal saline solution for 20 to 30 minutes while simultaneously calling a hospital or poison control center. Do not put any ointments, oils, or medication in the victim's eyes without specific instructions from a physician. *Immediately* transport the victim after flushing eyes to a hospital even if no symptoms (such as redness or irritation) develop. Skin: *Immediately* flood affected skin with water while removing and isolating all contaminated clothing. Gently wash all affected skin areas thoroughly with soap and water. If symptoms such as redness or irritation develop, *immediately* call a physician and be prepared to transport the victim to a hospital for treatment.

Inhalation: *Immediately* leave the contaminated area; take deep breaths of fresh air. If symptoms (such as wheezing, coughing, shortness of breath, or burning in the mouth, throat, or chest) develop, call a physician and be prepared to transport the victim to a hospital. Provide proper respiratory protection to rescuers entering an unknown atmosphere. Whenever possible, self-contained breathing apparatus (SCBA) should be used; if not available, use a level of protection greater than or equal to that advised under Protective Clothing. Ingestion: *Do not induce vomiting.* If the victim is conscious and not convulsing, give 1 or 2 glasses of water to dilute the chemical and *immediately* call a hospital or poison control center. Be prepared to transport the victim to a hospital if advised by a physician. If the victim is convulsing or unconscious, do not give anything by mouth, ensure that the victim's airway is open and lay the victim on his/her side with the head lower than the body. *Immediately* transport the victim to a hospital.

Personal Protective Methods: Smoking, eating, and drinking before washing should be absolutely prohibited when any pesticide is being handled or used. Applicators and other handlers must wear: Coveralls worn over long-sleeved shirt and long pants; Chemical-resistant gloves such as DuPont™ Tychem® suit fabrics, barrier laminate, or Viton®; Chemical-resistant footwear plus socks; Protective eye wear; Chemical-resistant headgear for overhead exposure; Chemical-resistant apron when cleaning equipment, mixing, or loading[83]. Agricultural Use/Engineering Controls: When handlers use closed systems, enclosed cabs, or aircraft in a manner that meets the requirements listed in the Worker Protection Standard (WPS) for agricultural pesticides, ***40 CFR 170.240(d)(4-6),*** the handler PPE requirements may be reduced or modified as specified in the Worker Protection Standard.

Respirator Selection: Where the neat (undiluted) test chemical is weighed and diluted, wear a NIOSH-approved half face respirator equipped with a combination filter cartridge, i.e. organic vapor/acid gas/HEPA (specific for organic vapors, HCl, acid gas, SO_2 and a high-efficiency particulate filter)[88]

Storage: Storage: Color Code-Green: General storage may be used. Prior to working with this chemical you should be trained on its proper handling and storage. Store in tightly closed containers in a cool, well-ventilated area away from oxidizers, acids, water, or combustible materials. Do not contaminate water, food or feed by disposal. Store product in original container only in a location inaccessible to children and pets. Not for use or storage in or around the home[DuPontTM]. Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: Environmentally hazardous substances, solid or liquid, usually fall in Hazard Class 9.

Spill Handling: First, remove all sources of ignition. Evacuate persons not wearing protective equipment from area of spill or leak until clean up is complete. Collect powdered material in the most convenient and safe manner and deposit in sealed containers. Ventilate area after clean up is complete. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable.

Fire Extinguishing: Hazardous decomposition includes oxides of nitrogen and carbon and hydrogen chloride fumes. As an immediate precautionary measure, isolate spill or leak area in all directions for at least 50 meters/150 feet for liquids and at least 25 meters/75 feet for solids. *Fire involving storage or vehicular tanks:* isolate for 800 meters/0.5 mile in all directions; also, consider initial evacuation for 800 meters/0.5 mile in all directions. *On a small fire:* use dry chemical, CO_2, water spray or regular foam. *On a large fire:* use water spray, fog or regular foam. Do not scatter spilled material with high-pressure streams of water. Move containers from fire area if you can do it without risk. Dike fire-control water for later disposal. *Fire involving tanks:* from a secure explosion-proof location, use water spray to cool exposed containers. If cooling streams are ineffective (venting sound increases in volume and pitch, tank discolors, or shows any signs of deforming), withdraw immediately to a secure position. Always stay away from tanks engulfed in fire. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode.

Disposal Method Suggested: It is the responsibility of chemical waste generators to determine if a discarded chemical is classified as a hazardous waste. See 40 CFR Parts 261.3 for U.S. EPA guidelines for the classification determination. Additionally, in order to ensure complete and accurate classification, waste generators must consult state and local hazardous waste regulations.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- United States National Library of Medicine, *ChemIDplus Advanced*, Bethesda, MD. http://chem.sis.nlm.nih.gov/chemidplus/rn/858956-08-8

Aminopyralid A:0747

Use Type: Herbicide

CAS Number: 150114-71-9

Formula: $C_6H_4Cl_2N_2O_2$

Synonyms: 4-Amino-3,6-dichloropicolinic acid; 4-Amino-3,6-dichloropyridine-2-carboxylic acid; 4-Amino-3,6-

dichloro-2-pyridinecarboxylic acid; 2-Pyridinecarboxylic acid, 4-amino-3,6-dichloro-

Trade names: BANISH®; FOREFRONT®; HALCYON®; MILESTONE® VM; PHARAOH®; PRO-BANISH®; RUNWAY®; SYNERO®; UPFRONT®

Chemical Class: Pyridinecarboxylic acid; Picolinic acid; Pyridine Carboxylic acid

EPA/OPP PC Code: 005100

California DPR Chemical Code: 5927

HSDB Number: 7939

UN/NA & ERG Number:

Uses: A systemic, post-emergence herbicide for industrial vegetation and pastures. Used to control woody plants, clovers, and thistles. This herbicide is absorbed by roots and leaves. Not listed for use in EU countries[115].

U.S. Maximum Allowable Residue Levels for for residues of the herbicide aminopyralid including its metabolites and degradates, in or on the following commodities. Compliance with the tolerance levels specified below is to be determined by measuring only aminopyralid. [40 CFR 180.610(a)(1)]: corn, field, forage 0.30 ppm; corn, field, grain 0.20 ppm; corn, field, stover 0.20 ppm; grain, aspirated fractions 0.2 ppm; grass, forage 25 ppm; grass, hay 50 ppm; wheat, bran 0.1 ppm; wheat, forage 2.0 ppm; wheat, grain 0.04 ppm; wheat, hay 4.0 ppm; wheat, straw 0.25 ppm. ***[40 CFR 180.610(a)(2)]:*** cattle, fat 0.02 ppm; cattle, kidney 0.3 ppm; cattle, meat 0.02 ppm; cattle, meat byproducts, except kidney 0.02 ppm; goat, fat 0.02 ppm; goat, kidney 0.3 ppm; goat, meat 0.02 ppm; goat, meat byproducts, except kidney 0.02 ppm; horse, fat 0.02 ppm; horse, kidney 0.3 ppm; horse, meat 0.02 ppm; horse, meat byproducts, except kidney 0.02 ppm; milk 0.03 ppm; sheep, fat 0.02 ppm; sheep, kidney 0.3 ppm; sheep, meat 0.02 ppm; sheep, meat byproducts, except kidney 0.02 ppm.

Regulatory Authority and Advisory Information:

Carcinogenicity[83]: EPA, not likely to be carcinogenic to humans.

EPA Oral reference dose (RfD) = 0.05 mg/kg/day

Acute Oral Category: 4, Caution; The technical product is in Category I, DANGER–POISON (human, fatal <1 teaspoon/5 gm).

Description: Yellowish to off-white powder. Odorless. Commercial products may be available as a flammable concentrated emulsion, oil in water, that may be mixed with water for spraying. Molecular weight = 207.026; Specific gravity (H_2O:1) = 1.72 @ 20 °C[83]; Boiling point = (decomposes); Freezing/Melting point = 161.75–165.23 °C[83]; 163.5 °C[Dow]; Vapor pressure = 1.59×10^{-10} mmHg @ 25 °C; Henry's Law constant = 1.74×10^{-12} atm-m^3/mol @ 25 °C (est)[83]. Soluble in water; solubility = 205 g/L @ pH = 7.

Incompatibilities: Dust may form explosive mixture with air. Keep away from strong oxidizers and strong acids, and isothiocyantes. May be flammable and corrosive.

Determination in Water: Log K_{ow} = >–2.0–<–3.0 @ pH 7. Negative. Unlikely to bioaccumulate in marine organisms.

Routes of Entry: Inhalation, dermal and/or eye contact

Harmful Effects and Symptoms

Short Term Exposure: An irritant. May be able to pass through the unbroken skin. Contact may cause eye damage. Lower levels may cause irritation of the skin, and respiratory tract. May be harmful if swallowed or inhaled. LD_{50} (oral, rat) = >5 g/kg; LD_{50} (dermal, rat) = >5 g/kg.

Long Term Exposure: High levels may cause stomach ulcers.

Points of Attack: Gastrointestinal tract. Mucosal lining of the stomach.

First Aid: If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least 15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately. If this chemical contacts the skin, remove contaminated clothing and wash immediately with soap and water. Seek medical attention immediately. If this chemical has been inhaled, remove from exposure, begin rescue breathing (using universal precautions) if breathing has stopped, and CPR if heart action has stopped. Transfer promptly to a medical facility. When this chemical has been swallowed, get medical attention. Give large quantities of water and induce vomiting. Do not make an unconscious person vomit.

Personal Protective Methods: Reacts with the following absorbent materials: Mineral-Based and Clay-Based[88]. Wear protective gloves and clothing to prevent any reasonable probability of dermal and/or eye contact. Safety equipment suppliers/manufacturers can provide recommendations on the most protective glove/clothing material for your operation. All protective clothing (suits, gloves, footwear, headgear) should be clean, available each day, and put on before work. Contact lenses should not be worn when working with this chemical. Wear dust-proof chemical goggles and face shield unless full facepiece respiratory protection is worn. Employees should wash immediately with soap when skin is wet or contaminated. Provide emergency showers and eyewash.

Respirator Selection: Wherever and whenever workplace conditions warrant respirator use, a respiratory protection program must be followed that meets one or more of the following government standards: OSHA's 29 CFR 1910.134, ANSI Z88.2, or European Standard EN 149.

Storage: Color Code-Green: General storage may be used. Prior to working with this chemical you should be trained on its proper handling and storage. Store in tightly closed containers in a cool, well-ventilated area away from oxidizers, acids, water, or combustible materials. Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: Depending on formulation, the dry material may be classified as Environmentally hazardous substances, solid, n.o.s. It usually falls in Hazard Class 9.

Spill Handling: If a spill occurs, clean it up promptly. Don't wash it away. Instead, sprinkle the liquid spill with sawdust, vermiculite, or kitty litter. Sweep it into a plastic garbage bag, and dispose of it as directed on the pesticide product label. Wash all contaminated surfaces with a soap and water solution.

Fire Extinguishing: Hazardous decomposition includes oxides of nitrogen and carbon, hydrogen chloride and chlorine gases. *Small fires:* dry chemical, carbon dioxide; water spray; or alcohol foam. *Large fires:* water spray, fog, or foam. Stay upwind; keep out of low areas. Ventilate closed spaces before entering them. Firefighting gear (including SCBA) may not provide adequate protection. If exposure occurs, remove and isolate gear immediately and thoroughly decontaminate personnel. Wear positive-pressure breathing apparatus and special protective clothing. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode. Remove and isolate contaminated clothing at the site. Move container from fire area if you can do so without risk. Fight fire from maximum distance. Dike fire-control water for later disposal. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies. From a secure, explosion-proof location, use water spray to cool exposed containers. If cooling streams are ineffective (venting sound increases in volume and pitch, tank discolors, or shows any signs of deforming), withdraw immediately to a secure position. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156.

Disposal Method Suggested: Containers must be disposed of properly by following package label directions or by contacting your local or federal environmental control agency, or by contacting your regional EPA office. Dissolve or mix the material with a combustible solvent and burn in a chemical incinerator equipped with an afterburner and scrubber. In accordance with 40CFR165, follow recommendations for the disposal of pesticides and pesticide containers.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- EPA pesticide fact sheet for Aminopyralid, 7501C August 10, 2005

Amitraz A:0940

Use Type: Insecticde, Acaricide, Veterinary medicine

CAS Number: 33089-61-1

Formula: $C_{19}H_{23}N_3$

Synonyms: A13-27967; Amitraze; Amitraz estrella; *N,N*-Bis(2,4-xylyliminomethyl)methylamine; 1,5-Di-(2,4-dimethylphenyl)-3-methyl-1,3,5-triazapenta-1,4-diene; *N'*-(2,4-Dimethylphenyl)-3-methyl-1,3,5-triazapenta-1,4-diene; *N'*-(2,4-Dimethylphenyl)-*N*-[((2,4-dimethylphenyl) imino)methyl]-*N*-methylmethanimidamide; *N,N*-Di-(2,4-xylyliminomethyl)methylamine; ENT 27967; Formamidine, *N*-methyl-*N'*-2,4-xylyl-*N*-(*N*-2,4-xylylformimidoyl)-; *N*-Methylbis(2,4-xylyliminomethyl) amine; 2-Methyl-1,3-di(2,4-xylylimino)-2-azapropane; *N,N'*-[(Methylimino)dimethylidyne]bis(2,4-xylidine); *N,N'*-[(Methylimino)dimethylidyne]d-2,4-xylidine; NSC 324552; OMS 1820; R. D.27419; 2,4-Xylidine, *N,N'*-(methyliminodimethylidyne)bis-

Trade Names: AAZDIENO®; ACARAC®; ACADREX®; ARMY®; AZODIENO®; BAAM®; BOOTS BTS 27419®; BTS 27,419®; BUMETRAN®; COYOTE®; DANICUT®; ECTODEX®; EDRIZAN®; EDRIZAR®; GARIAL®; ISTAMBUL®; MITABAN®; MITAC®; OVASYN®; OVIDREX®; PARSEC®; ROTRAZ®; SENDER®; TAC-PLUS®; TACTIK®; TRIATIX®; TRIATOX®; TUDY®; VAPCOZIN TAKTIC®; UPJOHN U-36059®

Chemical Class: Formamidine

EPA/OPP PC Code: 106201

California DPR Chemical Code: 2016

HSDB Number: 6939

UN/NA & ERG Number: UN3077(solid)/171

RTECS® Number: ZF0480000

EC Number: 251-375-4 [*Annex I Index No.:* 612-086-00-2]

Uses: Registered for control of pear psylla on pears, whitefly and mites on pears and cotton; cattle, dogs, sheep, and hog dip to control ticks, mange mites, lice and other pests. Not permitted on apples. Used to control red spider mites, leaf miners, scale insects, and aphids. Also used on cotton to control bollworms, white fly, leaf worms, and tobacco budworms. Not registered for use in EU countries[115].

U.S. Maximum Allowable Residue Levels for amitraz and its metabolites containing the 2,4-dimethylaniline moiety (calculated as the parent) in or on the following food commodities: [40 CFR 180.287]: cattle, fat 0.1 ppm; cattle, meat 0.02 ppm; cattle, meat byproducts 0.2 ppm; cotton, undelinted seed (there are no U.S. registrations on cottonseed as of may 3, 2006) 1.0 ppm; hog, fat 0.1 ppm; hog, kidney 0.1 ppm; hog, liver 0.1 ppm; hog, meat 0.05 ppm; hog, meat byproducts 0.3 ppm; milk 0.03 ppm; milk, fat 0.2 ppm.

Human toxicity (long-term)[101]: Extra high–0.30973 ppb, CHCL (Chronic Human Carcinogen Level)

Fish toxicity (threshold)[101]: Very low–12422.37656 ppb, MATC (Maximum Acceptable Toxicant Concentration)

Regulatory Authority and Advisory Information:

Carcinogenicity[83]: EPA Group C, Possible human carcinogen

California Proposition 65 Developmental/Reproductive toxin (3/3/1999)

Health Advisory: Nerve Toxin (S!), Developmental/ Reproductive Toxin

Acute Oral Category: 2, WARNING

CERCLA/SARA 40CFR372.65: Form R *de minimis* Concentration Reporting Level: 1.0%

European/International Regulations: Hazard Symbol: Xi, Xn, N; risk phrases: R22; R36; R38; R48/22; R43; R50/53; safety phrases: S2; S22; S24; S36/37; S60; S61 (see Appendix 1)

Description: Amitraz forms white to pale yellow needle-like crystals. Commercial product is available as an emulsifiable concentrate and wettable powder. Liquid formulations may contain flammable organic solvents. Molecular weight = 293.45; Specific gravity (H_2O:1) = 1.129 @ 20 °C; Boiling point = (decomposes); Freezing/Melting point = 86–87 °C; Vapor pressure = 2.6×10^{-6} mmHg. Practically insoluble in water. Physical and toxicological properties may be affected by carrier solvents in commercial formulations.

Incompatibilities: Unstable in acidic media. Decomposes on burning, producing toxic fumes including nitrogen oxides. When stored for prolonged periods, slow decomposition occurs.

Permissible Concentration in Water: Runoff from spills or fire control may cause water pollution.

Determination in Water: Log K_{ow} = >5.0. Values above 3.0 are likely to bioaccumulate in aquatic organisms.

Routes of Entry: Inhalation, ingestion, skin

Harmful Effects and Symptoms

Short Term Exposure: This chemical is poisonous if ingested or absorbed through the skin. Eye or dermal contact can cause irritation. It may affect the central nervous system. May cause sedation with slow heart beat, low blood pressure, low body temperature. Because amitraz has a low vapor pressure, significant inhalation of vapors is unlikely at ordinary temperatures. LD_{50} (oral, rat) = <500 mg/kg; LD_{50} (dermal, rabbit) = >200 mg/kg[83].

Long Term Exposure: Prolonged or repeated exposure may cause organ damage. May affect the central nervous system and liver. Amitraz metabolizes to 2,4-dimethylaniline, which is a potential human carcinogen. May cause skin sensitization.

Points of Attack: Eyes, skin, central nervous system

Medical Surveillance: This chemical is a suspected or known human carcinogen. Exposed persons should contact a physician for advice regarding the possible long term health effects and advice for medical monitoring. In addition to comprehensive initial medical and work histories emphasizing reproductive experience and menstrual history, patient should have physical examination and testing of genito-urinary tract, sperm count, motility and morphology. If required, other tests, such as serum testosterone, serum follicle stimulating hormone (FSH), and serum lutenizing hormone (LH), may be indicated.

First Aid: If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least 15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately. If this chemical contacts the skin, remove contaminated clothing and wash immediately with soap and water. Seek medical attention immediately. If this chemical has been inhaled, remove from exposure, begin rescue breathing (using universal precautions) if breathing has stopped, and CPR if heart action has stopped. Transfer promptly to a medical facility. When this chemical has been swallowed, get medical attention. Give large quantities of water and induce vomiting. Do not make an unconscious person vomit.

Personal Protective Methods: Reacts with the following kinds of absorbents: Mineral- and Clay-Based[88]. Wear protective gloves and clothing to prevent any reasonable probability of dermal and/or eye contact. Safety equipment suppliers/manufacturers can provide recommendations on the most protective glove/clothing material for your operation. All protective clothing (suits, gloves, footwear, headgear) should be clean, available each day, and put on before work. Contact lenses should not be worn when working with this chemical. Wear dust-proof chemical goggles and face shield unless full facepiece respiratory protection is worn. Employees should wash immediately with soap when skin is wet or contaminated. Provide emergency showers and eyewash.

Respirator Selection: *At any detectable concentration:* SCBAF: Pd,Pp (APF = 10,000) (any NIOSH/MSHA- or European Standard EN 149-approved self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode); or SaF: Pd,Pp: ASCBA (APF = 10,000) (any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary, self-contained breathing apparatus operated in a pressure-demand or other positive-pressure mode). *Escape:* 100F (APF = 50) (any air-purifying, full facepiece respirator with and N100, R100, or P100 filter k-mounted organic vapor canister having a high-efficiency particulate filter); or SCBAE (any appropriate escape-type, self-contained breathing apparatus).

Storage: Color Code-Blue: Health Hazard/Poison. Store in a secure poison location. Prior to working with this chemical you should be trained on its proper handling and storage. Store in tightly closed containers in a cool, well-ventilated area, away from fertilizers, seed, and other pesticides, flammable materials and sources of heat and flame. Do not reuse containers. Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: Environmentally hazardous substances, solid or liquid, usually fall in Hazard Class 9.

Spill Handling: First, remove all sources of ignition. Evacuate persons not wearing protective equipment from area of spill or leak until clean up is complete. Stay upwind; keep out of low areas. Ventilate closed spaces before entering them. Remove and isolate contaminated clothing at the site. Do not touch spilled material; stop leak if you can do so without risk. Use water spray to reduce vapors. *Small spills:* absorb with sand or other noncombustible absorbent material and place into containers for later disposal. *Large spills:* dike far ahead of spill for later disposal. Collect powdered material in the most convenient and safe manner and deposit in sealed containers. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable. Seek professional environmental engineering assistance from the U.S. EPA Environmental Response Team at (908) 548-8730 (24-hour response line). Soil Adsorption Index (K_{oc}) = 1000 Estimate.

Fire Extinguishing: Hazardous decomposition includes nitrogen oxides. As an immediate precautionary measure, isolate spill or leak area in all directions for at least 50 meters/150 feet for liquids and at least 25 meters/75 feet for solids. *Fire involving storage or vehicular tanks:* isolate for 800 meters/0.5 mile in all directions; also, consider initial evacuation for 800 meters/0.5 mile in all directions. *On a small fire:* use dry chemical, CO_2, water spray or regular foam. *On a large fire:* use water spray, fog or regular foam. Do not scatter spilled material with high-pressure streams of water. Move containers from fire area if you can do it without risk. Dike fire-control water for later disposal. *Fire involving tanks:* from a secure explosion-proof location, use water spray to cool exposed containers. If cooling streams are ineffective (venting sound increases in volume and pitch, tank discolors, or shows any signs of deforming), withdraw immediately to a secure position. Always stay away from tanks engulfed in fire. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode.

Disposal Method Suggested: In accordance with 40CFR 165 recommendations for the disposal of pesticides and pesticide containers. Containers must be disposed of properly by following package label directions or by contacting your local or federal environmental control agency, or by contacting your regional EPA office.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- USEPA, Office of Pesticide Programs, Pesticide Residue Limits, "Amitraz", 40 CFR 180.127. http://www.epa.gov/pesticides/food/viewtols.htm
- EXTOXNET, Extension Toxicology Network, Pesticide Information Profile "Amitraz," Oregon State University (September, 1995). http://ace.orst.edu/cgi-bin/mfs/01/pips/amitraz.htm?6#mfs
- USEPA, *R.E.D. FACTS, Amitraz,*, EPA 738-F-98-031, Washington DC (November 1996)
- USEPA, "Rebuttable Presumption Against Registration (RPAR) of Pesticide Products Containing Amitraz," Washington DC (April 6, 1977)

Amitrole A:0945

Use Type: Herbicide, Plant growth regulator
CAS Number: 61-82-5
Formula: $C_2H_4N_4$
Synonyms: Aminotriazole; 2-Aminotriazole; 3-Aminotriazole; 3-Amino-*S*-triazole; 3-Amino-1,2,4-triazole; 2-Amino-1,3,4-triazole; 3-Amino-1*H*-1,2,4-triazole; ATA; Caswell No. 040; ENT 25445; 1,2,4-Triazol-3-amine; Triazolamine; 1*H*-1,2,4-Triazol-3-amine; *S*-Triazole, 3-amino-; δ-2-1,2,2,4-Triazoline, 5-imino-; 1*H*-1,2,4-Triazol-3-ylamine
Trade Names: AMITRIL®; ATLAZIN®; ATLAZINE® FLOWABLE; AT®; 3-AT®; AT-90®; ATRAFLOW PLUS®; AZAPLANT®; AZAPLANT KOMBI®; AZOLAN®; AZOLE®; BOROFLOW® A/ATA; CAMPAPRIM® A 1544; CDA SIMFLOW PLUS®; CHIPMAN® PATH; CYTROLE®; DIUROL® AMITROLE; DOMATOL®; ELMASIL®; EMISOL®; FARMCO®; HERBAZIN PLUS SC®; HERBICIDE® TOTAL; MASCOT HIGHWAY®; MSS AMINOTRIAZOLE®; MSS SIMAZINE®; ORGA-414®; RADOXONE® TL; RAMIZOL®; RASSAPRON®; SIMAZOL®; SIMFLOW PLUS®; SOLUTION CNCENTREE T271®; SYNCHEMICALS® TOTAL WEED KILLER; SYNTOX®; TORAPRON®; VOROX®; WEEDAR®; WEEDAZIN®; WEEDAZOL TL ®; WEEDOCLOR®
Chemical Class: Azole; Triazole
EPA/OPP PC Code: 004401
California DPR Chemical Code: 20
HSDB Number: 2953
UN/NA & ERG Number: UN3077(solid)/171
RTECS® Number: XZ3850000
EC Number: 200-521-5 [*Annex I Index No.:* 613-011-00-6]
Uses: A non-food use herbicide for control of grasses, woody plants and broad-leaf weeds on hard surface and in areas where crops are not normally grown.

Regulatory Authority and Advisory Information:

Carcinogenicity[83]: EPA Group B2, Probable human carcinogen; NTP: 12th Report on Carcinogens, 2011: Reasonably anticipated to be a human carcinogen; ACGIH A3 Confirmed animal carcinogen with unknown relevance to humans
California Proposition 65 Chemical: Carcinogen (7/1/1987)
Acute Oral Category: 4, Caution
Health Advisory: Mutagen, Developmental/Reproductive Toxin, Endocrine disruptor (S!)
EPA Hazardous Waste Number (RCRA No.): U011
RCRA Land Ban Waste Restrictions
Superfund/EPCRA 40CFR302.4 RQ: CERCLA, 10 lb (4.54 kg)
EPCRA Section 313 Form R *de minimus* concentration reporting level: 0.1%
U.S. DOT Regulated Marine Pollutant (49CFR172.101, Appendix B), severe pollutant
European/International Regulations: Hazard Symbol: Xn, N; risk phrases: R48/22; R51/53; R63; safety phrases: S2; S36/37; S61 (see Appendix 1)
WGK (German Aquatic Hazard Class): 2-Hazard to waters

Description: Amitrol is a colorless to off white crystalline solid. Odorless when pure. Commercial product is available in flakes, as an emulsifiable concentrate, and wettable powder. Molecular weight = 84.08; Specific gravity (H_2O:1) = 1.1138 @ 20 °C[88]; Boiling point = (decomposes); Freezing/Melting point = 158.89 °C[88]; Vapor pressure = 4.4×10^{-7} mmHg @ 20 °C[83]; 2.4×10^{-4} mmHg @ 60 °C. Highly soluble in water; solubility = 2.6×10^{5} ppm @ 25 °C. Physical and toxicological properties may be affected by carrier solvents in commercial formulations.

Incompatibilities: Dusts may form explosive mixture with air. The triazoles are sensitive to heat, friction, and impact. Sensitivity varies with the type substitution to the triazole ring. Metal chelated and halogen substitution of the triazol ring make for a particularly heat-sensitive material. Azido and nitro derivatives have been employed as high explosives. No matter the derivative these materials should be treated as explosives[88]. Incompatible with strong oxidizers, strong acids, and light (decomposes). Corrosive to iron, aluminum, and copper.

Permissible Exposure Limits in Air: NIOSH IDLH: Potential occupational carcinogen

OSHA PEL: None; Vacated 1989 OSHA PEL0.2 mg/m³ is still enforced in some states.

NIOSH REL: 0.2 mg/m³

ACGIH TLV: 0.2 mg/m³ A3 Confirmed animal carcinogen with unknown relevance to humans. Excursion Limit Recommendation: Excursions in worker exposure levels may exceed 3 times the TLV-TWA for no more than a total of 30 minutes during a work day, and under no circumstances should they exceed 5 times the TLV-TWA provided that the TLV-TWA is not exeeded.

DFG MAK: 0.2 mg/m³, total dust

Protective Action Criteria (PAC) Ver. 27[89]

PAC-1: 0.6 mg/m³
PAC-2: 8.2 mg/m³
PAC-3: 220 mg/m³

Determination in Air: NIOSH Method #0500(18)

Permissible Concentration in Water: Runoff from spills or fire control may cause water pollution.

Determination in Water: Log K_{ow} = <–1.0. Negative. Unlikely to bioaccumulate in marine organisms.

Harmful Effects and Symptoms

Short Term Exposure: Amitrol can be absorbed through the skin, thereby increasing exposure. Because this material has a low vapor pressure, significant inhalation of vapors is unlikely at ordinary temperatures. LD_{50} (oral, rat) = >2.5 g/kg; LD_{50} (dermal, rat) = >2.5 g/kg.

Long Term Exposure: Causes liver, thyroid, and pituitary cancer in animals. May damage the developing fetus. May cause liver, thyroid gland (possible goiter or underactive thyroid), and pituitary gland damage. Carcinogenicity is the primary observed effect. Amitrole is carcinogenic in mice and rats, producing thyroid and liver tumors following oral or subcutaneous administration.

Points of Attack: Liver, thyroid, and pituitary gland. Suspected reproductive toxin; may impair the reproductive capabilities in men and/or women.

Medical Surveillance: This chemical is a suspected or known human carcinogen. Exposed persons should contact a physician for advice regarding the possible long term health effects and advice for medical monitoring. Before beginning employment and at regular times after that, the following is recommended: Physical examination of the thyroid and thyroid function tests (T_4, TSH, and T_3). If symptoms develop or overexposure is suspected, the following may be useful: Liver function tests. Pituitary gland function tests. In addition to comprehensive initial medical and work histories emphasizing reproductive experience and menstrual history, patient should have physical examination and testing of genito-urinary tract, sperm count, motility and morphology. If required, other tests, such as serum testosterone, serum follicle stimulating hormone (FSH), and serum lutenizing hormone (LH), may be indicated.

First Aid: If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least 15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately. If this chemical contacts the skin, remove contaminated clothing and wash immediately with soap and water. Seek medical attention immediately. If this chemical has been inhaled, remove from exposure, begin rescue breathing (using universal precautions) if breathing has stopped, and CPR if heart action has stopped. Transfer promptly to a medical facility. When this chemical has been swallowed, get medical attention. Give large quantities of water and induce vomiting. Do not make an unconscious person vomit.

Personal Protective Methods: Applicators and other handlers must wear: Coveralls worn over long-sleeved shirt and long pants; Chemical-resistant gloves such as DuPont™ Tychem® suit fabrics, barrier laminate, or Viton®; Chemical-resistant footwear plus socks; Protective eye wear; Chemical-resistant headgear for overhead exposure; Chemical-resistant apron when cleaning equipment, mixing, or loading[83]. Agricultural Use/Engineering Controls: When handlers use closed systems, enclosed cabs, or aircraft in a manner that meets the requirements listed in the Worker Protection Standard (WPS) for agricultural pesticides, ***40 CFR 170.240(d)(4-6),*** the handler PPE requirements may be reduced or modified as specified in the Worker Protection Standard. Firefighters should wear NIOSH-approved self-contained breathing apparatus and full protective clothing.

Respirator Selection: *At any detectable concentration:* SCBAF: Pd,Pp (APF = 10,000) (any NIOSH/MSHA- or European Standard EN 149-approved self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode); or SaF: Pd,Pp: ASCBA (APF = 10,000) (any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary, self-contained breathing apparatus operated in a pressure-demand or other positive-pressure mode). *Escape:* 100 F (APF = 50) (any air-purifying, full facepiece respirator with and N100, R100, or P100 filter k-mounted organic vapor canister having a high-efficiency particulate filter); or SCBAE (any appropriate escape-type, self-contained breathing apparatus).

Storage: Color Code-Blue: Health Hazard/Poison. Store in a secure poison location. Prior to working with this chemical you should be trained on its proper handling and storage. Store in tightly closed containers in a cool, well-ventilated area. Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: Environmentally hazardous substances, solid or liquid, usually fall in Hazard Class 9 and Packing Group II or III.

Spill Handling: First, remove all sources of ignition. Evacuate persons not wearing protective equipment from area of spill or leak until clean up is complete. Collect powdered material in the most convenient and safe manner and deposit in sealed containers. Ventilate area after clean up is complete. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable.

Fire Extinguishing: Hazardous decomposition includes oxides of nitrogen and carbon. As an immediate precautionary measure, isolate spill or leak area in all directions for at least 50 meters/150 feet for liquids and at least 25 meters/75 feet for solids. *Fire involving storage or vehicular tanks:* isolate for 800 meters/0.5 mile in all directions; also, consider initial evacuation for 800 meters/0.5 mile in all directions. *On a small fire:* use dry chemical, CO_2, water spray or regular foam. *On a large fire:* use water spray, fog or regular foam. Do not scatter spilled material with high-pressurestreams of water. Move containers from fire area if you can do it without risk. Dike fire-control water for later disposal. *Fire involving tanks:* from a secure explosion-proof location, use water spray to cool exposed containers. If cooling streams are ineffective (venting sound increases in volume and pitch, tank discolors, or shows any signs of deforming), withdraw immediately to a secure position. Always stay away from tanks engulfed in fire. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode.

Disposal Method Suggested: Consult with environmental regulatory agencies for guidance on acceptable disposal practices. Contact a licensed disposal facility about surplus and non-recyclable solutions. Burn in a chemical incinerator equipped with an afterburner and scrubber. Extra care must be exercised as the material in an organic solvent is highly flammable. Generators of waste containing this contaminant (≥100 kg/mo) must conform with EPA regulations governing storage, transportation, treatment, and waste disposal. In accordance with 40CFR165, follow recommendations for the disposal of pesticides and pesticide containers. Containers must be disposed of properly by following package label directions or by contacting your local or federal environmental control agency, or by contacting your regional EPA office. Incineration or permanganate oxidation.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- EXTOXNET, Extension Toxicology Network, "Pesticide Information Profile, Amitrol," Oregon State University, Corvallis, OR (June 1996). http://ace.orst.edu/info/extoxnet/pips/amitrole.htm
- Sax, N. I., Ed., Dangerous Properties of Industrial materials Report, 1, No. 4, 34-35 (1981) and 4, No. 2, 41-43 (1984)
- New Jersey Department of Health and Senior Services, "Hazardous Substance Fact Sheet: Amitrol," Trenton, NJ (June 1998). http://www.state.nj.us/health/eoh/rtkweb/0083.pdf
- USEPA, *R.E.D. FACTS, Amitrol*, EPA 738-F-96-002, Washington DC (August 1996)

Anthraquinone A:1390

Use Type: Repellent, Seed treatment

CAS Number: 84-65-1

Formula: $C_{14}H_8O_2$

Synonyms: 9,10-Anthracenedione; Anthradione; 9,10-Anthraquinone; Antraquinona (Spanish); 9,10-Dioxoanthracene; Anthradione

Trade Names: (*p*)ANTHRAPEL®; FLIGHT CONTROL-PLUS®; HOELITE®; MORKIT®; REPELL®

Chemical Class: Unclassified

EPA/OPP PC Code: 122701

California DPR Chemical Code: 5229

HSDB Number: 2074

UN/NA & ERG Number: UN1325/133; UN3143/151

RTECS® Number: CB4725000

EC Number: 201-549-0

Uses: Used as a seed dressing or protectant. Banned in EU.

Regulatory Authority and Advisory Information:

Carcinogenicity[83]: IARC:[12] Group 2b possible carcinogen to humans.

California Proposition 65 Chemical: Cancer (9/28/2007)

Health Advisory: Mutagen

Atmospheric Standards: ***[40 CFR 60.489]:*** Anthraquinone is produced, as an intermediate or a final product, by process units covered under standards of performance for equipment leaks of Volatile Organic Compounds (VOC) in the Synthetic Organic Chemical Manufacturing Industry (SOCMI).

TSCA 40CFR704.30; 40CFR716.120(a) List of substances; 40CFR712.30(m); 40CFR799.500 Testing Requirements. Export notification required by §12(b)

WGK (German Aquatic Hazard Class): 1-Low hazard to waters.

Description: Anthraquinone is a combustible, light yellow to green crystalline solid. Molecular weight = 208.22; Specific gravity (H_2O:1) = 1.438 @ 20 °C; Boiling point = 378.89–381.11 °C; Freezing/Melting point = (sublimes) 286.11 °C; Vapor pressure = 1 @ 190 °C; Flash point = 185 °C (cc)[17]. Autoignition temperature = 650 °C. Explosive limits: LEL = 0.8%; UEL 4.75%. NFPA 704 M Hazard Identification (based on NFPA-704 M Rating System): Health 2, Flammability 1, Reactivity 0. Very slightly soluble in water; solubility = <1 mg/L @ 22.8 °C.

Incompatibilities: A weak acid. Incompatible with alkaline material and bases. Contact with strong oxidizers may cause fire and explosions.

Permissible Exposure Limits in Air: Protective Action Criteria (PAC) Ver. 27[89]

PAC-1: 0.87 mg/m^3
PAC-2: 9.6 mg/m^3
PAC-3: 57 mg/m^3

Permissible Concentration in Water: Runoff from spills or fire control may cause water pollution.

Determination in Water: Log K_{ow} = >3.0. Values above 3.0 are likely to bioaccumulate in aquatic organisms.

Routes of Entry: Ingestion, inhalation, dermal contact; absorbed through the unbroken skin.

Harmful Effects and Symptoms

Short Term Exposure: Can be absorbed through the skin, thereby increasing exposure. Eye or dermal contact can cause irritation. An allergen, may cause skin irritation and sensitization. Severe poisoning may cause seizures and coma. LD_{50} (oral, rat) = >5 g/kg; LD_{50} (dermal, rat) = >500 mg/kg.

Long Term Exposure: May cause skin allergy. It may be mutagenic and cause tumors.

Points of Attack: Skin and lungs. May cause reproductive, chromosome, and DNA damage.

Medical Surveillance: This chemical is a suspected or known human carcinogen. Exposed persons should contact a physician for advice regarding the possible long term health effects and advice for medical monitoring. Evaluation by a qualified allergist, including exposure history and testing, may help diagnose allergy. In addition to comprehensive initial medical and work histories emphasizing reproductive experience and menstrual history, patient should have physical examination and testing of genito-urinary tract, sperm count, motility and morphology. If required, other tests, such as serum testosterone, serum follicle stimulating hormone (FSH), and serum lutenizing hormone (LH), may be indicated.

First Aid: If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least 15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately. If this chemical contacts the skin, remove contaminated clothing and wash immediately with soap and water. Seek medical attention immediately. If this chemical has been inhaled, remove from exposure, begin rescue breathing (using universal precautions) if breathing has stopped, and CPR if heart action has stopped. Transfer promptly to a medical facility. When this chemical has been swallowed, get medical attention. Give large quantities of water and induce vomiting. Do not make an unconscious person vomit.

Personal Protective Methods: Wear protective gloves and clothing to prevent any reasonable probability of dermal and/or eye contact. Safety equipment suppliers/manufacturers can provide recommendations on the most protective glove/clothing material for your operation. All protective clothing (suits, gloves, footwear, headgear) should be clean, available each day, and put on before work. Contact lenses should not be worn when working with this chemical. Wear dust-proof chemical goggles and face shield unless full facepiece respiratory protection is worn. Employees should wash immediately with soap when skin is wet or contaminated. Provide emergency showers and eyewash.

Respirator Selection: SCBA > 0.87 mg/m^3 NIOSH: *At any detectable concentration:* SCBAF: Pd,Pp (APF = 10,000) (any NIOSH/MSHA- or European Standard EN 149-approved self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode); or SaF: Pd,Pp: ASCBA (APF = 10,000) (any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary, self-contained breathing apparatus operated in a pressure-demand or other positive-pressure mode). *Escape:* 100 F (APF = 50) (any air-purifying, full facepiece respirator with and N100, R100, or P100 filter k-mounted organic vapor canister having a high-efficiency particulate filter); or SCBAE (any appropriate escape-type, self-contained breathing apparatus).

Storage: Color Code-Red Stripe: Flammability Hazard: Store separately from all other flammable materials. Prior to working with this chemical you should be trained on its proper handling and storage. Before entering confined space where this chemical may be present, check to make sure that an explosive concentration does not exist. Store in tightly closed containers in a cool, well-ventilated area away from chlorine compounds, oxidizing agents, and combustible materials. Sources of ignition, such as smoking and open flames, are prohibited where the chemical is handled, used, or stored. Use only non-sparking tools and equipment, especially when opening and closing containers. Wherever this chemical is used, handled, manufactured, or stored, use explosion-proof electrical equipment and fittings. Piping should be electrically bonded and grounded. Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: Flammable solids, organic, n. o. s. Hazard Class 4.1, Packing Group II or III. Technical name required.

Spill Handling: First, remove all sources of ignition. Evacuate persons not wearing protective equipment from area of spill or leak until clean up is complete. Dampen spilled material with toluene to avoid airborne dust. Collect powdered material in the most convenient and safe manner and deposit in sealed containers. Ventilate area after clean up is complete. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable.

Fire Extinguishing: Hazardous decomposition includes oxides of carbon. This chemical is a combustible solid. Use dry chemical, water spray, or alcohol-resistant foam extinguishers. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies. From a secure, explosion-proof location, use water spray to cool exposed containers. If cooling streams are ineffective (venting sound increases in volume and pitch, tank discolors, or shows any signs of deforming), withdraw immediately to a secure position. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode.

Disposal Method Suggested: Dissolve or mix the material with a combustible solvent and burn in a chemical incinerator equipped with an afterburner and scrubber. All federal, state, and local environmental regulations must be observed.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- New Jersey Department of Health and Senior Services, "Hazardous Substance Fact Sheet, Anthraquinone," Trenton, NJ (January 1999). http://www.state.nj.us/health/eoh/rtkweb/0140.pdf

Antimycin A A:1490

Use Type: Fungicide, Piscicide

CAS Number: 1397-94-0 (A-); 11118-72-2 (Antimycin/Fintrol); 518-75-2 (Antimycin/Citrinin); 642-15-9 (A_1-Dimidin); 522-70-3 (A_3-); 27220-59-3 (A_4-) *Note:* Both A_1 CAS numbers are found in RTECS, with the same chemical formula, although EPA regulates only 1397-94-0 as Antimycin A

Formulas: $C_{28}H_{40}N_2O_9$ (Antimycin A_1); $C_{26}H_{36}N_2O_9$ (Antimycin A_3); $C_{25}H_{34}N_2O_9$ (Antimycin A_4)

Synonyms: Antimicina A (Spanish); Antimycin A; Antipiricullin; Dihyrosamidin; Isovaleric acid-8-ester with 3-formamido-*N*-(7-hexyl-8-hydroxy-4,9-dimethyl-2,6-dioxo-1,5-dioxonan-3-yl)salicylamide isovaleric acid 8 ester

Trade Names: FINTROL®; VIROSIN®

Chemical Class: Antibiotic; Natural product

EPA/OPP PC Code: 6314

California DPR Chemical Code: 1001; 2001(1397-94-0)

HSDB Number: 6417

UN/NA & ERG Number: UN2811 (toxic solid, organic, n. o. s.)/154

RTECS® Number: CD0350000

EC Number: 208-257-2 (Antimycin/Citrinin) (CAS 518-75-2)

Uses: A U.S. EPA restricted Use Pesticide (RUP). May also be used as an insecticide.

Regulatory Authority and Advisory Information: *518-75-2 (Antimycin/Citrinin)*

IARC: Animal Inadequate Evidence; Human No Adequate Data, *not classifiable as carcinogenic to humans*, Group 3

Health Advisory: Mutagen

CERCLA/SARA 40CFR302 Extremely Hazardous Substances: TPQ = 1000/10,000 lb (454/4540 kg)[7]

CERCLA Reportable Quantity (RQ): 1 lb (0.454 kg)

WGK (German Aquatic Hazard Class): 3-Highly water polluting (*Antimycin A*-)

Description: Antimycin ($A_3C_{26}H_{36}N_2O_9$) and antimycin A_1 ($C_{28}H_{40}N_2O_9$) are crystalline solids. Molecular weight = 548.71 (A); 520.64 (A_3-); 506.6 (A_4-); Freezing/Melting point = 170–175 °C; 149–150 °C (A_1); 174–175 °C (A_3); Vapor pressure = 1×10^{-5} mmHg @ 25 °C. These substances are complex 9-membered (2 oxygens and 7 carbons) ring derivatives with complex side chains. Hazard Identification (based on NFPA-704 M Rating System): Health 3, Flammability 0, Reactivity 0. Insoluble in water.

Permissible Exposure Limits in Air: Protective Action Criteria (PAC) Ver. 27[89]

PAC-1: 0.16 mg/m^3
PAC-2: 1.8 mg/m^3
PAC-3: 5.5 mg/m^3

Permissible Concentration in Water: Runoff from spills or fire control may cause water pollution.

Routes of Entry: Ingestion and intramuscular

Harmful Effects and Symptoms

Short Term Exposure: Subcutaneous, intravenous, and intraperitoneal route poisons. Moderately toxic by ingestion and intramuscular routes. LD_{50} (oral rat) = <1 to 28 mg/kg(9); LD_{50} (dermal, rat) = 25 mg/kg.

Long Term Exposure: May be mutagenic[9].

Points of Attack: Reproductive system, DNA

Medical Surveillance: In addition to comprehensive initial medical and work histories emphasizing reproductive experience and menstrual history, patient should have physical examination and testing of genito-urinary tract, sperm count, motility and morphology. If required, other tests, such as serum testosterone, serum follicle stimulating hormone (FSH), and serum lutenizing hormone (LH), may be indicated.

First Aid: If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least 15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately. If this chemical contacts the skin, remove contaminated clothing and wash immediately with soap and water. Seek medical attention immediately. If this chemical has been inhaled, remove from exposure, begin rescue breathing (using universal precautions) if breathing has stopped, and CPR if heart action has stopped. Transfer promptly to a medical facility. When this chemical has been swallowed, get medical attention. Give large quantities of water and induce vomiting. Do not make an unconscious person vomit.

Personal Protective Methods: Wear protective gloves and clothing to prevent any reasonable probability of dermal and/or eye contact. Safety equipment suppliers/manufacturers can provide recommendations on the most protective glove/clothing material for your operation. All protective clothing (suits, gloves, footwear, headgear) should be clean, available each day, and put on before work. Contact lenses should not be worn when working with this chemical. Wear dust-proof chemical goggles and face shield unless full facepiece respiratory protection is worn. Employees should wash immediately with soap when skin is wet or contaminated. Provide emergency showers and eyewash.

Respirator Selection: SCBA >0.16 mg/m^3. Wherever and whenever workplace conditions warrant respirator use, a respiratory protection program must be followed that meets one or more of the following government standards: OSHA's 29 CFR 1910.134, ANSI Z88.2, or European Standard EN 149.

Storage: Color Code-Blue: Health Hazard/Poison. Store in a secure poison location. Prior to working with this chemical you should be trained on its proper handling and storage. Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: Toxic, solids, organic, n.o.s. require a label of "poisonous materials." This material falls in Hazard Class 6.1 and Packing Group III.

Spill Handling: As an immediate precautionary measure, isolate spill or leak area in all directions for at least 50 meters/150 feet for liquids and at least 25 meters/75 feet for solids. Increase, in the downwind direction, as necessary, the isolation distance shown above. Eliminate all ignition sources (no smoking, flares, sparks or flames in immediate area). Do not touch damaged containers or spilled material unless wearing appropriate protective clothing. Stop leak if you can do it without risk. Prevent entry into waterways, sewers, basements or confined areas. Absorb or cover with dry earth, sand or other non-combustible material and transfer to containers. Do not get water inside containers.

Fire Extinguishing: Hazardous decomposition includes nitrogen oxides. *Fire involving storage or vehicular tanks: isolate* for 800 meters/0.5 mile in all directions; also, consider initial evacuation for 800 meters/0.5 mile in all directions. *Small fire*: dry chemical, carbon dioxide or water spray. *Large fire:* dry chemical, carbon dioxide, alcohol-resistant foam or water spray. Move containers from fire area if you can do it without risk. Dike fire-control water for later disposal; do not scatter the material. *Fire involving tanks or car/trailer loads*: fight fire from maximum distance or use unmanned hose holders or monitor nozzles. Do not get water inside containers. Cool containers with flooding quantities of water until well after fire is out. Withdraw immediately in the case of rising sound from venting safety devices or discoloration of tank. Always stay away from tanks engulfed in fire. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies.

Disposal Method Suggested: In accordance with 40CFR165, follow recommendations for the disposal of pesticides and pesticide containers. Containers must be disposed of properly by following package label directions or by contacting your local or federal environmental control agency, or by contacting your regional EPA office.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- USEPA, "Chemical Profile: Antimycin A," Washington DC, Chemical Emergency Preparedness Program (November 30, 1987)
- USEPA, *Reregistration Eligibility Decision for Antimycin A*, EPA 738-R-07-007, Washington DC (May 2007)

Atrazine A:1610

Use Type: Herbicide, Plant growth regulator

CAS Number: 1912-24-9

Formula: $C_8H_{14}ClN_5$

Synonyms: 2-Chloro-4-ethylamineisopropylamine-*s*-triazine; 1-Chloro-3-ethylamino-5-isopropylamino-*S*-triazine; 1-Chloro-3-ethylamino-5-isopropylamino-2,4,6-triazine; 2-Chloro-4-ethylamino-6-isopropylamino-*S*-triazine; 2-Chloro-4-ethylamino-6-isopropylamino-1,3,5-triazine; 6-Chloro-*N*-ethyl-*N*'-(1-methylethyl)-1,3,5-triazine-2,4-diamine; 2-Chloro-4-ethylamono-6-isopropylamino-; 6-Chloro-*N*-ethyl-*N*-isopropyl-1,3,5-triazinediyl-2,4-diamine; 2-Chloro-4-(2-propylamino)-6-ethylamino-*S*-triazine;2-Ethylamino-4-isopropylamino-6-chloro-*S*-triazine; NSC 163046; Penatrol; *S*-Triazine, 2-chloro-4-(ethylamino)-6-(isopropylamino)-; 1,3,5-Triazine-2,4-diamine, 6-chloro-*N*-ethyl-*N*-(1-methylethyl)-

Trade Names: AI3-28244®; AATRAM®; AATREX®; ACTINITE PK®; ACTINIT A®; AGIMIX® Atrazine; AKTIKON®; AKTIKON PK®; AKTINIT A®; ALAZINE®; ARGEZIN®; ATAZINAX®; ATERBUTEX®; ATERBUTOX®; ATLAS ATRAZINE®; ATLAZIN D-WEED®; ATRANEX®; ATRASINE®; ATRATAF®; ATRATOL®; ATRAZINEK®; ATRAZINE 90DF®; ATREX®; AXIOM® Atrazine; AZINOTOX®; BICEP®; BLADEX/ATRAZINE (2:1) 80W®[C]; BUCTRIL+ATRAZINE GEL®[C]; CANDEX®; CEKUZINA-T®; CHROMOZIN®; CO-OP ATRAZINE®[C]; CRISATRINA®; CRISAZINE®; CYAZIN®; DOW ATRAZINE 80W HERBICIDE®[C]; ERUNIT 500 FW®; FARMCO® ATRAZINE; FENAMIN®; FENATROL®[C]; FIELD MASTER®; FLOWABLE ATRAZINE®; G 30027®; GEIGY 30,027®; GESAPRIM®; GESOPRIM®; GRIFFEX®; GRIFFIN ATRAZINE 90 DRY FLOWABLE HERBICIDE®[C]; HAVILAND ATRAZINE LINURON WEED KILLER®[C]; HELENA ATRAZINE TECHNICAL®[C]; GUARDSMAN® herbicide (mixture of atrazine and dimethenamid); HELENA BRAND ATRAZINE®[C]; HERBATOXOL®; HERBIMIX SC®; HERBITRIN 500 BR®; HUNGAZIN®; INAKOR®; LADDOK®; LANCO ATRAZINE®[C]; LARIAT®; LEADOFF®; MAGIC CARPET FERTILIZER WITH ATRAZINE®[C]; MALLET PM BROMOXYNIL, ATRAZINE BROADLEAF HERBICIDE®[C]; MARKSMAN®; MARZONE ATRAZINE®[C]; MITAC®; NEW CHLOREA®; NU-TRAZINE 900 DF®; NU-ZINOLE AA®; OLEOGESAPRIM®; PATRIOT®; PITEZIN®; POSMIL®; PRIMATOP®; PRIMOLE®; PROKIL ATRAZINE 80W®[C]; RADAZIN®; RADIZINE®; READY MASTER®; RESIDOX®; SHELL® ATRAZINE 80W HERBICIDE[C]; SIMAZAT®; STRAZINE® TRIAZINE A 1294; TRIPART® ATRAZINE 50 SC; VECTAL®; WEEDEX®; WONUK®; ZEAZIN®; ZEAZINE®

Chemical Class: Triazine

EPA/OPP PC Code: 080803

California DPR Chemical Code: 00045

HSDB Number: 413

UN/NA & ERG Number: UN2763/151

RTECS® Number: XY5600000

EC Number: 217-617-8 [*Annex I Index No.:* 613-068-00-7]

Uses: Not approved for use in EU countries[115]. A U.S. EPA restricted Use Pesticide (RUP). In 2009 a report from the Natural Resources Defense Council (NRDC) reported that atrazine is the most commonly detected pesticide in U.S. waters. Atrazine is a selective pre- and post-emergence herbicide used for the control of broadleaf and grassy weeds in crops, such as corn (field and sweet), guava, hay, macadamia nuts, range grasses for the establishment of permanent grass cover on range lands and pastures in Oklahoma, Nebraska, Texas and Oregon, wheat, residential and recreational turf and sod farms, sorghum, sugarcane, pineapples, and Christmas trees and ornamentals. It is also used in forestry and, at higher application rates, for non-selective weed control in non-crop areas. It is the most widely used pesticide in the United States. Use data from 1900 to 1997 indicate that approximately 76.5 million pounds of atrazine active ingredient is used domestically each year. Certified herbicide workers may spread atrazine on crops or crop lands as a powder, liquid, or in a granular form. Atrazine is usually used in the spring and summer months. For it to be active, atrazine needs to dissolve in water and enter the plants through their roots. It then acts in the shoots and leaves of the weed to stop photosynthesis. Atrazine is taken up by all plants, but in plants not affected by atrazine it is broken down before it can have an effect on photosynthesis. Atrazine degrades into hydroxy compounds and chlorotriazine degradates. The application of atrazine to crops as a herbicide accounts for almost all of the atrazine that enters the environment, but some may be released from manufacture, formulation, transport, and disposal. Atrazine does not tend to accumulate in living organisms such as algae, bacteria, clams, or fish, and, therefore, does not tend to build up in the food chain. Atrazine can be applied by ground boom sprayer, aircraft, tractor-drawn spreader, rights-of-way sprayer, hand-held sprayer, backpack sprayer, lawn handgun, push-type spreader, and bellygrinder.

U.S. Maximum Allowable Residue Levels for Atrazine [40 CFR 180.220]: cattle, fat 0.02 ppm; cattle, meat 0.02 ppm; cattle, meat byproducts 0.02 ppm; corn, field, forage 15 ppm; corn, field, grain 0.20 ppm; corn, field, stover 0.5 ppm; corn, pop, forage 1.5 ppm; corn, pop, grain 0.20 ppm; corn, pop, stover 0.5 ppm; corn, sweet, forage 15 ppm; corn, sweet, kernel plus cob with husks removed 0.20 ppm; corn, sweet, stover 2.0 ppm; goat, fat 0.02 ppm; goat, meat 0.02 ppm; goat, meat byproducts 0.02 ppm; grass, forage 4.0 ppm; grass, hay 4.0 ppm; guava 0.05 ppm; horse, fat 0.02 ppm; horse, meat 0.02 ppm; horse, meat byproducts 0.02 ppm; milk 0.02 ppm; nut, macadamia 0.20 ppm; sheep, fat 0.02 ppm; sheep, meat 0.02 ppm; sheep, meat byproducts 0.02 ppm; sorghum, forage, forage 15 ppm; sorghum, grain forage 15 ppm; sorghum, grain, grain 0.20 ppm; sorghum, grain, stover 0.50 ppm; sugarcane, cane 0.20 ppm; wheat, forage 1.5 ppm; wheat, grain 0.10 ppm; wheat, hay 5.0 ppm; wheat, straw 0.50 ppm. ***[40 CFR 180.220 (d)]*** vegetable, leafy, except brassica, group 4, 0.25 ppm.

Human toxicity (long-term)[101]: High–3.00 ppb, MCL (Maximum Contaminant Level)

Fish toxicity (threshold)[101]: Intermediate–88.31816 ppb, MATC (Maximum Acceptable Toxicant Concentration)

Regulatory Authority and Advisory Information:

Carcinogenicity[83]: EPA, Not likely to be carcinogenic to humans; ACGIH A4, not classified as a human carcinogen.

Health Advisory: Nerve Toxin, Mutagen, Developmental/Reproductive Toxin, Skin irritant/sensitizer, Endocrine disruptor (Known)

Acute Oral Category: 3, CAUTION

Potential Ground Water Pollutant [California FAC Section 13149)

U.S. EPA TSCA Section 8(e) Risk Notification, 8EHQ-0892-8894

Safe Drinking Water Act: 40CFR141.61(c)5, MCL, 0.003 mg/L; 40CFR141.50(b)7, MCGL 0.003 mg/L; 40CFR142.62, Variances and Exceptions from the MCLs; 40CFR9352 Regulated Chemical; 40CFR141.24, Requirements for Sampling and Analytical Testing; 40CFR 141.32 Public Notification Requirements

CERCLA/SARA 40CFR372.65: Form R *de minimis* Concentration Reporting Level: 0.1%

European/International Regulations: Hazard Symbol: Xn, N; risk phrases R43; R48/22; R50/53; safety phrases: S2; S36/37; S60; S61 (see Appendix 1)

WGK (German Aquatic Hazard Class): 3-Severe hazard to waters

Description: Atrazine is a white, odorless, crystalline solid or powder. Commercial products are often mixed with a flammable liquid, such as methanol. Specific gravity (H_2O:1) = 1.19 @ 20 °C (solid); = 215.72; Boiling point = decomposes; Freezing/Melting point = 175–177 °C; Specific gravity (H_2O:1) = 1.19; Vapor pressure = 3×10^{-7}. Hazard Identification (based on NFPA-704 M Rating System): Health 1, Flammability 0, Reactivity 0; Solution in methanol: Health 2, Flammability 3, Reactivity 0. Slightly soluble in water; solubility 0.003%. Physical and toxicological properties may be affected by carrier solvents in commercial formulations.

Incompatibilities: Incompatible with oxidizers, acids, acid chlorides, acid halides, isocyanates, halogenated organics, peroxides, phenols (acidic), epoxides, anhydrides. Contact with strong reducing agents such as halides may generate a flammable gas.

Permissible Exposure Limits in Air: OSHA PEL: None

NIOSH REL: 5 mg/m^3 TWA

ACGIH TLV®[1]: 5 mg/m^3 TWA; not classifiable as a human carcinogen

No Protective Action Criteria (PAC) available.

DFG MAK: 2 mg/m^3, inhalable fraction TWA; Peak Limitation Category II(8) (2004)

Determination in Air: Use OSHA versatile sampler-2; Reagent; Gas chromatography/Electron capture detection; NIOSH #5602(18)

Permissible Concentration in Water: Federal Drinking Water Guidelines: EPA 3 μg/L; State Drinking Water Standards: California 1 μg/L; State Drinking Water Guidelines: Arizona 3 μg/L; Minnesota 3 μg/L.

Determination in Water: Analysis of atrazine is by a gas chromatographic (GC) method applicable to the determination of certain nitrogen-phosphorus-containing pesticides in water samples. In this method, approximately 1 L of sample is extracted with methylene chloride. The extract is concentrated, and the compounds are separated using capillary column GC. Measurement is made using a nitrogen phosphorus detector. The method detection limit has not been determined for this compound, but it is estimated that the detection limits for the method analytes are in the range of 0.1 to 2 μg/L. Log K_{ow} = >2.5. Values above 3.0 are likely to bioaccumulate in aquatic organisms.

Routes of Entry: Inhalation, dermal contact; passing through the unbroken skin

Harmful Effects and Symptoms

Short Term Exposure: Contact may cause congestion of heart, lungs and kidneys; low blood pressure; muscle spasms; weight loss; damage to adrenal glands, and skin and severe eye irritation. Because this material has a low vapor pressure, significant inhalation of vapors is unlikely at ordinary temperatures. LD_{50} (oral, rat) = 1900 mg/kg; LD_{50} (dermal, rat) = >3000 mg/kg.

Long Term Exposure: Atrazine interrupts regular hormone function, causing birth defects, reproductive tumors, and weight loss in mothers and embryos. Atrazine may cause skin sensitization and allergy. Atrazine has the potential to cause weight loss, cardiovascular damage, retinal and some muscle degeneration, and mammary tumors from a lifetime exposure at levels above the MCL. There is the increased risks for tumors known to be associated with hormonal factors. These have been observed in both animals and human beings, and are consistent with the known effects of atrazine on the hypothalamic pituitary gonadal axis. May be a neurotoxin.

Points of Attack: Eyes, skin, respiratory system, central nervous system, liver, kidneys. May cause reproductive and fetal effects.

Medical Surveillance: Evaluation by a qualified allergist. Examination of the nervous system. Preliminary medical exam to detect chronic diseases of central nervous system, liver, heart, kidneys, lung and skin, as well as endocrinological or immunological disturbances, should protect susceptible individuals. Periodical medical exams of internal organs, skin and eyes are important to avoid chronic occupational intoxications. They should include lab and patch tests when necessary[83]. In addition to comprehensive initial medical and work histories emphasizing reproductive experience and menstrual history, patient should have physical examination and testing of genito-urinary tract, sperm count, motility and morphology. If required, other tests, such as serum testosterone, serum follicle stimulating hormone (FSH), and serum lutenizing hormone (LH), may be indicated.

First Aid: If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least 15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately. If this chemical contacts the skin, remove contaminated clothing and wash immediately with soap and water. Seek medical attention immediately. If this chemical has been inhaled, remove from exposure, begin rescue breathing (using universal precautions) if breathing has stopped, and CPR if heart action has stopped. Transfer promptly to a medical facility. When this chemical has been swallowed, get medical attention. Give large quantities of water or milk and induce vomiting. Do not make an unconscious person vomit.

Personal Protective Methods: Applicators and other handlers must wear: Coveralls worn over long-sleeved shirt and long pants; Chemical-resistant gloves such as DuPont™ Tychem® suit fabrics, barrier laminate, or Viton®; Chemical-resistant footwear plus socks; Protective eye wear; Chemical-resistant headgear for overhead exposure;

Chemical-resistant apron when cleaning equipment, mixing, or loading[83]. Agricultural Use/Engineering Controls: When handlers use closed systems, enclosed cabs, or aircraft in a manner that meets the requirements listed in the Worker Protection Standard (WPS) for agricultural pesticides, ***40 CFR 170.240(d)(4-6),*** the handler PPE requirements may be reduced or modified as specified in the Worker Protection Standard. Firefighters should wear NIOSH-approved self-contained breathing apparatus and full protective clothing.

Respirator Selection: *At any concentrations above the NIOSH REL, or where there is no REL, at any detectable concentration:* SCBAF: Pd,Pp (APF = 10,000) (any NIOSH/MSHA- or European Standard EN 149-approved self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode); or SaF: Pd,Pp: ASCBA (APF = 10,000) (any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary, self-contained breathing apparatus operated in a pressure-demand or other positive-pressure mode).

Storage: Color Code-Blue: Health Hazard/Poison. Store in a secure poison location. Prior to working with this chemical you should be trained on its proper handling and storage. Should be stored in tightly closed containers away from strong acids. Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: Triazine pesticides, solid, toxic, n. o. s. require a shipping label of “poisonous materials.” Triazines fall in Hazard Class 6.1.

Spill Handling: First, remove all sources of ignition. Evacuate persons not wearing protective equipment from area of spill or leak until clean up is complete. Ventilate area of spill or leak. Collect spilled dry material in the most convenient and safe manner and deposit in sealed containers for reclamation or for disposal in an approved facility. Absorb liquid containing atrazine in vermiculite, dry sand, earth, or similar material. Treatment technologies which will remove atrazine from water include activated carbon adsorption, ion exchange, reverse osmosis, ozone oxidation and ultraviolet irradiation. Conventional treatment methods have been found to be ineffective for the removal of atrazine from drinking water. Limited data suggest that aeration would not be effective in atrazine removal. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable. Soil Adsorption Index K_{oc} = 100.

Fire Extinguishing: Hazardous decomposition includes hydrogen chloride and nitrogen oxide. Extinguish fire using an agent suitable for the type of surrounding fire; atrazine itself does not burn. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies. *On a small fire:* use dry chemical, CO_2 or water spray. *On a large fire:* use water spray, fog or regular foam. Move containers from fire area if you can do it without risk. Dike fire-control water for later disposal; do not scatter the material. Use water spray or fog; do not use straight streams. *Fire involving tanks or car/trailer loads:* isolate for 800 meters/0.5 mile in all directions; also, consider initial evacuation for 800 meters/0.5 mile in all directions. Fight fire from maximum distance or use unmanned hose holders or monitor nozzles. Do not get water inside containers. Cool containers with flooding quantities of water until well after fire is out. Withdraw immediately in the case of rising sound from venting safety devices or discoloration of tank. ALWAYS stay away from tanks engulfed in fire. For massive fire, use unmanned hose holders or monitor nozzles; if this is impossible, withdraw from area and let fire burn. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode.

Disposal Method Suggested: Atrazine is hydrolyzed by either acid or base. The hydroxy compounds are generally herbicidally inactive, but their complete environmental effects are uncertain. However, the method appears suitable for limited use and quantities of triazine. Atrazine underwent >99% decomposition when burned in a polyethylene bag, and combustion with a hydrocarbon fuel would appear to be a generally suitable method for small quantities. Combustion of larger quantities would probably require the use of a caustic wet scrubber to remove nitrogen oxides and HCl from the product gases.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- USEPA, Office of Pesticide Programs, 40 CFR 180.220, “Pesticide Residue Limits,” http://www.epa.gov/pesticides/food/viewtols.htm
- Federal Register Environmental Documents, EPA, http://www.epa.gov/fedrgstr/EPA-PEST/2002/July/Day-17/p17870.htm
- FIFRA Scientific Advisory Panel, June 2000
- ATSDR, U.S. Department of Health and Human Services, Public Health Service, “Managing Hazardous Materials Incidents,” Atlanta, GA (June 2003)
- Agency for Toxic Substances and Disease Registry (ASTDR), “Public Health Statement for Atrazine,” September, 2001. http://www.atsdr.cdc.gov/toxprofiles/phs153.htm
- Interim Reregistration Eligibility Decision for Atrazine, Case No. 0062, EPA, January 31, 2003. http://www.epa.gov/REDs/atrazine_ired.pdf

- "Summary of Atrazine Risk Assessment," EPA, May 2, 2002, http://www.epa.gov/oppsrrd1/reregistration/atrazine/index.htm
- New Jersey Department of Health and Senior Services, "Hazardous Substance Fact Sheet: Atrazine," Trenton, NJ (June 1998), http://www.state.nj.us/health/eoh/rtkweb/rtkhsfs.htm
- Wu, M., Quirindongo, M., Sass, J., Wetzler, A., *How the EPA is Ignoring Atrazine Contamination in Surface and Drinking Water in the Central United States*, Natural Resources Defense Council (NRDC), Chicago, IL (2009)
- USEPA, *Decision Document for Atrazine*, Washington DC (April 2006)

Auramine A:1620

Use Type: Fungicide

CAS Number: 492-80-8; 2465-27-2 (hydrochloride salt)

Formula: $C_{17}H_{21}N_3$; $(CH_3)_2N\text{-}C_6H_4CNH\text{-}C_6H_4\text{-}N(CH_3)_2$

Synonyms: Apyonine auramarine base; Auramina (Spanish); Auramine base; Auramine *N* base; Auramine OAF; Auramine O base; Auramine SS; Basic Yellow 2; Baso Yellow 124; Benzeneamine, 4,4'-cabonimidoyl-bis[*N*-dimethyl-; C. I. Solvent Yellow 34; Brilliant Oil Yellow; 4,4'-carbonimidoylbis(*N,N*-dimethylbenzenamine); C. I.41000B; C. I. Basic Yellow 2, free base; C. I. Solvent Yellow 34; 4,4'-Dimethylaminobenzophenonimide; Glauramine; 4,4-(Imidocarbonyl)bis(*N,N*-dimethylaniline); Tetramethyldiaminodiphenylacetimine; Yellow pyoctanine

Trade Names: WAXOLINE YELLOW O®

Chemical Class: Unclassified

EPA/OPP PC Code: 039501

California DPR Chemical Code: 702

HSDB Number: 2935

UN/NA & ERG Number: UN3077(solid)/171

RTECS® Number: BY3500000; BY3675000 (hydrochloride salt)

EC Number: 207-762-5 [*Annex I Index No.:* 612-096-00-7]; 219-567-2 Not listed in Annex I (*hydrochloride*)

Uses: Auramine is used industrially as a dye or dye intermediate for coloring textiles, paper, and leather. Also used as an antiseptic (a powerful antiseptic in ear and nose surgery and in gonorrhea treatment)

Regulatory Authority and Advisory Information:

Carcinogenicity[83]: IARC: Animal Sufficient Evidence, Human Sufficient Evidence, *carcinogenic to humans*, Group 1; *Technical grade*: Human Possibly Carcinogenic, *possibly carcinogenic to humans*, Group 2b, 1998

California Proposition 65 Chemical: Cancer (7/1/1987)

Health Advisory: Mutagen (*hydrochloride*)

U.S. EPA Hazardous Waste Number (RCRA No.): U014 (as C. I. Solvent Yellow 34)

Superfund/EPCRA 40CFR302.4, Appendix A, Reportable Quantity (RQ): 100 lb (45.4 kg)

CERCLA/SARA 40CFR372.65: Form R *de minimis* Concentration Reporting Level: 0.1%

European/International Regulations (*492-80-8 and salts*): Hazard Symbol: Xn, N; risk phrases: R22; R36; R40; R51/53; safety phrases: S2; S36/37; S61 (see Appendix 1)

Description: Auramine is a yellow crystalline powder or flaky material. Molecular weight = 267.4; 321.85 (*hydrochloride*) Freezing/Melting point = 136 °C. Hazard Identification (based on NFPA-704 M Rating System): Health 3, Flammability 1, Reactivity 0; (*hydrochloride*) Health 3, Flammability 0, Reactivity 0. Insoluble in water.

Incompatibilities: Strong oxidizers. Emits nitrogen oxides and hydrogen chloride when heated to decomposition

Permissible Exposure Limits in Air: Protective Action Criteria (PAC) ver.27

2465-27-2

PAC-1: 0.49 mg/m^3
PAC-2: 5.4 mg/m^3
PAC-3: 53 mg/m^3

technical grade and hydrochloride

DFG MAK: [skin] Carcinogen Category 2

No numerical occupational exposure limits (OELs) have been established. However, auramine may be a carcinogen; there may be no safe level of exposure. This chemical can be absorbed through the skin, thereby increasing the potential for exposure. Zero in New York, North Dakota[60] in ambient air.

Permissible Concentration in Water: Runoff from spills or fire control may cause water pollution.

Routes of Entry: Inhalation, ingestion, skin absorption. Low-level dermal exposure to the consumer may occur but would be limited to any migration of auramine from fabric, leather, or paper goods.

Harmful Effects and Symptoms

Short Term Exposure: Contact can irritate the eyes, and may cause damage. Skin absorption may result in dermatitis and burns, nausea and vomiting.

Long Term Exposure: Commercial auramine is carcinogenic in mice and rats after oral administration, producing liver tumors, and after subcutaneous injection in rats, producing local sarcomas. May cause reproductive and fetal effects.

Points of Attack: Liver, bladder. Reproductive cells.

Medical Surveillance: This chemical is a suspected or known human carcinogen. Exposed persons should contact a physician for advice regarding the possible long term health effects and advice for medical monitoring. Monthly urinalysis. Physical exam every 6 months focused on bladder.

First Aid: If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least 15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately. If this chemical contacts the skin, remove contaminated clothing and wash immediately with soap and water. Seek medical attention immediately. If this chemical has been inhaled, remove from exposure, begin rescue breathing (using universal precautions) if breathing has stopped, and CPR if heart action has stopped. Transfer promptly to a medical facility. When this chemical has been swallowed, get medical attention.

Give large quantities of water and induce vomiting. Do not make an unconscious person vomit.

Personal Protective Methods: Wear protective gloves and clothing to prevent any reasonable probability of dermal and/or eye contact. Safety equipment suppliers/manufacturers can provide recommendations on the most protective glove/clothing material for your operation. All protective clothing (suits, gloves, footwear, headgear) should be clean, available each day, and put on before work. Contact lenses should not be worn when working with this chemical. Wear dust-proof chemical goggles and face shield unless full facepiece respiratory protection is worn. Employees should wash immediately with soap when skin is wet or contaminated. Provide emergency showers and eyewash.

Respirator Selection: Engineering controls should be used wherever feasible to maintain airborne concentrations of this chemical below the prescribed exposure limit. Respirators and protective equipment are less effective than engineering controls, and should be used only in non-routine or emergency situations which may result in exposure concentrations in excess of the TWA environmental limit. *Where there is no REL, at any detectable concentration:* SCBAF: Pd,Pp (APF = 10,000) (any NIOSH/MSHA- or European Standard EN 149-approved self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode); or SaF: Pd,Pp: ASCBA (APF = 10,000) (any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary, self-contained breathing apparatus operated in a pressure-demand or other positive-pressure mode).

Storage: Color Code-Blue: Health Hazard/Poison. Store in a secure poison location. Prior to working with auramine you should be trained on its proper handling and storage. Store in tightly closed containers in a cool, well-ventilated area away from oxidizers. A regulated, marked area should be established where this chemical is handled, used, or stored in compliance with OSHA Standard 1910.1045. Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: Toxic, solids, organic, n.o.s. require a label of "poisonous materials." This material falls in Hazard Class 6.1 and Packing Group I or II.

Spill Handling: First, remove all sources of ignition. Evacuate persons not wearing protective equipment from area of spill or leak until clean up is complete. Cover with sand and soda ash. Collect powdered material in the most convenient and safe manner and deposit in sealed containers. Ventilate area after clean up is complete. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable.

Fire Extinguishing: Hazardous decomposition includes oxides of nitrogen and carbon. As an immediate precautionary measure, isolate spill or leak area in all directions for at least 50 meters/150 feet for liquids and at least 25 meters/75 feet for solids. *Fire involving storage or vehicular tanks:* isolate for 800 meters/0.5 mile in all directions; also, consider initial evacuation for 800 meters (0.5 mile) in all directions. *On a small fire:* use dry chemical, CO_2, water spray or regular foam. *On a large fire:* use water spray, fog or regular foam. Do not scatter spilled material with high-pressure streams of water. Move containers from fire area if you can do it without risk. Dike fire-control water for later disposal. *Fire involving tanks:* from a secure explosion-proof location, use water spray to cool exposed containers. If cooling streams are ineffective (venting sound increases in volume and pitch, tank discolors, or shows any signs of deforming), withdraw immediately to a secure position. Always stay away from tanks engulfed in fire. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode.

Disposal Method Suggested: Consult with environmental regulatory agencies for guidance on acceptable disposal practices. Generators of waste containing this contaminant (≥100 kg/mo) must conform with EPA regulations governing storage, transportation, treatment, and waste disposal. Incinerate in furnace with afterburner and scrubber[24].

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- Sax, N. I., Ed., "Dangerous Properties of Industrial Materials Report" 1, No. 5, 37-38 (1981)
- New Jersey Department of Health and Senior Services, Hazardous Substance Fact Sheet, "Auramine," Trenton, NJ (April 1997, rev. February 2004). http://www.state.nj.us/health/eoh/rtkweb/2894.pdf

Azadirachtin A:1625

Use Type: Insecticides, Nematicide

CAS Number: 11141-17-6

Formula: $C_{35}H_{44}O_{16}$

Synonyms: Azadirachtin A; Dimethyl (3S,3aR,4S,5S,5aR,5a + 1R,7aS,8R,10S,10aS)-8-acetoxy-3,3a,4,5,5a,5a + 1,7a,8,9,10-decahydro-3,5-dihydroxy-4-

((1S,3S,7S,8R,9S,11R)-7-hydroxy-9-methyl-2,4,10-trioxatetracyclo(6.3.1.0 + 3.7.0 + 9.11) dodec-5-en-11-yl)-4-methyl-10((E)-2-methylbuy-2-enoyloxy)-1H,7H-naphtho(1,8a,8-bc:4,4a-c')difuran-3,7a-dicarboxylate; Dimethyl (2aR-(2aalpha,3beta,4beta(1aR*,2S*,3aS*,6aS*,7S*,7aS*),4abeta,5alpha,7aS*,8beta(E),10beta,10aalpha,10bbeta))-10-(acetyloxy)octahydro-3,5-dihydroxy-4-methyl-8-((2-methyl-1-oxo-2-butenyl)oxy)-4-(3a,6a,7,7a-tetrahydro-6a-hydroxy-7a-methyl-2,7-methanofuro(2,3-b)oxireno(e)oxepin-1a(2H)-yl)-1H,7H-naphtho(1,8-bc:4,4a-c')difuran-5,10a(8H)-dicarboxylate

Trade Names: ALIGN®; AZATIN EC®; AZATIN®-XL PLUS; AZATROL EC®; AMAZIN® ECOZIN® EI-783®; MARGOSAN-O®; NEEM®; NEEMAZAL®; ORNAZIN® SALANNIN®; SUPERNEEM®; TURPLEX®

Chemical Class: Tetranortriterpenoid; Botanical

EPA/OPP PC Code: 121701

California DPR Chemical Code: 2328

HSDB Number: 7372

UN/NA & ERG Number: UN3077(solid)/171

Uses: Azadirachtin is an extract of fruit from the Neem tree, which is largely grown in India. It is used as a commercial insect growth regulator that controls the metamorphosis process as the insect passes from the larva stage to the pupa stage. The Neem tree also yields extracts from its bark, leaves and wood that are used in medicine and cosmetics.

U.S. Maximum Allowable Residue Levels for Azadirachtin 40 CFR 180.1119]: An exemption from the requirement of a tolerance is established for the biochemical azadirachtin, which is isolated from the berries of the Neem tree (*Azadirachta indica*), when used as a pesticide at 20 grams or less per acre on all raw agricultural commodities.

Human toxicity (long-term)[101]: Very low–225.00 ppb, Health Advisory

Fish toxicity (threshold)[101]: High–4.46000 ppb, MATC (Maximum Acceptable Toxicant Concentration)

Regulatory Authority and Advisory Information: Acute Oral Category: 4, Caution

Description: Light beige to yellowish microcrystalline solid or powder. A yellow to amber viscous liquid. Strong onion or garlic odor. Characteristic odor. Molecular weight = 720.69; Specific gravity (H_2O:1) = 1.508 @ 20 °C; Boiling point = >750 °C; Freezing/Melting point = 155–158 °C; Flash point = 245 °C; Henry's Law constant = 2.8×10^{-25} atm-m^3/mole @ 25 °C (est)[83]. Low solubility in water.

Determination in Water: Log K_{ow} = <1.5. Unlikely to bioaccumulate in marine organisms.

Harmful Effects and Symptoms

Neem seed oil is used as a traditional remedy in India and Malaysia, where it has caused poisoning (sometimes fatal), occasional diarrhea, nausea and general discomfort when given orally as an anthelmintic.

Five to ten ml of the oil given orally to children against minor ailments caused vomiting, drowsiness, tachypnea with acidotic respiration, and polymorphonuclear leukocytosis, and encephalopathy developed within hours of ingestion. Seizures, associated with coma, developed in some cases. Autopsy demonstrated pronounced fatty acid infiltration of the liver and proximal renal tubules, with mitochondrial damage, and cerebral edema, changes consistent with Reye's syndrome[Krieger].

Short Term Exposure: Contact with eyes or skin may cause irritation or injury. Inhalation should be avoided. LD_{50} (oral, rat) = >4 g/kg; LD_{50} (dermal, rat) = >2 g/kg.

Long Term Exposure: Toxicological properties of this chemical have not been fully investigated.

First Aid: If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least 15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately. If this chemical contacts the skin, remove contaminated clothing and wash immediately with soap and water. Seek medical attention immediately. If this chemical has been inhaled, remove from exposure, begin rescue breathing (using universal precautions) if breathing has stopped, and CPR if heart action has stopped. Transfer promptly to a medical facility. When this chemical has been swallowed, get medical attention. *Do not induce vomiting when formulations containing petroleum solvents are ingested*. Otherwise, give large quantities of water and induce vomiting. Do not make an unconscious person vomit.

Personal Protective Methods: Applicators and other handlers must wear: Coveralls worn over long-sleeved shirt and long pants; Chemical-resistant gloves such as DuPont™ Tychem® suit fabrics, barrier laminate, or Viton®; Chemical-resistant footwear plus socks; Protective eye wear; Chemical-resistant headgear for overhead exposure; Chemical-resistant apron when cleaning equipment, mixing, or loading[83]. Agricultural Use/Engineering Controls: When handlers use closed systems, enclosed cabs, or aircraft in a manner that meets the requirements listed in the Worker Protection Standard (WPS) for agricultural pesticides, ***40 CFR 170.240(d)(4-6),*** the handler PPE requirements may be reduced or modified as specified in the Worker Protection Standard. Firefighters should wear NIOSH-approved self-contained breathing apparatus and full protective clothing.

Respirator Selection: Wherever and whenever workplace conditions warrant respirator use, a respiratory protection program must be followed that meets one or more of the following government standards: OSHA's 29 CFR 1910.134, ANSI Z88.2, or European Standard EN 149.

Storage: Color Code-Blue: Health Hazard/Poison. Store in a secure poison location. Prior to working with this chemical you should be trained on its proper handling and storage. Store in tightly closed containers in a cool, well-ventilated area. Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: This material may be classified as environmentally hazardous substances, solid or liquid, n. o. s. It usually falls in Hazard Class 9.

Spill Handling: First, remove all sources of ignition. Evacuate persons not wearing protective equipment from area of spill or leak until clean up is complete. Ventilate area of spill or leak. Use water spray to reduce vapor. Absorb liquids in vermiculite, dry sand, earth, or a similar material and deposit in sealed containers. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable.

Fire Extinguishing: Hazardous decomposition includes oxides of carbon. As an immediate precautionary measure, isolate spill or leak area in all directions for at least 50 meters/150 feet for liquids and at least 25 meters/75 feet for solids. *Fire involving storage or vehicular tanks:* isolate for 800 meters/0.5 mile in all directions; also, consider initial evacuation for 800 meters/0.5 mile in all directions. *On a small fire:* use dry chemical, CO_2, water spray or regular foam. *On a large fire:* use water spray, fog or regular foam. Do not scatter spilled material with high-pressure streams of water. Move containers from fire area if you can do it without risk. Dike fire-control water for later disposal. *Fire involving tanks:* from a secure explosion-proof location, use water spray to cool exposed containers. If cooling streams are ineffective (venting sound increases in volume and pitch, tank discolors, or shows any signs of deforming), withdraw immediately to a secure position. Always stay away from tanks engulfed in fire. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode.

Disposal Method Suggested: Incineration. In accordance with 40CFR165, follow recommendations for the disposal of pesticides and pesticide containers.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- EXTOXNET, Extension Toxicology Network, “Pesticide Information Profile, Azadirachtin,” Oregon State University, Corvallis, OR. http://extoxnet.orst.edu/pips/azadirac.htm
- USEPA, Office of Pesticide Programs, Pesticide Residue Limits, “Azadirachtin,” 40 CFR 180.1119. http://www.epa.gov/pesticides/food/viewtols.htm
- Krieger, R. (ed.). Handbook of Pesticide Toxicology. Volume 2, 2nd edition, p 1822. Academic Press, San Diego, California. (2001)

Azinphos-methyl A:1650

Use Type: Insecticide, Acaricide

CAS Number: 86-50-0

Formula: $C_{10}H_{12}N_3O_3PS_2$

Synonyms: Benzotriazine derivative of a methyl dithiophosphate; Benzotriazinedithiophosphoric acid dimethoxy ester; DBD; *S*-(3,4-Dihydro-4-oxobenzo [*a*][1,2,3] triazin-3-ylmethyl) *O,O*-dimethyl phosphorodithioate; *S*-(3,4-Dihydro-4-oxobenzol[d][1,2,3]triazin-3-ylmethyl) *O,O*-dimethyl phosphorodithioate; *S*-(3,4-Dihydro-4-oxo-1,2,3-benzotriazin-3-ylmethyl) *O,O*-dimethyl hosphorodithioate; Dimethoxy ester of (4-*oxo*-1,2,3-benzotriazin-3(4*H*)-yl) methyl ester of dithiophosphoric acid; *O,O*-Dimethyl-*S*-(1,2,3-bezotriazinyl-4-keto) methylphosphorodithioate; *O,O*-Dimethyl-*S*-(3,4-dihydro-4-keto-1,2,3-bezotriazinyl-3-methyl) dithiophosphate; *O,O*-Dimethyl-*S*-(4-oxo-1,2,3-bezotriazin-3(4H)-yl methyl)phosphorodithioate; Dimethyldithiophosphoric acid *N*-methylbenzazimide ester; *O,O*-Dimethyl-*S*-(4-oxo-3H-1,2,3-benzotriazine-3-methyl) phosphorodithioate; *O,O*-Dimethyl-*S*-(4-oxo-benzotriazino-3-methyl)phosphorodithioate; *O,O*-Dimethyl-*S*-(4-oxo-1,2,3-benzotriazino(3)-methyl) thiophosphorodithioate; *O,O*-Dimethyl-*S*-oxo-1,2,3-benzotriazin-3-(4H)-yl-methyl) phosphodithioate; Ent 23,233; 3-(Mercaptomethyl)-1,2,3-benzotriazin-4(3H)-one-*O,O*-dimethyl phosphorodithioate; 3-(Mercaptomethyl)-1,2,3-benzotriazin-4(3H)-one-*O,O*-dimethyl phosphorodithioate-*S*-ester; Methyl azinphos; *N*-methylbenzazimide, dimethyldithiophosphoric acid ester; Methyl guthion; NCI-C00066

Trade Names: ACIFON®; AZINPHOS-METHYL GUTHION®; BAY 9027®; BAYER 17147®; CARFENE®; COTNION-METHYL®; CRYSTHION 2L®; CRYSTHYON®; DBD®; GOTHNION®; GUSATHION®; GUSATHION M®; GUTHION®; R 1582®

Chemical Class: Organophosphate

EPA/OPP PC Code: 058001

California DPR Chemical Code: 314

HSDB Number: 1171

UN/NA & ERG Number: UN2783 (solid)/152; UN3018 (liquid)/152

RTECS® Number: TE1925000

EC Number: 201-676-1 [*Annex I Index No.:* 015-039-00-9]

Uses: Not approved for use in EU countries[115]. Azinphos-methyl liquids with a concentration greater than 13.5% are classified as a U.S. Restricted Use Pesticides (RUP) Insecticide used to control certain chewing and sucking insects in forestry settings, on fruits and fruit trees, vines, nuts, vegetables, cereals, maize, cotton, ornamentals, soy beans, tobacco, rice, coffee, sugar cane, and other crops. Also used as an intermediate in the manufacture, formulation and application of insecticides and acaricides. There are 31 global suppliers[97].

U.S. Maximum Allowable Residue Levels for Azinphos-methyl [40 CFR 180.154 (a)]: in or on the following raw agricultural commodities: alfalfa 2.0 ppm; alfalfa, hay 5.0 ppm; almond 0.2 ppm; almond, hulls 5.0 ppm; apple 1.5 ppm; bean, snap, succulent 2.0 ppm; birdfoot trefoil 2.0 ppm; blackberry 2.0 ppm; blueberry 5.0 ppm; boysenberry 2.0 ppm; broccoli 2.0 ppm; Brussels sprouts 2.0 ppm; cabbage 2.0 ppm; cauliflower 2.0 ppm; celery 2.0 ppm; cherry 2.0 ppm; clover 2.0 ppm; clover, hay 5.0 ppm; cotton, undelinted seed 0.5 ppm; crabapple 1.5 ppm; cranberry 0.5 ppm; cucumber 2.0 ppm; eggplant 0.3 ppm; filbert 0.3 ppm; fruit, citrus, group 10, 2.0 ppm; grape 4.0 ppm; loganberry 2.0 ppm; melon 2.0 ppm; onion 2.0 ppm; parsley, leaves 5.0 ppm; parsley, turnip rooted, roots 2.0 ppm; peach 2.0 ppm; pear 1.5 ppm; pecan 0.3 ppm; pepper 0.3 ppm; pistachio 0.3 ppm; plum, prune 2.0 ppm; potato 0.2 ppm; quince 1.5 ppm; raspberry 2.0 ppm; spinach 2.0 ppm; strawberry 2.0 ppm; sugarcane, cane 0.3 ppm (Expiration/Revocation Date: 6/30/00); tomato, postharvest 2.0 ppm; trefoil, birdsfoot, hay 5.0 ppm; and walnut 0.3 ppm.

Human toxicity (long-term)[101]: Intermediate–10.50 ppb, Health Advisory

Fish toxicity (threshold)[101]: Extra high–0.28636 ppb, MATC (Maximum Acceptable Toxicant Concentration)

Regulatory Authority and Advisory Information:

Carcinogenicity[83]: EPA: Not likely to be carcinogenic to humans.

Acute Oral Category: 1, DANGER–POISON

Health Advisory: Nerve Toxin, Mutagen, Developmental/Reproductive Toxin.

Potential Ground Water Pollutant [California FAC Section 13145(d)/12811, active]

Clean Water Act: 40CFR116.4 Hazardous Substances; 40CFR117.3, RQ (same as CERCLA) as guthion

CERCLA/SARA 40CFR355, Extremely Hazardous Substances: TPQ = 100 /10,000 lb (45.4/4540 kg)

Superfund/EPCRA 40CFR302.4, Appendix A, Reportable Quantity (RQ): 1 lb (0.454 kg)

US DOT Regulated Marine Pollutant (49CFR172.101, appendix B) severe pollutant

US DOT 49CFR172.101, Inhalation Hazardous Chemical as organophosphates

European/International Regulations: Hazard Symbol: T+, T, Xi, N; risk phrases: R24; R26/28; R43; R50/53; safety phrases: S1/2; S28; S36/37; S45; S60; S61 (see Appendix 1)

WGK (German Aquatic Hazard Class): 3-Severe hazard to waters

Description: Azinphos-methyl is a brown, waxy solid or colorless, crystalline material. Its technical form is a brown waxy solid. There are various formulation types registered with the EPA, including ready-to-use, dusts, flowable concentrates, emulsifiable concentrates, wettable powders, granules, and water-dispersable granules. Molecular weight = 317.34; Specific gravity (H_2O:1) = 1.44 @ 20 °C; Boiling point = (decomposes); Freezing/Melting point = 72.8–73.9 °C; Vapor pressure = neglible @ 20 °C[83]. Hazard Identification (based on NFPA-704 M Rating System): Health 3, Flammability 0, Reactivity 0. Very low solubility in water; solubility = <1 mg/mL @ 19 °C. Physical and toxicological properties may be affected by carrier solvents in commercial formulations.

Incompatibilities: May be dissolved in flammable solvent; containers may explode at elevated temperatures. Incompatible with oxidizers, chlorates, nitrates, peroxides, sulfuric acid, caustics, ammonia, aliphatic amines, alkanolamines, isocyanates, alkylene oxides, epichlorohydrin. In the presence of strong reducing agents such as hydrides, organophosphates form highly toxic and flammable phosphine gas. Contact with oxidizers can cause the release of toxic oxides of phosphorus.

Permissible Exposure Limits in Air: NIOSH IDLH: 10 mg/m^3

OSHA PEL: 0.2 mg/m^3 TWA; [skin]

NIOSH REL: 0.2 mg/m^3 TWA; [skin]

ACGIH TLV®[1]: 0.2 mg/m^3 TWA; [skin], not classifiable as a human carcinogen; BEI: Cholinesterase activity in red cells = 70% of individual's baseline, sample time discretionary

Protective Action Criteria (PAC) Ver. 27[89]

PAC-1: 0.2 mg/m^3

PAC-2: 0.7 mg/m^3

PAC-3: 20 mg/m^3

DFG MAK: 0.2 mg/m^3, inhalable fraction; [skin] Peak limitation II(8)

Determination in Air: Collection by impinger or fritter bubbler, analysis by gas-liquid chromatography. OSHA versatile sampler-2; Toluene/Acetone; Gas chromatography/Flame photometric detection for sulfur, nitrogen, or phosphorus; NIOSH Method (IV) #5600, Organophosphorus pesticides.[18].

Permissible Concentration in Water: Federal Drinking Water Guidelines: 10 ppb[14]. State Drinking Water Guidelines: Maine 11 μg/L.

Determination in Water: Pesticide residue methods which should be applicable involve hydrolysis with KOH in isopropanol to give anthranilic acid, which is diazotized and coupled to give a measurable color. NIOSH Method 1657. The determination of organophosphorus pesticides in municipal and industrial wastewater by gas chromatography. Detection limit = 6.0 ng/L. Log K_{ow} = ~2.8–2.9. Values above 3.0 are likely to bioaccumulate in aquatic organisms.

Routes of Entry: Inhalation, skin absorption, ingestion, skin and/or eye contact

Harmful Effects and Symptoms

Organophosphates are highly toxic. Symptoms may develop rapidly, or there may be a delay of several hours following exposure before they become noticeable. The delay tends to be longer in the case of some compounds that dissolve fats, lipids, oils and non-polar solvents such as toluene. Symptoms may increase in severity for more than a single day and last for several days. In severe cases of organophosphate intoxication, respiratory failure may occur.

Short Term Exposure: Exposure can cause rapid, fatal organophosphorus poisoning. Inhalation can irritate the lungs, causing coughing and/or shortness of breath.

Higher exposures can cause pulmonary edema, a medical emergency that can be delayed for several hours. This can cause death. Organic phosphorus insecticides are absorbed by the skin, as well as by the respiratory and gastrointestinal tracts. They are cholinesterase inhibitors. Symptoms of exposure include headache, giddiness, blurred vision, nervousness, weakness, nausea, cramps, diarrhea, and discomfort in the chest. Signs include sweating, tearing, salivation, vomiting, cyanosis, convulsions, coma, loss of reflexes and loss of sphincter control. Delayed pulmonary edema may occur after inhalation. LD_{50} (oral, rat) = 4.6–11 mg/kg; LD_{50} (dermal, rat) = 175–220 mg/kg.

Long Term Exposure: Cholinesterase inhibitor; cumulative effect is possible. A neurotoxin; this chemical may damage the nervous system, causing weakness, "pins and needles," and poor coordination in arms and legs, with repeated exposure, resulting in convulsions, respiratory failure. May cause liver damage. Repeated exposure may cause personality changes of depression, anxiety, or irritability. May cause skin sensitization; tumors.

Points of Attack: Skin, respiratory system, lungs, central nervous system, cardiovascular system, blood cholinesterase.

Medical Surveillance: Medical observation is recommended for 24 to 48 hours following breathing overexposure, as pulmonary edema may be delayed. Routine biological monitoring of pesticide applicators and field workers includes testing of plasma and red blood cell acetylcholinesterase levels (for enzyme poisoned by this chemical). These tests are normally accurate only if done within about two hours of exposure. If exposure stops, plasma levels return to normal in 1–2 weeks while red blood cell levels may be reduced for 1–3 months. When acetylcholinesterase enzyme levels are reduced by 25% or more below preemployment levels, risk of poisoning is increased, even if results are in lower ranges of "normal." Reassignment to work not involving organophosphate pesticides is recommended until enzyme levels recover. Do not drink any alcoholic beverages before or during use as it promotes absorption of organophosphates. Evaluation by a qualified allergist, including exposure history and testing, may help diagnose allergy.

First Aid: **Treatment for organophosphate poisoning consists of thorough decontamination, cardiorespiratory support, and administration of the antidotes atropine and pralidoxime. In cases of severe poisoning, diazepam, an anticonvulsant, should also be administered. Antidotes should be administered as prevention even if the diagnosis is in doubt**. Speed in removing material from eyes and skin is of extreme importance. *Eyes:* Eye contact can cause dangerous amounts of these chemicals to be quickly absorbed through the mucous membrane into the bloodstream. Immediately and gently flush eyes with plenty of warm or cold water (NO hot water) for at least 15 minutes, occasionally lifting the upper and lower eyelids. Get medical aid immediately. *Skin:* Get medical aid. Dermal contact can cause dangerous amounts of these chemicals to be absorbed into the bloodstream. Wearing the appropriate PPE equipment and respirator for organophosphate/carbamate pesticides, immediately flush skin with plenty of soap and water for at least 15 minutes while removing contaminated clothing and shoes. Shampoo hair promptly if contaminated. The removed, contaminated clothing and shoes should be double-bagged and left in Hot Zone for later disposal by hazardous materials experts. Skin may also be decontaminated with diluted hypochlorite solution. *Inhalation:* Get medical aid. Do not contaminate yourself. Wearing the appropriate PPE equipment and respirator for organophosphate pesticides, immediately remove the victim from the contaminated area to fresh air. If the victim is not breathing, administer artificial respiration. Do not use mouth-to-mouth method if victim ingested or inhaled the substance; give artificial respiration with the aid of a pocket mask equipped with a one-way valve or other proper respiratory medical device. If breathing is difficult, administer oxygen through bag/mask apparatus until medical help arrives. Do not leave victim unattended. *Ingestion:* Call poison control. Loosen all clothing. Never give anything by mouth to an unconscious person. If victim is *unconscious or having convulsions,* do nothing except keep victim warm. Get medical aid. Transfer promptly to a medical facility. In cases of ingestion, **do not induce vomiting**. If the victim is alert and asymptomatic, administer a slurry of activated charcoal at a dose of 1 g/kg (infant, child, and adult dose). A soda can and straw may be of assistance when offering charcoal to a child. *In some cases you may be specifically instructed by poison control to induce vomiting by way of 2 tablespoons of syrup of ipecac (adult) washed down with a cup of water*. Do NOT give activated charcoal before or with ipecac syrup.

Note to physician or authorized medical personnel: Treat cases of respiratory compromise, coma, or excessive pulmonary secretions with respiratory support using protocols and techniques available and within the scope of training. Some cases may necessitate procedures such as endotracheal intubation or cricothyrotomy by properly trained and equipped personnel. When possible, atropine (see *Antidotes*, below) should be given under medical supervision. Patients who are comatose, hypotensive, or having seizures or cardiac arrhythmias should be treated according to advanced life support protocols. *Antidotes:* Two antidotes are administered to treat organophosphate poisoning. Atropine is a competitive antagonist of acetylcholine at muscarinic receptors and is used to control the excessive bronchial secretions which are often responsible for death. Pralidoxime relieves both the nicotinic and muscarine effects of organophosphate poisoning by regenerating acetylcholinesterase and can reduce both the bronchial secretions and the muscle weakness associated with poisoning. The initial intravenous dose of atropine in adults should be determined by the severity of symptoms: An initial adult dose of 1.0 to 2.0 mg or pediatric dose of 0.01 mg/kg (minimum 0.01 mg) should be administered intravenously. If intravenous access cannot be established, atropine may also be given intramuscularly, subcutaneously or via endotracheal tube. Doses should be repeated every 15 minutes until excessive secretions and sweating have been controlled. Once bronchial secretion has been controlled, atropine administration should be repeated whenever the secretions begin to recur. In seriously poisoned patients, very large doses may be required. Alterations of pulse rate and pupillary size should not be used as indicators of treatment adequacy. Pralidoxime should be administered as early in poisoning as possible as its efficacy may diminish when given more than 24 to 36 hours after exposure. Doses are as follows: adult 1.0 g; pediatric 25 to 50 mg/kg. The drug should be administered intravenously over 30 to 60 minutes, but in a life-threatening situation, one-half of the total dose can be given per minute for a total administration time of 2 minutes. Treatment should begin to take effect within 40 minutes with a reduction in symptoms and the amount of atropine necessary to control bronchial secretion. The initial dose can be repeated in 1 hour and then every 8 to 12 hours until the patient is clinically well and no longer requires atropine. If intravenous access cannot be established, pralidoxime may also be given intramuscularly. Early administration of diazepam in addition to the combined atropine and pralidoxime treatment may help prevent the onset of seizures and potential brain and cardiac morphologic damage following high-level organophosphate poisoning.

Personal Protective Methods: Wear protective gloves and clothing to prevent any reasonable probability of dermal and/or eye contact. Safety equipment suppliers/manufacturers can provide recommendations on the most protective glove/clothing material for your operation. One recommendation is the use of DuPont™ Tychem® suit fabrics[88]. All protective clothing (suits, gloves, footwear, headgear) should be clean, available each day, and put on before work. Contact lenses should not be worn when working with this chemical. Wear splash chemical goggles and face shield unless full facepiece respiratory protection is worn. Employees should wash immediately with soap when skin is wet or contaminated. Provide emergency showers and eyewash.

Respirator Selection: SCBA >0.2 mg/m^3. Engineering controls should be used wherever feasible to maintain airborne concentrations of this chemical below the prescribed exposure limit. Respirators and protective equipment are less effective than engineering controls, and should be used only in non-routine or emergency situations which may result in exposure concentrations in excess of the TWA environmental limit. *At any concentrations above the NIOSH REL, or where there is no REL, at any detectable concentration:* SCBAF: Pd,Pp (APF = 10,000) (any NIOSH/MSHA- or European Standard EN 149-approved self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode); or SaF: Pd,Pp: ASCBA (APF = 10,000) (any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary, self-contained breathing apparatus operated in a pressure-demand or other positive-pressure mode).

Storage: Color Code-Blue: Health Hazard/Poison. Store in a secure poison location. Prior to working with this chemical you should be trained on its proper handling and storage. Where possible, automatically transfer material from other storage containers to process containers. Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: Organophosphorus pesticides, solid or liquid, toxic, n. o. s. require a "poisonous materials" label. They usually fall in Hazard Class 6.1. STN: 49-215-26; Azinphos-methyl/Guthion (agricultural insecticides, not elsewhere classified, liquid); 49-215-27; Azinphos-methyl/Guthion(agricultural insecticides, not elsewhere classified, other than liquid); 49-215-28; Azinphos-methyl/Guthion(insecticides, other than agricultural, not elsewhere classified); 49-215-29; Azinphos-methyl mixture or Guthion mixture, liquid (agricultural insecticides, not elsewhere classified, liquid).

Spill Handling: First, remove all sources of ignition. Evacuate persons not wearing protective equipment from area of spill or leak until clean up is complete. Stay upwind; keep out of low areas. Ventilate area of spill or leak. Remove and isolate contaminated clothing at the site. Do not touch spilled material; stop leak if you can do so without risk. Use water spray to reduce vapors. *Small spills:* absorb with sand or other noncombustible absorbent material and place into containers for later disposal. *Large spills:* dike far ahead of spill for later disposal. Collect powdered material in the most convenient and safe manner and deposit in sealed containers. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable. Seek professional environmental engineering assistance from the U.S. EPA Environmental Response Team at (908) 548-8730 (24-hour response line).

Fire Extinguishing: Hazardous decomposition includes oxides of phosphorus, sulfur, and nitrogen. May be fatal if inhaled, ingested or absorbed through skin. Inhalation or contact with some of these materials will irritate or burn skin and eyes. Vapors may cause dizziness or suffocation. *Small fires:* dry chemical, carbon dioxide; water spray; or foam. *Large fires:* water spray, fog, or foam. Stay upwind; keep out of low areas. Ventilate closed spaces before entering them. Firefighting gear (including SCBA) may not provide adequate protection. If exposure occurs, remove and isolate gear immediately and thoroughly decontaminate personnel. Wear positive-pressure breathing apparatus and special protective clothing. Remove and isolate contaminated clothing at the site. Move container from fire area if you can do so without risk. Fight fire from maximum distance. Dike fire-control water for later disposal; do not scatter the material. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies. From a secure, explosion-proof location, use water spray to cool exposed containers. If cooling streams are ineffective (venting sound increases in volume and pitch, tank discolors, or shows any signs of deforming), withdraw immediately to a secure position. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode.

Disposal Method Suggested: Destruction by alkali hydrolysis or incineration. Containers must be disposed of properly by following package label directions or by contacting your local or federal environmental control agency, or by contacting your regional EPA office.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- USEPA, Office of Pesticide Programs, "Pesticide Residue Limits, Azinphos-methyl," 40 CFR 180.154. http://www.epa.gov/cgi-bin/oppsrch
- Sax, N. I., Ed., "Dangerous Properties of Industrial Materials Report" 3, No. 4, 60-65 (1983)
- USEPA, "Chemical Profile: Azinphos-Methyl," Chemical, Emergency Preparedness Program Washington DC (November 30, 1987)
- New York State Department of Health, "Chemical Fact Sheet: Guthion," Albany, NY, Bureau of Toxic Substance Assessment (March 1, 1986)
- Agency for Toxic Substances and Disease Registry, U.S. Department of Health and Human Services, Public Health Service, "Managing Hazardous Materials Incidents," Atlanta, GA (June 2003)
- New Jersey Department of Health and Senior Services, "Hazardous Substance Fact Sheet: Guthion," Trenton, NJ (May 1999). http://www.state.nj.us/health/eoh/rtkweb/0966.pdf
- USEPA, *Azinphos-Methyl* Interim Reregistration Eligibility Decision (IRED) *FACTS,* Washington DC (October 31, 2001)

Azoxystrobin A:1680

Use Type: Fungicide

CAS Number: 131860-33-8

Formula: $C_{22}H_{17}N_3O_5$

Synonyms: Azoksystrobin; Azoxistrobin; Azoxystrolin

Trade Names: ABOUND®; AMISTAR®; AMISTAR OPTI; AMISTAR PRO; BANKIT®; HERITAGE®; ICIA5504 80WG®; OLYMPUS®; ORTIVA®; PROTEGE®; PROTEGE-ALLEGIANCE WP®; PROTEGE-FL SEED APPLIED FUNGICIDE®; QUADRIS OPTI®; QUILT®; SOYGARD WITH PROTEGE®

Chemical Class: Strobilurin; β-Methoxyacrylates (derived from naturally occurring *strobilurins*)

EPA/OPP PC Code: 128810

California DPR Chemical Code: 4037

HSDB Number: 7017

UN/NA & ERG Number: UN3077 (solid)/171

EC Number: [*Annex I Index No.* 607-256-00-8]

Uses: Azoxystrobin has been processed as a Reduced Risk pesticide for Turf uses. Azoxystrobin is a systemic, broad-spectrum fungicide that was first introduced in 1998. It inhibits spore germination and is used on grape vines, cereals, potatoes, apples, bananas, citrus, tomatoes and other crops. Largest crop uses in California are on almonds, rice, pistachios, wine grapes, raisins and garlic. Among the diseases it controls are rusts, downey and powdery mildew, rice blast and apple scab. A U.S. EPA restricted Use Pesticide (RUP)

U.S. Maximum Allowable Residue Levels for Azoxystrobin [40 CFR 180.507 (a)]: acerola 2.0 ppm; almond, hulls 4.0 ppm; animal feed, nongrass, forage, group 18, 45 ppm animal feed, nongrass, hay, group 18, 120 ppm; artichoke, globe 4.0 ppm; asparagus 0.04 ppm; atemoya 2.0 ppm; avocado 2.0 ppm; banana (pre-harvest and post harvest) 2.0 ppm; (of which not more than 0.1 is contained in the pulp); barley, bran 6.0 ppm; barley, forage 25 ppm; barley, grain 3.0 ppm; barley, hay 15.0 ppm; barley, straw 7.0 ppm; biriba 2.0 ppm; brassica, head and stem, subgroup 5a, 3.0 ppm; brassica, leafy greens, subgroup 5b, 25 ppm; bushberry subgroup 13b, 3.0 ppm; caneberry subgroup 13a, 5.0 ppm; canistel 2.0 ppm; canola, seed 1.0 ppm; citrus, dried pulp 20.0 ppm; citrus, oil 40.0 ppm; cherimoya 2.0 ppm; coriander, leaves 30.0 ppm; corn, field, forage 12.0 ppm; corn, field, grain 0.05 ppm; corn, field, refined oil 0.3 ppm corn, field, stover 25.0 ppm; corn, pop, grain 0.05 ppm; corn, pop, stover 25.0 ppm; corn, sweet, forage 12.0 ppm; corn, sweet, kernel plus cob with husks removed 0.05 ppm; corn, sweet, stover 25.0 ppm; cotton, gin byproducts 45 ppm; cotton, undelinted seed 0.6 ppm; crambe, seed 0.5 ppm; cranberry 0.50 ppm; cucurbits 0.3 custard apple 2.0 ppm; feijoa 2.0 ppm; flax, seed 0.5 ppm; fruit, citrus, group 10, 10.0 ppm; fruit, stone 1.5 ppm; grain, aspirated fractions 420 ppm; grape 1.0 ppm; grass, forage 15 ppm; grass, hay 20 ppm; guava 2.0 ppm; herb subgroup 19a, dried leaves 260 ppm; herb subgroup 19a, fresh leaves 50 ppm; hop, dried cones 20.0 ppm; ilama 2.0 ppm; jaboticaba 2.0 ppm; jackfruit 2.0 ppm; juneberry 3.0 ppm; lingonberry 3.0 ppm; longan 2.0 ppm; loquat 2.0 ppm; lychee 2.0 ppm; mango 2.0 ppm; mustard, field, seed 0.5 ppm; mustard, indian, seed 0.5 ppm; mustard, seed 0.5 ppm; nut, tree, group 14, 0.02 ppm; okra 2.0 ppm; onion, bulb 1.0 ppm; onion, green 7.5 ppm; passionfruit 2.0 ppm; pawpaw 2.0 ppm; papaya 2.0 ppm; pea and bean, dried shelled, except soybean, subgroup 6c, 0.5 ppm; pea and bean, succulent shelled, subgroup 6b, 0.5 ppm; peanut 0.2 peanut, hay 15.0 ppm; peanut, refined oil 0.6 ppm;

pecan 0.01 ppm; peppermint, tops 30 ppm; persimmon 2.0 ppm; pistachio 0.50 ppm; potato 0.03 ppm; pulasan 2.0 ppm; rambutan 2.0 ppm; rapeseed, indian 0.5 ppm; rapeseed, seed 0.5 ppm; rice, grain 5.0 ppm; rice, hulls 20 ppm; rice, straw 12 rice, wild, grain 5.0 ppm; safflower, seed 0.5 ppm; salal 3.0 ppm; sapodilla 2.0 ppm; sapote, black 2.0 ppm; sapote, mamey 2.0 ppm; sapote, white 2.0 ppm; sorghum, forage 25 ppm; sorghum, grain 11 ppm; sorghum, stover 40 ppm; soursop 2.0 ppm; soybean, hay 55.0 ppm; soybean, hulls 1.0 ppm; soybean, seed 0.5 ppm; spanish lime 2.0 ppm; spearmint, tops 30 ppm; spice subgroup 19b, except black pepper 38 star apple 2.0 ppm; starfruit 2.0 ppm; strawberry 10 ppm; sugar apple 2.0 ppm; sunflower, seed 0.5 ppm; tamarind 2.0 ppm; tomato 0.2 ppm; tomato, paste 0.6 ppm; turnip, greens 25 ppm; vegetable, foliage of legume, group 7, 30.0 ppm; vegetable, fruiting, group 8 except tomato 2.0 ppm; vegetable, leafy, except brassica, group 4, 30.0 ppm; vegetable, leaves of root and tuber, group 2, 50.0 ppm; vegetable, legume, edible podded, subgroup 6a except soybean 3.0 ppm; vegetable, root, subgroup 1a, 0.5 ppm; vegetable, tuberous and corn, subgroup 1c, 0.03 ppm; watercress 3.0 ppm; wax jambu 2.0 ppm; wheat, bran 0.20 ppm; wheat, forage 25 ppm; wheat, grain 0.10 ppm; wheat, hay 15 ppm; wheat, straw 4.0 ppm. ***[40 CFR 180.507 (a) (2)]*** cattle, fat 0.03 ppm; cattle, meat 0.01 ppm; cattle, meat byproducts 0.07 ppm; goat, fat 0.03 ppm; goat, meat 0.01 ppm; goat, meat byproducts 0.07 ppm; hog, fat 0.010 ppm; hog, meat 0.01 ppm; hog, meat byproducts 0.010 ppm; horse, fat 0.03 ppm; horse, meat 0.01 ppm; horse, meat byproducts 0.07 ppm; milk 0.006 ppm; sheep, fat 0.03 ppm; sheep, meat 0.01 ppm; sheep, meat byproducts 0.07 ppm.

Human toxicity (long-term)[101]: Very low–1260.00 ppb, Health Advisory. Azoxystrobin is of low acute and chronic toxicity to humans, birds, mammals, and bees.[EPA]

Fish toxicity (threshold)[101]: Intermediate–54.86655 ppb, MATC (Maximum Acceptable Toxicant Concentration). Highly toxic to freshwater fish, freshwater invertebrates, and estuarine/marine fish, and very highly toxic to estuarine/marine invertebrates. The azoxystrobin degradate R234886 is practically nontoxic to Rainbow Trout and daphnids, while the degradates R402173 and R401553 may be slightly toxic to daphnids[83].

Regulatory Authority and Advisory Information:

Carcinogenicity[83]: EPA: Not likely to be carcinogenic to humans

Potential Ground Water Pollutant [California FAC Section 13145(d)/12811, active]

European/International Regulations: Hazard Symbol: T, N; risk phrases: R23; R50/53; safety phrases: S1/2; S22; S45; S60; S61 (see Appendix 1)

Description: Azoxystrobin is a white to beige crystalline solid. Odorless. Molecular weight = 403.38; Specific gravity (H_2O:1) = 1.384 @ 20 °C; Boiling point = >360[EU]; 581 °C; Freezing/Melting point = 116 °C; 118–119 °C; Vapor pressure = 8×10^{-13} mmHg @ 25 °C; pH = 7.14 (1% dispersion of Heritage fungicide); Low solubility in water; solubility = 6 mg/L.

Note: Boiling appears in the literature as 581, 581.3 and the EU listed it as "more than 360C."

Incompatibilities: Strong oxidizers. Dust may form explosive mixture with air.

Determination in Water: Log K_{ow} = ~ 3.0. Values above 3.0 are likely to bioaccumulate in aquatic organisms.

Routes of Entry: Dermal contact and inhalation

Harmful Effects and Symptoms

Short Term Exposure: Contact with eyes or skin may cause irritation or injury. Inhalation should be avoided; use NIOSH- or CEN (UK)-approved air-purifying respirators for pesticides. May be harmful if swallowed. May cause skin sensitization. LD_{50} (oral, rat) = >5 g/kg; LD_{50} (dermal, rat) = >2 g/kg.

Medical Surveillance: Evaluation by a qualified allergist, including exposure history and testing, may help diagnose allergy.

First Aid: If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least 15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately. If this chemical contacts the skin, remove contaminated clothing and wash immediately with soap and water. Seek medical attention immediately. If this chemical has been inhaled, remove from exposure, begin rescue breathing (using universal precautions) if breathing has stopped, and CPR if heart action has stopped. Transfer promptly to a medical facility. When this chemical has been swallowed, get medical attention. *Do not induce vomiting when formulations containing petroleum solvents are ingested*. Otherwise, give large quantities of water and induce vomiting. Do not make an unconscious person vomit.

Personal Protective Methods: Applicators and other handlers must wear: Coveralls worn over long-sleeved shirt and long pants; Chemical®-resistant gloves such as DuPont™ Tychem® suit fabrics, barrier laminate, or Viton®; Chemical-resistant footwear plus socks; Protective eye wear; Chemical-resistant headgear for overhead exposure; Chemical-resistant apron when cleaning equipment, mixing, or loading[83]. Agricultural Use/Engineering Controls: When handlers use closed systems, enclosed cabs, or aircraft in a manner that meets the requirements listed in the Worker Protection Standard (WPS) for agricultural pesticides, ***40 CFR 170.240(d)(4-6),*** the handler PPE requirements may be reduced or modified as specified in the Worker Protection Standard. Firefighters should wear NIOSH-approved self-contained breathing apparatus and full protective clothing.

Respirator Selection: Wherever and whenever workplace conditions warrant respirator use, a respiratory protection program must be followed that meets one or more of the following government standards: OSHA's 29 CFR 1910.134, ANSI Z88.2, or European Standard EN 149.

Storage: Color Code-Blue: Health Hazard/Poison: Store in a tightly closed container in a dry, well-ventilated and secure poison location. Prior to working with this chemical you should be trained on its proper handling and storage. Where possible, automatically transfer material from other storage containers to process containers. Chemically stable for at least 24 days at 54 °C.

Shipping: Varies with product being shipped: Toxic, solids, organic, n.o.s. require a label of "poisonous materials." This material falls in Hazard Class 6.1 and Packing Group III. Environmentally hazardous substances usually fall in Hazard Class 9.

Spill Handling: First, remove all sources of ignition. Evacuate persons not wearing protective equipment from area of spill or leak until clean up is complete. Cover with sand and soda ash. Collect powdered material in the most convenient and safe manner and deposit in sealed containers. Ventilate area after clean up is complete. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable.

Fire Extinguishing: Hazardous decomposition includes oxides of nitrogen and oxygen. As an immediate precautionary measure, isolate spill or leak area in all directions for at least 50 meters/150 feet for liquids and at least 25 meters/75 feet for solids. *Fire involving storage or vehicular tanks:* isolate for 800 meters/0.5 mile in all directions; also, consider initial evacuation for 800 meters (0.5 mile) in all directions. *On a small fire:* use dry chemical, CO_2, water spray or regular foam. *On a large fire:* use water spray, fog or regular foam. Do not scatter spilled material with high-pressure streams of water. Move containers from fire area if you can do it without risk. Dike fire-control water for later disposal. *Fire involving tanks:* from a secure explosion-proof location, use water spray to cool exposed containers. If cooling streams are ineffective (venting sound increases in volume and pitch, tank discolors, or shows any signs of deforming), withdraw immediately to a secure position. Always stay away from tanks engulfed in fire. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode.

Disposal Method Suggested: Do not discharge into drains or sewers. Dispose of waste material as hazardous waste using a licensed disposal contractor to an approved landfill. Consult with environmental regulatory agencies for guidance on acceptable disposal practices. Incineration with effluent gas scrubbing is recommended. Containers must be disposed of properly by following package label directions or by contacting your local or federal environmental control agency, or by contacting your regional EPA office.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- Pesticide Management Education Program, "Azoxystrobin," Cornell University, Ithaca, NY (October 1997). http://pmep.cce.cornell.edu/profiles/extoxnet/24d-captan/azoxystrobin-ext.html
- USEPA, Office of Pesticide Programs, Pesticide Residue Limits, "Azoxystrobin," 40 CFR 180.507. http://www.epa.gov/pesticides/food/viewtols.htm
- USEPA, Office of Prevention, Pesticides, and Toxic Substances, *Pesticide Fact Sheet*:"Azoxystrobin, Washington DC (February 1997)

B

Benfluralin B:0224

Use Type: Herbicide
CAS Number: 1861-40-1
Formula: $C_{13}H_{16}F_3N_3O_4$
Synonyms: Benefin; Benfluraline; Benzenamine; *N*-Butyl-*N*-ethyl-2,6-dinitro-4-(trifluoromethyl)-; *N*-Butyl-2,6-dinitro-*N*-ethyl-4-trifluoromethylaniline; *N*-Butyl-*N*-ethyl-2,6-dinitro-4-trifluoromethylbenzenamine; *N*-Butyl-*N*-ethyl-2,6-dinitro-4-(trifluromethyl)benzeneamine; *N*-Butyl-*N*-ethyl-2,6-dinitro-4-trifluoromethylaniline; *N*-Butyl-*N*-ethyl-*α,α,α*-trifluoro-2,6-dinitro-*p*-toluidine; Caswell No. 130; *p*-Toluidine,*N*-butyl-*N*-ethyl-*α,α,α*-trifluoro-2,6-dinitro-; *α,α,α*-Trifluoro-2,6-dinitro-*N,N*-ethylbutyl-*p*-toluidine
Trade Names: BALAN®; BALFIN®; BENEFEX®; BETHRODINE®; BHULAN®; BINNELL®; BONALAN®; CARPIDOR®; EL-110®; EMBLEM®; FLUBALEX®; PEL-TECH®; QUILAN®; TEAM; XL 2G
Chemical class: 2,6-Dinitroaniline
EPA/OPP PC Code: 084301
California DPR Chemical Code: 53
HSDB Number: 407 as benfluralin
UN/NA & ERG Number: UN1596 (Dinitroanilines)/153; UN3077(solid)/171
RTECS® Number: XU4550000
EC Number: 217-465-2
Uses: Selective pre-emergence herbicidal control of annual grasses and broad-leaf weeds. Used on alfalfa, red clover, seeded lettuce, trefoil; peanuts, certain tobaccos, vegetables such as endive, field and French beans and lentils.
U.S. Maximum Allowable Residue Levels for Benfluralin [(40 CFR 180.208 (a)]: alfalfa, forage 0.05 ppm (negligible); alfalfa, hay 0.05 ppm (negligible); alover, forage 0.05 ppm (negligible); alover, hay 0.05 ppm (negligible); lettuce 0.05 ppm (negligible); peanut 0.05 ppm (negligible); trefoil, birdsfoot, forage 0.05 ppm (negligible); trefoil, birdsfoot, hay 0.05 ppm.
Human toxicity (long-term)[101]: Very low–2100.00 ppb, Health Advisory
Fish toxicity (threshold)[101]: High–3.08219 ppb, MATC (Maximum Acceptable Toxicant Concentration)
Regulatory Authority and Advisory Information:
Carcinogenicity[83]: EPA, Suggestive evidence of carcinogenicity, but not sufficient to assess human carcinogenic potential
Health Advisory: Mutagen, Developmental/Reproductive Toxin, Skin irritant/sensitizer
Acute Oral Category: 4, Caution
EPCRA Section 313 Form R *de minimis* concentration reporting level: 1.0%
Description: Yellow-orange crystalline solid. Commercial product is available as an emulsifiable concentrate. Molecular weight = 335.31; Specific gravity (H_2O:1) = 1.278 @ 20 °C; Freezing/Melting point = 66 °C; Vapor pressure = 1×10^{-5} mmHg @ 20 °C; Flash point = <190 °C. Slightly soluble in water: solubility = 70 mg/L @ 25 °C; <1 mg/L @ 25 °C. Physical and toxicological properties may be affected by carrier solvents in commercial formulations.
Incompatibilities: Incompatible with strong oxidizers. Moderate heat causes decomposition that produces toxic vapors that can form an explosive mixture with air.
Permissible Concentration in Water: Runoff from spills or fire control may cause water pollution.
Determination in Water: Log K_{ow} = >4.5. Values above 3.0 are likely to bioaccumulate in aquatic organisms.
Routes of Entry: Ingestion, dermal contact; absorbed through the skin, inhalation of the dust or vapor when these materials are heated
Harmful Effects and Symptoms
Short Term Exposure: Severely irritates eyes, skin and respiratory tract, with burning sensation, pain, redness and swelling. Metabolic stimulant. If inhaled, causes coughing, dilated pupils, headache, profuse perspiration, intense thirst, extreme fatigue, rapid pulse, high fever, clammy, flushed skin, rapid breathing, nausea, vomiting, yellowish tint to skin and lips, anxiety and confusion, convulsions, risk of lung edema. If swallowed, face and lips turn bluish. Liver injury with associated jaundice, kidney failure, and cardiac arrhythmia is commonly noted. Because this material has a low vapor pressure, significant inhalation of vapors is unlikely at ordinary temperatures. Severe exposure can cause death from heart failure Dinitrobenzene materials are toxic to the blood; prevents hemoglobin from carrying oxygen. May be more toxic than aniline. LD_{50} (oral, rat) = >5 g/kg; LD_{50} (dermal, rat) = >5 g/kg.
Long Term Exposure: Fluorides may cause bone disease (pain and tenderness of the bones); mottled teeth in children. May damage the liver, kidneys and blood cells. This chemical may stain yellow the skin, eyes, and fingernails. Repeated exposure may cause anxiety, fatigue, insomnia, excessive perspiration, unusual thirst, weight loss and cataracts in the eyes. May affect the thyroid gland. May cause skin sensitization in some persons.
Points of Attack: Skin, bones, liver, kidneys, lungs, peripheral nervous system, eyes, thyroid gland, blood. May cause reproductive and fetal effects.
Medical Surveillance: Before beginning employment, at regular times after that and if symptoms develop or overexposure has occurred, the following may be useful: Exam of eyes for cataracts. Exam of skin and nails for staining. Liver and kidney function tests. Complete blood count.

Blood methemoglobin levels. Evaluation by a qualified allergist, including exposure history and testing, may help diagnose allergy.

First Aid: If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least 15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately. If this chemical contacts the skin, remove contaminated clothing and wash immediately with soap and water. Seek medical attention immediately. If this chemical has been inhaled, remove from exposure, begin rescue breathing (using universal precautions) if breathing has stopped, and CPR if heart action has stopped. Transfer promptly to a medical facility. When this chemical has been swallowed, get medical attention. *Do not induce vomiting when formulations containing petroleum solvents are ingested*. Otherwise, give large quantities of water and induce vomiting. Do not make an unconscious person vomit. *Note to Physician:* Treat for methemoglobinemia. Spectrophotometry may be required for precise determination of levels of methemoglobinemia in urine.

Personal Protective Methods: Dinitroanilines react with cellulose-based and expanded polymeric absorbents[88]. Wear protective gloves and clothing to prevent any reasonable probability of dermal and/or eye contact. Safety equipment suppliers/manufacturers can provide recommendations on the most protective glove/clothing material for your operation. All protective clothing (suits, gloves, footwear, headgear) should be clean, available each day, and put on before work. Contact lenses should not be worn when working with this chemical. Wear dust-proof chemical goggles and face shield unless full facepiece respiratory protection is worn. Employees should wash immediately with soap when skin is wet or contaminated. Provide emergency showers and eyewash.

Respirator Selection: Follow regulations in OSHA 29CFR1910.134 or European Standard EN149. Use a NIOSH/MSHA- or European Standard EN149-approved respirator; or use an approved supplied-air respirator with a full facepiece operated in the positive-pressure mode, or with a full facepiece, hood, or helmet in the continuous-flow mode; or use a NIOSH/MSHA- or European Standard EN149-approved self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive-pressure mode.

Storage: Color Code-Blue: Health Hazard/Poison: Store in a tightly closed container in a dry, well-ventilated and secure poison location. Prior to working with this chemical you should be trained on its proper handling and storage. Where possible, automatically transfer material from other storage containers to process containers. Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: Dinotroanilines require a label of "Poisonous material" and usually fall in Hazard Class 6.1. Environmentally hazardous substances, solid or liquid, usually fall in Hazard Class 9.

Spill Handling: First, remove all sources of ignition. Evacuate persons not wearing protective equipment from area of spill or leak until clean up is complete. Do not dry sweep. Collect powdered material in the most convenient and safe manner and deposit in sealed containers. Ventilate area after clean up is complete. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable.

Fire Extinguishing: Decomposition product includes oxides of nitrogen and carbon and hydrogen fluoride gas. This chemical is a combustible solid but does not readily ignite. Moderate heat causes decomposition that produces toxic vapors that form an explosive mixture with air. As an immediate precautionary measure, isolate spill or leak area in all directions for at least 50 meters/150 feet for liquids and at least 25 meters/75 feet for solids. *Fire involving storage or vehicular tanks:* isolate for 800 meters/0.5 mile in all directions; also, consider initial evacuation for 800 meters/0.5 mile in all directions. *On a small fire:* use dry chemical, CO_2, water spray or regular foam. *On a large fire:* use water spray, fog or regular foam. Do not scatter spilled material with high-pressure streams of water. Move containers from fire area if you can do it without risk. Dike fire-control water for later disposal. *Fire involving tanks:* from a secure, explosion-proof location, use water spray to cool exposed containers. If cooling streams are ineffective (venting sound increases in volume and pitch, tank discolors, or shows any signs of deforming), withdraw immediately to a secure position. Always stay away from tanks engulfed in fire. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode.

Disposal Method Suggested: Do not discharge into drains or sewers. Dispose of waste material as hazardous waste using a licensed disposal contractor to an approved landfill. Consult with environmental regulatory agencies for guidance on acceptable disposal practices. If allowed, incineration with effluent gas scrubbing is recommended. Containers must be disposed of properly by following package label directions or by contacting your local or federal environmental control agency, or by contacting your regional EPA office. Ultraviolet-radiation: This liquid herbicide is reported to be susceptible to decomposition by UV radiation[UN].

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- USEPA, Office of Pesticide Programs, Pesticide Residue Limits, "Benfluralin", 40 CFR 180.208. http://www.epa.gov/pesticides/food/viewtols.htm
- USEPA, *R.E.D. FACTS, Benfluralin*, EPA 738-F-04-007, Washington DC (July 31, 2004)

Benomyl B:0230

Use Type: Fungicide

CAS Number: 17804-35-2

Formula: $C_{14}H_{18}N_4O_3$

Synonyms: BBC; 2-Benzimidazolecarbamic acid, 1-(butylcarbamoyl)-, methyl ester; BNM; 1-(Butylamino) carbonyl-1*H*-benzimidazol-2-yl-, methyl ester; 1-(Butylcarbamoyl)-2-benzimidazolec arbamic acid, methyl ester; Carbamic acid, 1-(butylamino)carbonyl-1*H*-benzimidazol-2yl, methyl ester; Carbamic acid, methyl-, 1-(butylcarbamoyl)-2-benzimidazole ester; Caswell No. 075A; MBC; Methyl 1-(butylcarbamoyl)-2-benzimidazolyl carbamate

Trade Names: ABORTRINE®; AGROCITE®; ARILATE®; BBC 6597®; BENEX®; BENLAT®[C]; BENLATE®, withdrawn 5/7/01; BENLATE 50®; BENLATE 50W®; BENLATE 50WP®; BENOMYL® 50W; BENOSAN®; D 1991®[C]; F 1991®; FUNDAZOL®; FUNGICIDE 1991®; FUNGACIDE D-1991®; FUNGOCHROM®; TARSAN®; TERSAN®; TERSAN 1991®; UZGN®

Chemical class: Benzimidazole

EPA/OPP PC Code: 099101

California DPR Chemical Code: 1552

HSDB Number: 1655

UN/NA & ERG Number: UN3077 (solid)/171; UN1325 (flammable solid, organic)/133;

RTECS® Number: DD6475000

EC Number: 241-775-7 [*Annex I Index No.:* 613-049-00-3]

Uses: Used as a pre-harvest systemic fungicide and as a post-harvest dip. Used on arable and vegetable crops, apples, soft fruit, nuts, mushrooms, lettuce, tomatoes and turf. In California, the top five crops for which benomyl is used are pistachios, table and raisin grapes, almonds, strawberries and wine grapes. All uses of benomyl products in the United States was phased out with a deadline of December 31, 2003. Not approved for use in EU countries[115].

U.S. Maximum Allowable Residue Levels for Benomyl. and its metabolites containing the benzimidazole moiety (calculated as benomyl) (40 [CFR 180.294 (a)]: in or on the following raw agricultural commodities: almond hulls 1.0 ppm; apples (pre- and post-harvest) 7.0 ppm; apricots (pre- and post harvest) 15.0 ppm; bananas (pre- and post-harvest, not more than 0.2 ppm negligible residue, present in the pulp after the peel is removed and discarded) 1.0 ppm; barley, grain 0.2 ppm; barley, straw 0.2 ppm; beans 2.0 ppm; beans vine forage 50.0 ppm; beets, sugar, roots 0.2 ppm; beets, sugar, tops 15 ppm; blackberries 7.0 ppm; blueberries 7.0 ppm; boysenberries 7.0 ppm; broccoli 0.2 ppm, brussel sprouts 15.0 ppm; cabbage 0.2 ppm; carrots 0.2 ppm; cattle, fat 0.1 ppm; cattle, meat 0.1 ppm; cattle meat-by-products 0.1 ppm; cauliflower 0.2 ppm; celery 3.0 ppm; cherries (pre- and post-harvest) 15.0 ppm; Chinese cabbage 10.0 ppm; citrus, dried pulp 50.0 ppm; citrus fruit (pre- and post-harvest) 10.0 ppm; collards 0.2 ppm; corn, fresh (including kernel plus cob with husk removed) 0.2 ppm; corn, sweet fodder and forage 0.2 ppm; cucumbers 1.0 ppm; currants 7.0 ppm; dewberries 7.0 ppm; eggplants 0.2 ppm; eggs 0.1 ppm; garlic 0.2 ppm; goats, fat 0.1 ppm; goats, meat 0.1 ppm; goats, meat by-products 0.1 ppm; grapes 10.0 ppm; hogs, fat 0.1 ppm; hogs, meat 0.1 ppm; hogs, meat by-products 0.1 ppm; horses, fat 0.1 ppm; horses, meat 0.1 ppm; horses, meat by-products 0.1 ppm; kale 0.2 ppm, kohlrabi 0.2 ppm; loganberries 7.0 ppm; mangoes 3.0 ppm; melons 1.0 ppm; milk 0.1 ppm; mushrooms (pre- and post-harvest) 10.0 ppm; mustard greens 0.2 ppm; nectarines (pre- and post-harvest) 15.0 ppm; nuts 0.2 ppm (negligible residues); oats, grain 0.2 ppm; oats, straw 0.2 ppm; peaches (pre- and post-harvest) 15.0 ppm; peanuts 0.2 ppm; peanut forage 15.0 ppm; peanut hay 15.0 ppm; pears (pre- and post-harvest) 7.0 ppm; peppers 0.2 ppm; pineapples (post-harvest) 35.0 ppm; pistachios 0.2 ppm; plums (incl fresh prunes, pre- and post harvest) 15.0 ppm; poultry, fat 0.1 ppm; poultry, liver 0.2 ppm; poultry, meat 0.1 ppm; poultry, meat by-products 0.1 ppm; pumpkins 1.0 ppm; raisins 50.0 ppm; raspberries 7.0 ppm; rice 5.0 ppm; rice, hulls 20.0 ppm; rice straw 15.0 ppm; rutabagas 0.2 ppm; rye, grain 0.2 ppm; rye, straw 0.2 ppm; sheep, fat 0.1 ppm; sheep, meat 0.1 ppm; sheep, meat by-products 0.1 ppm; soybeans 0.2 ppm; spinach 0.2 ppm; squash, summer 1.0 ppm; squash, winter 1.0 ppm; strawberries 5.0 ppm; sweet potatoes 0.2 ppm; tomatoes 5.0 ppm; tomato products, concentrated 50.0 ppm; turnips, roots 0.2 ppm; wheat, grain 0.2 ppm; wheat, straw 15.0 ppm. ***Regional registration, as defined in section 180.1(n)* [*40 CFR 180.294(c)*]** in or on the following raw agricultural commodities: avocado 30. ppm; dandelions 10.0 ppm; papayas 3.0 ppm; pistachios 0.2 ppm; turnip greens 6.0 ppm; watercress 10.0 ppm.

Human toxicity (long-term)[101]: Intermediate–17.50 ppb, Health Advisory

Fish toxicity (threshold)[101]: High–2.19089 ppb, MATC (Maximum Acceptable Toxicant Concentration)

Regulatory Authority and Advisory Information: Carcinogenicity[83]: EPA Group C, possible human carcinogen; ACGIH A3 Confirmed animal carcinogen with unknown relevance to humans.

California Proposition 65 Chemical: Developmental/Reproductive toxin (male) (7/1/1991)

Acute Oral Category: 4, Caution

Health Advisory: Nerve Toxin (S!), Mutagen, Developmental/Reproductive Toxin (S!), Endocrine disruptor (S!)

EPA Oral reference dose (RfD) = 0.05 mg/kg/day

U.S. EPA Hazardous Waste Number (RCRA No.): U271

Superfund/EPCRA [40CFR 302 and 355, F R: 8/16/06, Vol 71, No. 158] Reportable Quantity (RQ): 10 lb (4.54 kg)

RCRA 40CFR268.48; 61FR15654, Universal Treatment Standards: Wastewater (mg/L), 0.056; Non-wastewater (mg/kg), 1.4

EPCRA Section 313 Form R *de minimis* concentration reporting level: 1.0%

US DOT Regulated Marine Pollutant (49CFR172.101, appendix B)

Rotterdam Convention Annex III [Chemicals Subject to the Prior Informed Consent Procedure (PIC)](as dustable powder formulations containing a combination of: Benomyl @ or >7%; carbofuran @ or >10%; thiram @ or >15%)

European/International Regulations: Hazard Symbol: T, N; risk phrases: R46; R60; R61; R37/38; R43; R50/53; safety phrases: S2; S53; S45; S60; S61 (see Appendix 1)

Description: Benomyl is a white crystalline solid with a faint acrid odor. Molecular weight = 290.36; Boiling point = (decomposes) without melting; Freezing/Melting point = (decomposes) ≥ 300 °C; Vapor pressure = 1×10^{-10} mmHg; Autoignition temperature = 220 °C; LEL (Lower Explosive Limit) = 0.5 g/L[88]; Hazard Identification (based on NFPA-704 M Rating System)*: Health 1, Flammability 2, Reactivity 0. Very slightly soluble in water; solubility = <1 mg/mL @ 20 °C. *Physical and toxicological properties may be affected by commercial formulations.

Incompatibilities: Strong bases [forms toxic oxides of nitrogen], strong acids, peroxides and oxidizers.

Permissible Exposure Limits in Air: OSHA PEL: 15 mg/m^3 total dust, TWA; 5 mg/m^3 respirable fraction, TWA

NIOSH REL: None established. See Appendix D of the *NIOSH Pocket Guide*

ACGIH TLV®[1]: 10 mg/m^3 TWA; not classifiable as a human carcinogen

No Protective Action Criteria (PAC) available.

DFG MAK: [skin] possible sensitization of skin; Germ Cell Mutagen Group: 3A (2005).

Determination in Air: Filter; none; Gravimetric; NIOSH IV[18] [Particulates NOR; #0500 (total), #0600 (respirable)]

Permissible Concentration in Water: State Drinking Water Guidelines: Florida 350 μg/L.

Determination in Water: Log K_{ow} = <2.5. Unlikely to bioaccumulate in marine organisms.

Routes of Entry: Inhalation, ingestion

Harmful Effects and Symptoms

Short Term Exposure: The substance irritates the skin eyes and upper respiratory system. Exposure could cause depression of the central nervous system and lack of muscular coordination. LD_{50} (oral, rat) = >9500 mg/kg; LD_{50} (dermal, rat) = >1000 mg/kg.

Long Term Exposure: May cause cancer. Repeated or prolonged contact may cause skin sensitization and allergy. Human mutation data reported. Also experimental and reproductive effect. May damage the male reproductive system; cause heritable genetic damage in humans. May be a neurotoxin.

Points of Attack: Eyes, skin, kidneys, liver, respiratory system, reproductive system. Central nervous system.

Medical Surveillance: This chemical is a suspected or known human carcinogen. Exposed persons should contact a physician for advice regarding the possible long term health effects and advice for medical monitoring. Recommendations from the physician may depend upon the specific compound, its chemical, physical and toxicity properties, the exposure level, length of exposure, and the route of exposure. Comprehensive physical examination with emphasis on the genito-urinary tract including testicle size and consistency in males. Semen analysis to include sperm count, motility and morphology. Other tests, such as serum testosterone, serum follicle stimulating hormone (FSH), and serum lutenizing hormone (LH), may be carried out if, in the opinion of a physician, they are indicated. Evaluation by a qualified allergist, including exposure history and testing, may help diagnose allergy.

First Aid: If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least 15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately. If this chemical contacts the skin, remove contaminated clothing and wash immediately with soap and water. Seek medical attention immediately. If this chemical has been inhaled, remove from exposure, begin rescue breathing (using universal precautions) if breathing has stopped, and CPR if heart action has stopped. Transfer promptly to a medical facility. When this chemical has been swallowed, get medical attention. Give large quantities of water and induce vomiting. Do not make an unconscious person vomit.

Personal Protective Methods: Wear protective gloves and clothing to prevent any reasonable probability of dermal and/or eye contact. Safety equipment suppliers/manufacturers can provide recommendations on the most protective glove/clothing material for your operation. All protective clothing (suits, gloves, footwear, headgear) should be clean, available each day, and put on before work. Contact lenses should not be worn when working with this chemical. Wear dust-proof chemical goggles and face shield unless full facepiece respiratory protection is worn. Employees should wash immediately with soap when skin is wet or contaminated. Provide emergency showers and eyewash.

Respirator Selection: *At any concentrations above the NIOSH REL, or where there is no REL, at any detectable concentration:* SCBAF: Pd,Pp (APF = 10,000) (any NIOSH/MSHA- or European Standard EN 149-approved self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode); or SaF: Pd,Pp: ASCBA (APF = 10,000) (any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary, self-contained breathing apparatus operated in a pressure-demand or other positive-pressure mode).

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* *Note:* In some cases you may be specifically instructed by poison control to induce vomiting by way of 2 tablespoons of syrup of ipecac (adult) washed down with a cup of water. Do NOT give activated charcoal before or with ipecac syrup

Storage: Color Code-Blue: Health Hazard: Store in a tightly closed container in a dry, well-ventilated and secure poison location. Prior to working with this chemical you should be trained on its proper handling and storage. Where possible, automatically transfer material from other storage containers to process containers. Store in tightly closed containers in a cool, well-ventilated area away from oxidizers, acids, water, or combustible materials. Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: Environmentally hazardous substances, solid or liquid, usually fall in Hazard Class 9; FLAMMABLE SOLID, N. O. S., Hazard Class 4.1, Packing Group II.

Spill Handling: Evacuate and restrict persons not wearing protective equipment from area of spill or leak until clean up is complete. Dampen spilled material with toluene to avoid dust, then transfer material to a suitable container. Use absorbent paper dampened with toluene to pick up remaining material. Wash surfaces well with soap and water. Seal all wastes in vapor-tight plastic bags for eventual disposal[52]. Ventilate area of spill or leak after clean up is complete. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable. Soil Adsorption Index (K_{oc}) = 1900.

Fire Extinguishing: Hazardous decomposition includes oxides of nitrogen and carbon. Use dry chemical, carbon dioxide; water spray; or alcohol-resistant foam extinguishers. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies. From a secure, explosion-proof location, use water spray to cool exposed containers. If cooling streams are ineffective (venting sound increases in volume and pitch, tank discolors, or shows any signs of deforming), withdraw immediately to a secure position. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode. Extinguish fires using an agent suitable for the type of surrounding fire; benomyl itself does not burn.

Disposal Method Suggested: Generators of waste containing this contaminant (≥100 kg/mo) must conform with EPA regulations governing storage, transportation, treatment, and waste disposal. In accordance with 40CFR165, follow recommendations for the disposal of pesticides and pesticide containers. Containers must be disposed of properly by following package label directions or by contacting your local or federal environmental control agency, or by contacting your regional EPA office.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- USEPA, Office of Pesticide Programs, Pesticide Residue Limits, "Benomyl", 40 CFR 180.294, http://www.epa.gov/pesticides/food/viewtols.htm
- EXTOXNET, Extension Toxicology Network, "Pesticide Information Profile, Benomyl," Oregon State University, Corvallis, OR (June 1996). http://extoxnet.orst.edu/pips/benomyl.htm
- New Jersey Department of Health and Senior Services, "Hazardous Substance Fact Sheet: Benomyl," Trenton, NJ (February 1989, revised April 2004). http://www.state.nj.us/health/eoh/rtkweb/0192.pdf
- Sax, N. I., Ed., "Dangerous Properties of Industrial Materials Report" 4, No. 1, 20-21 (1984)

Bensulide B:0238

Use Type: Herbicide

CAS Number: 741-58-2

Formula: $C_{14}H_{24}NO_4PS_3$

Synonyms: Benzulfide; *O,O*-Bis(1-methylethyl)-*S*-[2-((phenylsulfonyl) amino)ethyl]pheosphorodithioate; *N*-[2-(*O,O*-Diisopropyldithiophosphoryl)ethyl]benzenesulfonamide; *N*-(*β*-*O,O*-Diisopropyl dithiophosphorylethyl) bezenesulfonamide; *S*-(*O,O*-Diisopropyl phosphorodithioate) ester of *N*-(2-mercaptoethyl)benzenesulfonamide; *N*-(2-Mercaptoethylbenzenesulfonamide)-*S*-(*O,O*-diisopropyl phosphorodithioate); Phosphorodithioic acid-*O,O*-bis(1-methylethyl)-*S*-[2-((phenylsulfonyl)amino)ethyl]ester

Trade Names: BENSUMEC®; BETAMEC®; BETASAN®; BETASAN®-E; BETASAN®-G; DISAN®; EXPORSAN®; KAYAPHENONE®; PREFAR®; PREFAR®-E; PRESAN®; PROTURF®; R-4461®; SAP (herbicide)

Chemical class: Organophosphate

EPA/OPP PC Code: 009801

California DPR Chemical Code: 70

HSDB Number: 393

UN/NA & ERG Number: UN3018 (liquid)/152

RTECS® Number: TE0250000

EC Number: 212-010-4 [*Annex I Index No.:* 015-083-00-9]

Uses: A selective pre-emergence herbicide used to control bluegrass, crabgrass and other annual grasses and broadleaf weeds in agriculture crops, cotton and turf. It is widely used on golf courses and home lawns. Target weeds also include barnyardgrass, burning nettle and canarygrass. Not approved for use in EU countries[115].

U.S. Maximum Allowable Residue Levels for Bensulide (40 CFR 180.241): in or on the following food commodities: carrots, roots 0.1 ppm (negligible residues); cucurbits, 0.1 ppm (negligible residues); onion, dry bulb 0.1 ppm (negligible residues); vegetable, fruiting 0.1 ppm (negligible residues); and vegetable, leafy 0.1 ppm (negligible residues).

Human toxicity (long-term)[101]: Intermediate–46.20 ppb, Health Advisory

Fish toxicity (threshold)[101]***:*** Intermediate–43.42721 ppb, MATC (Maximum Acceptable Toxicant Concentration)

Regulatory Authority and Advisory Information: Carcinogenicity[83]: EPA, Not likely to be carcinogenic in humans.

Acute Oral Category: 2, WARNING

Health Advisory: Nerve toxin

Potential Ground Water Pollutant [California FAC Section 13145(d)/12811, active]

U.S. DOT 49CFR172.101, Inhalation Hazard Chemical as organophosphates

European/International Regulations: Hazard Symbol: Xn, N; risk phrases: R22; R50/R53; safety phrases: S2; S24; S36; S60; S61 (see Appendix 1)

Description: Amber, viscous liquid, or forms colorless or white crystalline solid below 34.4 °C. Combustible. Commercial product is available as an emulsifiable concentrate. Molecular weight = 397.49; Specific gravity (H_2O:1) = 1.25 @ 22 °C; Molecular weight = 397.54; Freezing/Melting point = 34 °C; Vapor pressure = 8×10^{-7} mmHg; 0.53 mmHg @ 20 °C. Flash point = 160 °C; Practically insoluble in water; solubility = 0.0025 g/ml @ 20 °C. Physical and toxicological properties may be affected by carrier solvents in commercial formulations.

Incompatibilities: Incompatible with oxidizers; chlorates nitrates, peroxides. Decomposes slowly in light and strong UV. Corrosive to copper, aluminum, magnesium, zinc. Slowly hydrolyzes in water, releasing ammonia gas and forming acetate salts. In the presence of strong reducing agents such as hydrides, organophosphates form highly toxic and flammable phosphine gas. Contact with oxidizers can cause the release of toxic oxides of phosphorus. Stable @ 80 °C for 50 hours; decomposes @ 200 °C in 18 – 40 hours.

Determination in Air: OSHA versatile sampler-2; Toluene/Acetone; Gas chromatography/Flame ionization detection; NIOSH IV[18], Method #5600, Organophosphorus Pesticides

Permissible Concentration in Water: Runoff from spills or fire control may cause water pollution.

Determination in Water: NIOSH Method 1657. The determination of organophosphorus pesticides in municipal and industrial wastewater by gas chromatography. Detection limit = 6.0 ng/L. Log K_{ow} = >4.0. Values above 3.0 are likely to bioaccumulate in aquatic organisms.

Routes of Entry: Inhalation, ingestion, dermal contact, passes through the skin

Harmful Effects and Symptoms: Organophosphates are highly toxic. Symptoms may develop rapidly, or there may be a delay of several hours following exposure before they become noticeable. The delay tends to be longer in the case of some compounds that dissolve fats, lipids, oils and non-polar solvents such as toluene. Symptoms may increase in severity for more than a single day and last for several days. In severe cases of of organophosphate intoxication, respiratory failure may occur.

Short Term Exposure: Eye pupils are small; blurred vision; eye watering; runny nose; cough; shortness of breath; salivation; dizziness; nausea, stomach cramps, diarrhea, and vomiting; increased blood pressure; profuse sweating; hypermotility, hallucinations; irritability; tingling of the skin; drowsiness; slow heartbeat; convulsions; fluid in lungs; loss of consciousness; incontinence; breathing stops; death. Organophosphates inhibit the action of acetylcholinesterase enzymes, and alter the way in which nervous impulses are transmitted. The effects can last for hours, days, or much longer. The action of the enzymes is reestablished after new enzymes are formed. LD_{50} (oral, rat) = 270–360 mg/kg; LD_{50} (dermal, rat) = 3500–4000 mg/kg.

Long Term Exposure: Cholinesterase inhibitor; cumulative effect is possible. May be a neurotoxin; may damage the nervous system with repeated exposure, resulting in convulsions, respiratory failure. May cause liver and/or kideny damage. May be a skin sensitizer.

Points of Attack: Respiratory system, central nervous system, cardiovascular system, blood cholinesterase. Liver, kidneys, skin.

Medical Surveillance: Medical observation is recommended for 24 to 48 hours following breathing overexposure, as pulmonary edema may be delayed. Cigarette smoking may exacerbate pulmonary injury and should be discouraged for at least 72 hours following exposure. Routine biological monitoring of pesticide applicators and field workers includes testing of plasma and red blood cell acetylcholinesterase levels (for enzyme poisoned by this chemical). These tests are normally accurate only if done within about two hours of exposure. If exposure stops, plasma levels return to normal in 1–2 weeks while red blood cell levels may be reduced for 1–3 months. When acetylcholinesterase enzyme levels are reduced by 25% or more below preemployment levels, risk of poisoning is increased, even if results are in lower ranges of "normal." Reassignment to work not involving organophosphate pesticides is recommended until enzyme levels recover. Do not drink any alcoholic beverages before or during use as it promotes absorption of organophosphates. Evaluation by a qualified allergist, including exposure history and testing, may help diagnose allergy.

First Aid: **Treatment for organophosphate poisoning consists of thorough decontamination, cardiorespiratory support, and administration of the antidotes atropine and pralidoxime. In cases of severe poisoning, diazepam, an anticonvulsant, should also be administered. Antidotes should be administered as prevention even if the diagnosis is in doubt**. Speed in removing material from eyes and skin is of extreme importance. *Eyes:* Eye contact can cause dangerous amounts of these chemicals to be quickly absorbed through the mucous membrane into the bloodstream. Immediately and gently flush eyes with plenty of warm or cold water (NO hot water) for at least 15 minutes, occasionally lifting the upper and lower eyelids. Get medical aid immediately. *Skin:* Get medical aid. Dermal contact can cause dangerous amounts of these chemicals to be absorbed into the bloodstream. Wearing the appropriate PPE equipment and respirator for organophosphate/carbamate pesticides, immediately flush skin with plenty of soap and water for at least 15 minutes while removing contaminated clothing and shoes. Shampoo hair promptly if contaminated. The removed, contaminated clothing and shoes should be double-bagged and left in Hot Zone for later disposal by hazardous materials experts. Skin may also be decontaminated with diluted hypochlorite solution. *Inhalation:* Get medical aid. Do not contaminate yourself. Wearing the appropriate PPE equipment and respirator for organophosphate pesticides, immediately remove the victim from the contaminated area to fresh air. If the victim is not breathing, administer artificial respiration. Do not use mouth-to-mouth method if victim ingested or inhaled the substance; give artificial respiration with the aid of a pocket mask equipped with a one-way valve or other proper respiratory medical device. If breathing is difficult, administer oxygen through bag/mask apparatus until medical help arrives. Do not leave victim unattended. *Ingestion:* Call poison control. Loosen all clothing. Never give anything by mouth to an unconscious person. If victim is *unconscious or having convulsions,* do nothing except keep victim warm. Get medical aid. Transfer promptly to a medical facility. In cases of ingestion, **do not induce vomiting**. If the victim is alert and asymptomatic, administer a slurry of activated charcoal at a dose of 1 g/kg (infant, child, and adult dose). A soda can and straw may be of assistance when offering charcoal to a child. *In some cases you may be specifically instructed by poison control to induce vomiting by way of 2 tablespoons of syrup of ipecac (adult) washed down with a cup of water*. Do NOT give activated charcoal before or with ipecac syrup

Note to physician or authorized medical personnel: Treat cases of respiratory compromise, coma, or excessive pulmonary secretions with respiratory support using protocols and techniques available and within the scope of training. Some cases may necessitate procedures such as endotracheal intubation or cricothyrotomy by properly trained and equipped personnel. When possible, atropine (see *Antidotes*, below) should be given under medical supervision. Patients who are comatose, hypotensive, or having seizures or cardiac arrhythmias should be treated according to advanced life support protocols. *Antidotes:* Two antidotes are administered to treat organophosphate poisoning. Atropine is a competitive antagonist of acetylcholine at muscarinic receptors and is used to control the excessive bronchial secretions which are often responsible for death. Pralidoxime relieves both the nicotinic and muscarine effects of organophosphate poisoning by regenerating acetylcholinesterase and can reduce both the bronchial secretions and the muscle weakness associated with poisoning. The initial intravenous dose of atropine in adults should be determined by the severity of symptoms: An initial adult dose of 1.0 to 2.0 mg or pediatric dose of 0.01 mg/kg (minimum 0.01 mg) should be administered intravenously. If intravenous access cannot be established, atropine may also be given intramuscularly, subcutaneously or via endotracheal tube. Doses should be repeated every 15 minutes until excessive secretions and sweating have been controlled. Once bronchial secretion has been controlled, atropine administration should be repeated whenever the secretions begin to recur. In seriously poisoned patients, very large doses may be required. Alterations of pulse rate and pupillary size should not be used as indicators of treatment adequacy. Pralidoxime should be administered as early in poisoning as possible as its efficacy may diminish when given more than 24 to 36 hours after exposure. Doses are as follows: adult 1.0 g; pediatric 25 to 50 mg/kg. The drug should be administered intravenously over 30 to 60 minutes, but in a life-threatening situation, one-half of the total dose can be given per minute for a total administration time of 2 minutes. Treatment should begin to take effect within 40 minutes with a reduction in symptoms and the amount of atropine necessary to control bronchial secretion. The initial dose can be repeated in 1 hour and then every 8 to 12 hours until the patient is clinically well and no longer requires atropine. If intravenous access cannot be established, pralidoxime may also be given intramuscularly. Early administration of diazepam in addition to the combined atropine and pralidoxime treatment may help prevent the onset of seizures and potential brain and cardiac morphologic damage following high-level organophosphate poisoning.

Personal Protective Methods: Wear protective gloves and clothing to prevent any reasonable probability of dermal and/or eye contact. Safety equipment suppliers/manufacturers can provide recommendations on the most protective glove/clothing material for your operation. One recommendation is the use of DuPont™ Tychem® suit fabrics[88]. All protective clothing (suits, gloves, footwear, headgear) should be clean, available each day, and put on before work. Contact lenses should not be worn when working with this chemical. Wear splash chemical goggles and face shield unless full facepiece respiratory protection is worn. Employees should wash immediately with soap when skin is wet or contaminated. Provide emergency showers and eyewash.

Respirator Selection: Engineering controls should be used wherever feasible to maintain airborne concentrations of this chemical below the prescribed exposure limit. Respirators and protective equipment are less effective than engineering controls, and should be used only in non-routine or emergency situations which may result in exposure concentrations in excess of the TWA environmental limit. *At any concentrations above the NIOSH REL, or where there is no REL, at any detectable concentration:* SCBAF: Pd,Pp (APF = 10,000) (any NIOSH/MSHA- or European Standard EN 149-approved self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode); or SaF: Pd,Pp: ASCBA (APF = 10,000) (any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary, self-contained breathing apparatus operated in a pressure-demand or other positive-pressure mode).

Storage: Color Code-Blue: Health Hazard/Poison. Store in a secure poison location. Prior to working with this chemical you should be trained on its proper handling and storage. Where possible, automatically transfer material from other storage containers to process containers. Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: Organophosphorus pesticides, solid or liquid require a "Poisonous materials" label. They usually fall in Hazard Class 6.1.

Spill Handling: First, remove all sources of ignition. Evacuate persons not wearing protective equipment from area of spill or leak until clean up is complete. Stay upwind; keep out of low areas. Ventilate area of spill or leak. Remove and isolate contaminated clothing at the site. Do not touch spilled material; stop leak if you can do so without risk. Use water spray to reduce vapors. *Small spills:* absorb with sand or other noncombustible absorbent material and place into containers for later disposal. *Large spills:* dike far ahead of spill for later disposal. Collect powdered material in the most convenient and safe manner and deposit in sealed containers. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable. Seek professional environmental engineering assistance from the U.S. EPA Environmental Response Team at (908) 548-8730 (24-hour response line).

Fire Extinguishing: Hazardous decomposition includes oxides of nitrogen, phosphorus, sulfur and carbon. May be fatal if inhaled, ingested or absorbed through skin. Inhalation or contact with some of these materials will irritate or burn skin and eyes. Vapors may cause dizziness or suffocation. *Small fires:* dry chemical, carbon dioxide; water spray; or foam. *Large fires:* water spray, fog, or foam. Stay upwind; keep out of low areas. Ventilate closed spaces before entering them. Firefighting gear (including SCBA) may not provide adequate protection. If exposure occurs, remove and isolate gear immediately and thoroughly decontaminate personnel. Wear positive-pressure breathing apparatus and special protective clothing. Remove and isolate contaminated clothing at the site. Move container from fire area if you can do so without risk. Fight fire from maximum distance. Dike fire-control water for later disposal; do not scatter the material. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies. From a secure, explosion-proof location, use water spray to cool exposed containers. If cooling streams are ineffective (venting sound increases in volume and pitch, tank discolors, or shows any signs of deforming), withdraw immediately to a secure position. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode.

Disposal Method Suggested: Destruction by alkali hydrolysis or incineration. Containers must be disposed of properly by following package label directions or by contacting your local or federal environmental control agency, or by contacting your regional EPA office.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- EXTOXNET, Extension Toxicology Network, "Pesticide Information Profile, Bensulide," Oregon State University, Corvallis, OR (June 1996). http://extoxnet.orst.edu/pips/bensulid.htm
- USEPA, "Interim Reregistration Eligibility Decision (IRED), Bensulide", Office of Prevention, Pesticides and Toxic Substances, Washington, DC (June 2000). http://www.epa.gov/REDs/2035ired.pdf
- USEPA, Office of Pesticide Programs, Pesticide Residue Limits, "Bensulide", 40 CFR 180.242. http://www.epa.gov/pesticides/food/viewtols.htm
- USEPA, *R.E.D. FACTS, Bensulide*, EPA 738-F-01-001, Washington DC (June 2000)

Bentazon B:0240

Use Type: Selective post-emergent herbicide

CAS Number: 25057-89-0; 50723-80-3 (sodium bentazon)

Formula: $C_{10}H_{12}N_2O_3S$

Synonyms: Bentazone; 1*H*-2,1,3-Benzothiadiazin-4(3*H*)-one,3-(1-methylethyl)-2,2-dioxide; 1*H*-2,1,3-Benzothiadiazin-4(3*H*)-one,3-isopropyl-2,2-dioxide(8CI); 3-Isopropyl-1H-2,1,3-benzothiadiazin-4(3H)-one-2,2-dioxide;3-Isopropyl-1*H*-benzo-2,1,3-thiadiazin-4-one-2,2-dioxide; 3-Isopropyl-1H-2,1,3-benzothiadiazin-4(3*H*)-one-2,2-dioxide; 3-(1-Methylethyl)-1*H*-2,1,3-benzothiazain-4(3*H*)-one-2,2-dioxide

Trade Names: ASAGIO®; BAS 351-H®; BASAGRAN®; BENDIOXIDE®; BENTA®; BLAST®; ENTRY®; LADDOK®; LEADER®; PLEDGE®; STORM®

Chemical class: Benzothiazinone

EPA/OPP PC Code: 275200

California DPR Chemical Code: 2999 (Bentazon); 1944 (Bentazon, sodium salt)

HSDB Number: 3430

UN/NA & ERG Number: UN2588 (Pesticide, solid, poisonous, n.o.s.)/151; UN2902 (Pesticide, liquid, poisonous, n.o.s.)/151

RTECS® Number: DK9900000

EC Number: 246-585-8 [*Annex I Index No.:* 613-012-00-1]; 256-735-4 (sodium bentazon)

Uses: A post-emergence herbicide used to control broadleaf weeds in crops such as beans, corn, mint, soybeans, rice, and peanuts. All products formerly marketed in the U.S. contain the sodium salt of bentazon as the active ingredient, referred to as sodium bentazon. Also used in selective post-emergent control of broadlelaf weeds and sedges in alfalfa, asparagus, cereals, clover, digitalis, dry peas, flax, garlic, grasses, green lima beans, mint, onions, potatoes, snap beans for seed, sorghum, soybeans and sugarcane. Not currently registered in the U.S. It is reported to be used in most European countries.

U.S. Maximum Allowable Residue Levels for Bentazon and its 6- and 8-hydroxy metabolites [(40 CFR 180.355 (a)]: in or on the following food commodities: bean, dry seed 0.05 ppm; bean, succulent 0.5 ppm; cattle, meat-by-products 0.05 ppm; corn, field, forage 3 ppm; corn, field, grain 0.05 ppm; corn, field, stover 3 ppm; corn, pop, grain 0.05 ppm; corn, sweet, kernel plus cob with husks removed 0.05 ppm; cowpea, hay 3 ppm; cowpea, forage 3 ppm; mint 1 ppm; peanut 0.05 ppm; peanut, hay 3 ppm; peas, dry, seed 0.05 ppm; pea, field, hay 3 ppm; pea, field, vines 3 ppm; pea, succulent 3 ppm; rice, grain 0.05 ppm; rice, straw 3 ppm; sorghum, fodder 0.05 ppm; sorghum, forage 0.20 ppm; sorghum, grain 0.05 ppm; soybeans 0.05 ppm; soybeans, forage 3 ppm; soybeans, hay 0.3 ppm. ***[40 CFR 180.355(b)]*** bentazon and its metabolite 2 amino-*N*-isopropyl benzamide (AIBA) in or on the following food commodities: cattle, fat 0.05 ppm; cattle, meat-by-products (meat by-products) 0.05 ppm; cattle, meat 0.05 ppm; eggs 0.05 ppm; goats, fat 0.05 ppm; goats, meat-by-products 0.05 ppm; goats, meat 0.05 ppm; hogs, fat 0.05 ppm; hogs, meat-by-products 0.05 ppm; hogs, meat 0.05 ppm; milk 0.02 ppm; poultry, fat 0.05 ppm; poultry, meat-by-products 0.05 ppm; poultry, meat 0.05 ppm; sheep, fat 0.05 ppm; sheep, meat-by-products 0.05 ppm; sheep, meat 0.05 ppm.

Regulatory Authority and Advisory Information: Carcinogenicity[83]: EPA Group E, evidence of non-carcinogenicity in humans.

Potential Ground Water Pollutant [California FAC Section 13149)

Acute Oral Category: 3, CAUTION

Health Advisory: Developmental/Reproductive Toxin (S!); Skin irritant/sensitizer (S!)

Safe Drinking Water Act, 55FR1470 Priority List

European/International Regulations (*25057-89-0*): Hazard Symbol: Xi, Xn, N; risk phrases: R22; R36; R43; R52/53; safety phrases: S2; S24; S37; S61 (see Appendix 1)

WGK (German Aquatic Hazard Class): 2-Hazard to waters

Description: Bentazon is a colorless to white crystalline powder. Commercial product can be a soluble concentrate that may be mixed with water and used as a spray. Molecular weight = 240.3; Boiling point = (decomposes); Freezing/Melting point = 137–139 °C; Vapor pressure = 10^{-3} @ 20 °C. Hazard Identification (based on NFPA-704 M Rating System): Health 2, Flammability 2, Reactivity 0. Very slightly soluble in water; solubility = 490 mg/L @ 20 °C. Physical and toxicological properties may be affected by carrier solvents in commercial formulations.

Incompatibilities: Keep away from flammable materials, heat and flame. May form explosive mixture with air. Risk of fire and explosion if formulations contain flammable/explosive solvents.

Permissible Concentration in Water: Federal Drinking Water Guidelines: EPA 200 μg/L; State Drinking Water Standards: California 18 μg/L; Wisconsin 300 μg/L.

Determination in Water: Log K_{ow} = >2.5 Values above 3.0 are likely to bioaccumulate in aquatic organisms.

Routes of Entry: Ingestion, inhalation

Harmful Effects and Symptoms

Short Term Exposure: Avoid eye contact; may cause severe irritation or injury. May cause skin burns. LD_{50} (oral, rat) = 1100 mg/kg; LD_{50} (dermal, rat) = 2500[9] mg/kg.

Long Term Exposure: May be mutagenic. May cause skin sensitization.

Points of Attack: Reproductive material/DNA.

Medical Surveillance: Comprehensive physical examination with emphasis on the genito-urinary tract analysis to include sperm count, motility and morphology. Other tests, such as serum testosterone, serum follicle stimulating hormone (FSH), and serum lutenizing hormone (LH), may be carried out if, in the opinion of a physician, they are indicated.

Long Term Exposure: May be a Reproductive Toxin.

First Aid: If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least 15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately. Give artificial respiration if victim is not breathing. *Do not* use mouth-to-mouth method if victim ingested or inhaled the substance; give artificial respiration with the aid of a pocket mask equipped with a one-way valve or other proper respiratory medical device. Administer oxygen if breathing is difficult. Remove and isolate contaminated clothing and shoes. In cases of contact with substance, immediately flush skin or eyes with running water for at least 20 minutes. For minor skin contact, avoid spreading material on unaffected skin. Keep victim warm and quiet. Effects of exposure (inhalation, ingestion or skin contact) to substance may be delayed. Ensure that medical personnel are aware of the material(s) involved and take precautions to protect themselves. Evaluation by a qualified allergist, including exposure history and testing, may help diagnose allergy.

Personal Protective Methods: Wear protective gloves and clothing to prevent any reasonable probability of dermal and/or eye contact. Safety equipment suppliers/manufacturers can provide recommendations on the most protective glove/clothing material for your operation. All protective clothing (suits, gloves, footwear, headgear) should be clean, available each day, and put on before work. Contact lenses should not be worn when working with this chemical. Wear dust-proof chemical goggles and face shield unless full facepiece respiratory protection is worn. Employees should wash immediately with soap when skin is wet or contaminated. Provide emergency showers and eyewash.

Respirator Selection: Engineering controls should be used wherever feasible to maintain airborne concentrations of this chemical below the prescribed exposure limit. Respirators and protective equipment are less effective than engineering controls, and should be used only in non-routine or emergency situations which may result in exposure concentrations in excess of the TWA environmental limit. *Where there is no REL, at any detectable concentration:* SCBAF: Pd,Pp (APF = 10,000) (any NIOSH/MSHA- or European Standard EN 149-approved [for pesticides] self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode); or SaF: Pd,Pp: ASCBA (APF = 10,000) (any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary, self-contained breathing apparatus operated in a pressure-demand or other positive-pressure mode).

Storage: Color Code-Blue: Health Hazard/Poison. Store in a secure poison location. Store in tightly closed containers in a cool, well-ventilated area away from flammable materials, sources of heat and fire. Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: Pesticides, solid, toxic/poisonous, n.o.s require a shipping label of "poisonous materials" and fall in Hazard Class 6.1. Technical name required.

Spill Handling: Evacuate and restrict persons not wearing protective equipment from area of spill or leak until clean up is complete. Collect powdered material in the most convenient and safe manner and deposit in sealed containers. Ventilate area of spill or leak after clean up is complete. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable. Soil Adsorption Index (sodium bentazon) $K_{oc} = 34$.

Fire Extinguishing: Bentazon is not combustible, but may support combustion under fire conditions. Hazardous decomposition includes oxides of nitrogen, sulfur and carbon. Stay upwind of fire. Use dry chemical, carbon dioxide; water spray; or standard foam extinguishers. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies. From a secure, explosion-proof location, use water spray to cool exposed containers. If cooling streams are ineffective (venting sound increases in volume and pitch, tank discolors, or shows any signs of deforming), withdraw immediately to a secure position. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode.

Disposal Method Suggested: In accordance with 40CFR165, follow recommendations for the disposal of pesticides and pesticide containers. Containers must be disposed of properly by following package label directions or by contacting your local or federal environmental control agency, or by contacting your regional EPA office.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- USEPA, Office of Pesticide Programs, *Pesticide Residue Limits, Bentazon,* 40 CFR 180.355. http://www.epa.gov/pesticides/food/viewtols.htm
- EXTOXNET, Extension Toxicology Network, *Pesticide Information Profile, Bentazon*, Oregon State University, Corvallis, OR (September, 1993). http://pmep.cce.cornell.edu/profiles/extoxnet/24d-captan/bentazon-ext.html
- USEPA, *Health Advisory: Bentazon*, Washington DC, Office of Drinking Water (August 1987)
- USEPA, *R.E.D. FACTS, Bentazon*, EPA 738-F-94-024, Washington DC (September 1994)

N-Benzaldenine B:0255

Use Type: Plant growth regulator

CAS Number: 1214-39-7

Formula: $C_{12}H_{11}N_5$

Synonyms: Adenine, *N*-benzyl-; 6-BAP; BAP; 6-Benzyladenine; Benzyladenine; *N*-Benzyladenine; N^6-Benzyladenine; Benzylaminopurine; N^6-(Benzylamino)purine; 6-(Benzylamino)purine; 6-(*N*-Benzylamino)purine; *N*-(Phenylmethyl)-1*H*-purin-6-amine; 1*H*-Purin-6-amine, *N*-(phenylmethyl)-; Promalin, component of (with Gibberellin D); Verdan senescence inhibitor

Trade Names: ABG® 3034; ACCEL®; AGTROL®; 6-BA®; BA® (growth stimulant); CHRYSAL BVB®; EXILIS®; PERLAN®; PROMALIN®; SD® 4901; SQ® 4609

Chemical class: Amine; Polyamine

EPA/OPP PC Code: 116901

California DPR Chemical Code: 2000 (N^6-Benzyladenine)

HSDB Number: 7667

UN/NA & ERG Number: UN3259/154

RTECS® Number: AU6252200

EC Number: 214-927-5

Uses: A plant growth regulator used to lengthen and enhance the shape of apples and to increase the fruit set in pears. It increases the yield of pistachios and tomatoes. Not listed for use in EU countries[115]. Registered for use in the U.S.

U.S. Maximum Allowable Residue Levels for the biochemical plant regulator 6-benzyladenine (6-BA)[40 CFR 180.1150]: is exempt from the requirement of a tolerance in or on apple and pear when applied at a rate of ≤182 grams of active ingredient/acre/season, and in or on pistachio when applied at a rate of ≤60 grams of active ingredient/acre/season.

Regulatory Authority and Advisory Information: Health Advisory: Mutagen

Toxicity (oral) Category: 3, CAUTION

Description: Colorless to off-white or yellow powder. Corrosive. Molecular weight = 225.27; Freezing/Melting point = 233 °C; Vapor pressure = 2×10^{-11} mmHg @ 25 °C. Henry's Law constant = 9×10^{-14} atm-m^3/mol @ 25 °C (est). Hazard Identification (based on NFPA-704 M Rating System): Health 2, Flammability 0, Reactivity 0. Low solubility in water.

Incompatibilities: May react with strong oxidizers such as chlorates, peroxides, nitrates, etc. May release heat on contact with water. Solid and corrosive amines are chemical bases. Neutralize acids to form salts plus water in exothermic reactions. May be incompatible with isocyanates, halogenated organics, peroxides, phenols (acidic), epoxides, anhydrides, and acid halides. May generate flammable gaseous hydrogen in combination with strong reducing agents, such as hydrides[88].

Permissible Concentration in Water: Runoff from fire control or dilution water may be corrosive and/or toxic and cause pollution.

Determination in Water: Log K_{ow} = <2.0. Unlikely to bioaccumulate in marine organisms.

Routes of Entry: Inhalation of dust, dermal and/or eye contact.

Harmful Effects and Symptoms: Toxic; inhalation, ingestion or dermal contact with material may cause severe injury or death. Contact with molten substance may cause severe burns to skin and eyes. Avoid any dermal and/or eye contact. Effects of contact or inhalation may be delayed.

Short Term Exposure: Corrosive to the eyes, skin, and respiratory tract. Contact can cause burns and permanent damage. Higher exposures can cause pulmonary edema, a medical emergency that can be delayed for several hours. This can cause death. May be harmful if swallowed. LD_{50} (oral, rat) = 1300 mg/kg[83]; LD_{50} (dermal, rabbit) = 5 mg/kg[83]. LD_{50} (inhalation, rabbit) = 5 mg/L/1 hour[83].

Long Term Exposure: NIOSH warns this may be mutagenic.

Points of Attack: Lungs, eyes, Reproductive material/DNA

Medical Surveillance: In addition to comprehensive initial medical and work histories emphasizing reproductive experience and menstrual history, patient should have physical examination and testing of genito-urinary tract, sperm count, motility and morphology. If required, other tests, such as serum testosterone, serum follicle stimulating hormone (FSH), and serum lutenizing hormone (LH), may be indicated.

First Aid: Move victim to fresh air. Call 911 or emergency medical service. Give artificial respiration if victim is not breathing. Administer oxygen if breathing is difficult. Do not use mouth-to-mouth method if victim ingested or inhaled the substance; give artificial respiration with the aid of a pocket mask equipped with a one-way valve or other proper respiratory medical device. Remove and isolate contaminated clothing and shoes. In cases of contact with substance, immediately flush skin or eyes with running water for at least 20 minutes. For minor dermal contact, avoid spreading material on unaffected skin. Keep victim warm and quiet. Effects of exposure (inhalation, ingestion or dermal contact) to substance may be delayed. Ensure that medical personnel are aware of the material(s) involved and take precautions to protect themselves. *Eyes*: Check the victim for contact lenses and remove if present. Flush victim's eyes with water or normal saline solution for 20 to 30 minutes. Do not put any ointments, oils, or medication in the victim's eyes without specific instructions from a physician. Transport the victim after flushing eyes to a hospital even if no symptoms (such as redness or irritation) develop. *Skin*: Flood affected skin with water while removing and isolating all contaminated clothing. Gently wash all affected skin areas thoroughly with soap and water. If symptoms such as redness or irritation develop, call a physician and be prepared to transport the victim to a hospital for treatment. *Inhalation:* Leave the contaminated area; take deep breaths of fresh air. If symptoms (such as wheezing, coughing, shortness of breath, or burning in the mouth, throat, or chest) develop, call a physician and be prepared to transport the victim to a hospital. Provide proper respiratory protection to rescuers entering an unknown atmosphere. Whenever possible, self-contained breathing apparatus (SCBA) should be used; if not available, use a level of protection greater than or equal to that advised under Protective Clothing. *Ingestion*: *Do not induce vomiting.* If the victim is conscious and not convulsing, give 1 or 2 glasses of water to dilute the chemical and call a hospital or poison control center. Be prepared to transport the victim to a hospital if advised by a physician. If the victim is convulsing or unconscious, do not give anything by mouth, ensure that the victim's airway is open and lay the victim on his/her side with the head lower than the body. *Do not induce vomiting.* Immediately transport the victim to a hospital.

Personal Protective Methods: Reacts with the following kinds of absorbents: Mineral- and Clay-Based[88]. Applicators and other handlers must wear: Coveralls worn over long-sleeved shirt and long pants; Chemical-resistant gloves such as DuPont™ Tychem® suit fabrics, barrier laminate, or Viton®; Chemical-resistant footwear plus socks; Protective eye wear; Chemical-resistant headgear for overhead exposure; Chemical-resistant apron when cleaning equipment, mixing, or loading[83]. Agricultural Use/Engineering Controls: When handlers use closed systems, enclosed cabs, or aircraft in a manner that meets the requirements listed in the Worker Protection Standard (WPS) for agricultural pesticides, 40 CFR 170.240(d)(4-6), the handler PPE requirements may be reduced or modified as specified in the Worker Protection Standard. Firefighters should wear NIOSH approved self-contained breathing apparatus and full protective clothing.

Respirator Selection: Wherever and whenever workplace conditions warrant respirator use, a respiratory protection program must be followed that meets one or more of the following government standards: OSHA's 29 CFR 1910.134, ANSI Z88.2, or European Standard EN 149.

Storage: Color Code-White: Corrosive or Contact Hazard; Store separately in a corrosion-resistant location. Prior to working with this chemical you should be trained on its proper handling and storage. Store in tightly closed containers in a cool, well-ventilated area.

Spill Handling: As an immediate precautionary measure, isolate spill or leak area in all directions for at least 50 meters/150 feet for liquids and at least 25 meters/75 feet for solids. Stay upwind. Keep out of low areas. Ventilate enclosed areas. Do not touch damaged containers or spilled material unless wearing appropriate protective clothing. Stop leak if you can do it without risk. Wear positive-pressure self-contained breathing apparatus (SCBA). Wear chemical protective clothing that is specifically recommended by the manufacturer. It may provide little or no thermal protection. Structural firefighters' protective clothing provides limited protection in fire situations ONLY; it is not effective in spill situations where direct contact with the substance is possible. Remove all sources of ignition. Evacuate persons not wearing protective equipment from area of spill or leak until clean up is complete. Prevent entry into waterways, sewers, basements or confined areas. Sweep up or vacuum powdered material, being careful not to raise dust. Collect powdered material in the most convenient and safe manner and deposit in sealed containers. Absorb liquids in vermiculite, dry sand, earth, or a similar material and deposit in sealed containers. *Do not get water inside containers*. Ventilate area after clean up is complete. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable. Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: Amines, solid, corrosive, n.o.s., or Polyamines, solid, corrosive n.o.s. require a label of “CORROSIVE MATERIAL.” They fall in Hazard Class 8 and Packing Group I, II, II.

Spill Handling: As an immediate precautionary measure, isolate spill or leak area in all directions for at least 50 meters/150 feet for liquids and at least 25 meters/75 feet for solids. Increase, in the downwind direction, as necessary, the isolation distance shown above. Eliminate all ignition sources (no smoking, flares, sparks or flames in immediate area). Do not touch damaged containers or spilled material unless wearing appropriate protective clothing. Stop leak if you can do it without risk. Prevent entry into waterways, sewers, basements or confined areas. Absorb or cover with dry earth, sand or other non-combustible material and transfer to containers. Do not get water inside containers.

Fire Extinguishing: Hazardous decomposition includes poisonous oxides of nitrogen and carbon. *Fire involving storage or vehicular tanks:* isolate for 800 meters/0.5 mile in all directions; also, consider initial evacuation for 800 meters/0.5 mile in all directions. *Small fire:* dry chemical, carbon dioxide or water spray. *Large fire:* dry chemical, carbon dioxide, alcohol-resistant foam or water spray. Move containers from fire area if you can do it without risk. Dike fire-control water for later disposal; do not scatter the material. *Fire involving tanks or car/trailer loads:* fight fire from maximum distance or use unmanned hose holders or monitor nozzles. Do not get water inside containers. Cool containers with flooding quantities of water until well after fire is out. Withdraw immediately in the case of rising sound from venting safety devices or discoloration of tank. Always stay away from tanks engulfed in fire. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies.

Disposal Method Suggested: Dissolve or mix the material with a combustible solvent and burn in a chemical incinerator equipped with an afterburner and scrubber. All federal, state, and local environmental regulations must be observed.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- United States National Library of Medicine, ChemIDplus Advanced, Bethesda, MD. http://chem.sis.nlm.nih.gov/chemidplus/rn/1214-39-7

Benzoic acid B:0370

Use Type: Fungicide, Insecticide

CAS Number: 65-85-0

Formula: $C_7H_6O_2$; C_6H_5COOH

Synonyms: Acido benzoico (Spanish); Benzenecarboxylic acid; Benzeneformic acid; Benzenemethanoic acid; Benzoate; Carboxybenzene; Carboxylbenzene; Dracyclic acid; Oracylic acid; Phenyl carboxylic acid; Phenylformic acid

Trade Names: RETARDER BA®; MICROL® Preservative; TENN-PLAS®; RETARDEX®; SALVO LIQUID®; SALVO POWDER®; TULSA®

Chemical class: Benzoic Acid

EPA/OPP PC Code: 009101

California DPR Chemical Code: 1329

HSDB Number: 704

UN/NA & ERG Number: UN9094/153; UN3077(solid)/171

RTECS® Number: DG0875000

EC Number: 200-618-2

Uses: Used in the manufacture of benzoates; plasticizers, benzoyl chloride, alkyd resins, in the manufacture of food preservatives, in use as a dye binder in calico printing; in curing of tobacco, flavors, perfumes, dentifrices, standard in analytical chemistry. Not currently registered for use in the U.S. Benzoic acid is currently used in about a dozen European countries.

U.S. Maximum Allowable Residue Levels for Benzoic acid [40 CFR 180.1001(c)]: Residues of benzoic acid are exempted from the requirement of a tolerance when used as a preservative for formulation in accordance with good agricultural practices as inert (or occasionally active) ingredients in pesticide fomulations applied to growing crops or to raw agricultural commodities after harvest. [*40 CFR 180.1001(e)*] Benzoic acid is exempted from the requirement of a tolerance when used as a preservative for formulations in accordance with good agricultural practice as inert (or occasionally active) ingredients in pesticide formulations applied to animals.

Regulatory Authority and Advisory Information: Carcinogenicity[83]: EPA Group D, Not classifiable as a human carcinogen.

Health Advisory: Skin irritant/sensitizer, Mutagen

Clean Water Act: Section 311 Hazardous Substances/RQ 40CFR117.3 (same as CERCLA, see below)

CERCLA Reportable Quantity (RQ): 5000 lb (2270 kg)

European/International Regulations: Not listed in Annex 1.

WGK (German Aquatic Hazard Class): 1-Low hazard to waters.

Description: Benzoic acid is a white crystalline or flaky solid with a faint, pleasant odor. Molecular weight = 122.12; Specific gravity (H_2O:1) = 1.316 @ 28 °C[86]; Boiling point = 249.2 °C[86]; 248.89 °C[88]; Freezing/Melting point = 122.39 °C[88]; Specific gravity (H_2O:1) = 1.316 @ 28 °C (solid); Relative vapor density (air = 1) = 4.21; Vapor pressure = <0.076 mmHg @20 °C; Flash point = 121.1 °C (cc); Autoignition temperature = 572.8 °C; Explosive limits: LEL = 1.8%; UEL 7.9%. Henry's Law constant = 3.3 × 10^{-8} atm-m^3/mol @ 25 °C (est)[83]. Hazard Identification (based on NFPA-704 M Rating System): Health 2, Flammability 1, Reactivity 0. Soluble in water (forms a weak acid); solubility = <1 mg/mL @ 20 °C.

Incompatibilities: Incompatible with strong oxidizers, caustics, ammonia, amines, isocyanates. Dust from dry material or vapor from molten material may form explosive mixture with air. Water solution is a weak acid; may cause corrosion of metals and produce explosive hydrogen gas.

Permissible Exposure Limits in Air: Protective Action Criteria (PAC) Ver. 27[89]

PAC-1: 2.1 mg/m^3

PAC-2: 31 mg/m^3

PAC-3: 830 mg/m^3

Determination in Water: Log K_{ow} = <2.0. @ 20 °C. Unlikely to bioaccumulate in marine organisms.

Routes of Entry: Inhalation and ingestion

Harmful Effects and Symptoms

Short Term Exposure: Irritating to skin, eyes (possibly severe), and mucous membranes. Dermal contact may cause irritation, skin rash, or burning feeling on contact. Ingestion causes nausea and G. I. troubles. For most people, ingestion of 1/10 to 2/10 ounce will have no effect although some sensitive people may experience allergic reactions. Larger amounts may cause stomach upset. Information from animal studies shows that about 6 ounces may be lethal to a 150 pound person. LD_{50} (oral, rat) =1700–2100 mg/kg; LD_{50} (dermal, rat) = >5 g/kg.

Long Term Exposure: Repeated or prolonged contact may cause skin sensitization. Mutation data reported.

Points of Attack: Skin, eyes, and mucous membranes.

Medical Surveillance: Evaluation by a qualified allergist, including exposure history and testing, may help diagnose allergy.

First Aid: If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least 15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately. If this chemical contacts the skin, remove contaminated clothing and wash immediately with soap and water. Seek medical attention immediately. If this chemical has been inhaled, remove from exposure, begin rescue breathing (using universal precautions) if breathing has stopped, and CPR if heart action has stopped. Transfer promptly to a medical facility. When this chemical has been swallowed, get medical attention. Give large quantities of water and induce vomiting. Do not make an unconscious person vomit.

Personal Protective Methods: Wear protective gloves and clothing to prevent any reasonable probability of dermal and/or eye contact. Safety equipment suppliers/manufacturers can provide recommendations on the most protective glove/clothing material for your operation. Gloves: Neoprene and butyl rubber; Coveralls: Responder®, Tychem®; TK; Trellchem HPS & VPS. All protective clothing (suits, gloves, footwear, headgear) should be clean, available each day, and put on before work. Contact lenses should not be worn when working with this chemical. Wear dust-proof chemical goggles and face shield unless full facepiece respiratory protection is worn. Employees should wash immediately with soap when skin is wet or contaminated. Provide emergency showers and eyewash.

Respirator Selection: SCBA 2.1 mg/m^3. Bureau of Mines dust respirator; when melted material present, use eye protection and organic respirator for fumes[86]. Wherever and whenever workplace conditions warrant respirator use, a respiratory protection program must be followed that meets one or more of the following government standards: OSHA's 29 CFR 1910.134, ANSI Z88.2, or European Standard EN 149.

Storage: Color Code-Blue: Health Hazard/Poison: Store in a tightly closed container in a dry, well-ventilated and secure poison location. Prior to working with this chemical you should be trained on its proper handling and storage. Where possible, automatically transfer material from other storage containers to process containers. Store away from excessive heat. Benzoic acid must be stored to avoid contact with strong oxidizers (such as chlorine, bromine and fluorine), since violent reactions occur. Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: Environmentally hazardous substances, solid or liquid, usually fall in Hazard Class 9.

Spill Handling: Evacuate and restrict persons not wearing protective equipment from area of spill or leak until clean up is complete. Vapor may explode if ignited in an enclosed area. Solutions should be neutralized with soda ash. Collect powdered material in the most convenient and safe manner and deposit in sealed containers. Then flush the area with water. Ventilate area of spill or leak after clean up is complete. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable.

Fire Extinguishing: Decomposition products in fire include toxic gases of benzene and phenol and oxides of carbon. Benzoic acid is a combustible solid. Benzoic acid may burn, but does not readily ignite. High levels of dust may form an explosive concentration in air. As an immediate precautionary measure, isolate spill or leak area in all directions for at least 50 meters/150 feet for liquids and at least 25 meters/75 feet for solids. *Fire involving storage or vehicular tanks:* isolate for 800 meters/0.5 mile in all directions; also, consider initial evacuation for 800 meters/0.5 mile in all directions. *On a small fire:* use dry chemical, CO_2, water spray or regular foam. *On a large fire:* use water spray, fog or regular foam. Do not scatter spilled material with high-pressure streams of water. Move containers from fire area if you can do it without risk. Dike fire-control water for later disposal. *Fire involving tanks:* from a secure, explosion-proof location, use water spray to cool exposed containers. If cooling streams are ineffective (venting sound increases in volume and pitch, tank discolors, or shows any signs of deforming), withdraw immediately to a secure position. Always stay away from tanks engulfed in fire. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode.

Disposal Method Suggested: Dissolve or mix the material with a combustible solvent and burn in a chemical incinerator equipped with an afterburner and scrubber. All federal, state, and local environmental regulations must be observed.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- USEPA, Office of Pesticide Programs, Pesticide Residue Limits, "Benzoic Acid", 40 CFR 180.482. http://www.epa.gov/pesticides/food/viewtols.htm
- Sax, N. I., Ed., "Dangerous Properties of Industrial Materials Report" 1, No. 8, 38-40 (1981) and 3, No. 4, 37-40 (1983)
- New Jersey Department of Health and Senior Services, "Hazardous Substance Fact Sheet: Benzoic Acid," Trenton, NJ (May 2009). http://www.state.nj.us/health/eoh/rtkweb/0209.pdf
- New York State Department of Health, "Chemical Fact Sheet: Benzoic Acid," Albany, NY, Bureau of Toxic Substance Assessment (January 1986)

Bifenox B:0472

Use Type: Herbicide

CAS Number: 42576-02-3

Formula: $C_{14}H_9Cl_2NO_5$

Synonyms: Benzoic acid, 5-(2,4-dichlorophenoxy)-2-nitro-, methyl ester; 5-(2,4-Dichlorophenoxy)-nitrobenzoic acid, methyl ester; 2,4-Dichlorophenyl 3-(methoxycarbonyl)-4-nitrophenyl ether; Methyl 5-(2,4-dichlorophenoxy)-2-nitrobenzoate

Trade Names: ALIBI®; FOX®; MODOWN®[C]; MC-4379®; SABINE®

Chemical class: Diphenyl ether

EPA/OPP PC Code: 104301; (285200 former EPA code number)

California DPR Chemical Code: 1953

HSDB Number: 6567

UN/NA & ERG Number: UN3082 (liquid)/171

RTECS® Number: DG7890000

EC Number: 255-894-7

Uses: Used to control a variety of broadleaf weeds and grasses in legumes such as soybeans and peanuts, and post- emergent weed control in wheat, barley and sugar beets. Not currently registered in the U.S. However, it is used in 21 European countries and there are 27 global suppliers[97].

Regulatory Authority and Advisory Information: AB 2588-Air Toxics "Hot Spots" Chemicals (CAL) as chlorophenoxy pesticides

Acute Oral Category: 4, Caution

European/International Regulations: Not listed in Annex 1(42576-02-3)

Description: Yellow to beige crystalline solid or powder. Slight odor. Molecular weight =342.13; Specific gravity (H_2O:1) = 1.16 @ 20 °C; Boiling point = (decomposes); Freezing/Melting point = 83–85 °C; Vapor pressure = 2.4×10^{-6} mmHg @ 25 °C; Flash point = >200 °C. Practically insoluble in water.

Incompatibilities: Strong oxidizers. When heated to decomposition, emits nitrogen oxides and chlorine gas. Slightly corrosive to active metals such as aluminum.

Determination in Water: Log K_{ow} = >3.5. Values above 3.0 are likely to bioaccumulate in aquatic organisms.

Routes of Entry: Inhalation, ingestion, skin/eyes contact

Harmful Effects and Symptoms

Short Term Exposure: Poisonous; may be fatal if inhaled, swallowed, or absorbed through skin. Severely irritates eyes, skin and respiratory tract, with burning sensation, pain, redness and swelling. Metabolic stimulant. If inhaled, causes coughing, dilated pupils, headache, profuse perspiration, intense thirst, extreme fatigue, rapid pulse, high fever, clammy, flushed skin, rapid breathing, nausea, vomiting, cyanosis (bluish tint to skin and lips), anxiety and confusion, convulsions, risk of lung edema. If swallowed, face and lips turn bluish. Liver injury with associated jaundice, kidney failure, and cardiac arrhythmias are commonly noted. Nerve damage, which may be delayed, may include swelling of legs and feet, muscle twitch and stupor. Severe exposure can cause death from heart failure. Dust or liquid left in contact with the skin for several hours may be absorbed. This may result in severe delayed symptoms as listed above. These symptoms may last for months or years. LD_{50} (oral, rat) = >5 g/kg.; LD_{50} (dermal, rat) = >20000 mg/kg.

Long Term Exposure: Workers exposed to chlorophenoxy compounds over a 5 to 10 year period at levels above 10 mg/m^3 complained of weakness, rapid fatigue, headache and vertigo. Liver damage, low blood pressure and slowed heartbeat were also found. Based on animal tests, may affect human reproduction

Points of Attack: Eyes, skin, respiratory system, central nervous system, cardiovascular system, liver, kidney

Medical Surveillance: If symptoms develop or overexposure is suspected, the following may be useful: Liver and kidney function tests. Exam of the nervous system

First Aid: If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least 15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately. If this chemical contacts the skin, remove contaminated clothing and wash immediately with soap and water. Seek medical attention immediately. If this chemical has been inhaled, remove from exposure, begin rescue breathing (using universal precautions) if breathing has stopped, and CPR if heart action has stopped. Transfer promptly to a medical facility. When this chemical has been swallowed, get medical attention. *Do not induce vomiting when formulations containing petroleum solvents are ingested*. Otherwise, give large quantities of water and induce vomiting. Do not make an unconscious person vomit.

Personal Protective Methods: Diphenyl ether derivatives may react with the following absorbent materials: Cellulose-Based; Expanded Polymeric[88]. Wear protective gloves and clothing to prevent any reasonable probability of dermal and/or eye contact. Safety equipment suppliers/manufacturers can provide recommendations on the most protective glove/clothing material for your operation. DuPont™ Tychem® suit fabrics[88]. All protective clothing (suits, gloves, footwear, headgear) should be clean, available each day, and put on before work. Contact lenses should not be worn when working with this chemical. Wear splash chemical goggles and face shield unless full facepiece respiratory protection is worn. Employees should wash immediately with soap when skin is wet or contaminated. Provide emergency showers and eyewash.

Respirator Selection: Wherever and whenever workplace conditions warrant respirator use, a respiratory protection program must be followed that meets one or more of the following government standards: OSHA's 29 CFR 1910.134, ANSI Z88.2, or European Standard EN 149.

Storage: Color Code-Green: General storage may be used. Prior to working with this chemical you should be trained on its proper handling and storage. Store in tightly closed containers in a cool, well-ventilated area away from oxidizers, acids, water, or combustible materials. Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: Environmentally hazardous substances, solid or liquid, usually fall in Hazard Class 9.

Spill Handling: First, remove all sources of ignition. Evacuate persons not wearing protective equipment from area of spill or leak until clean up is complete. Collect powdered material in the most convenient and safe manner and deposit in sealed containers. Absorb liquid containing this chemical in vermiculite, dry sand, earth, or similar material. Ventilate area after clean up is complete. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable.

Fire Extinguishing: Hazardous decomposition includes toxic oxides of nitrogen and carbon. As an immediate precautionary measure, isolate spill or leak area in all directions for at least 50 meters/150 feet for liquids and at least 25 meters/75 feet for solids. *Fire involving storage or vehicular tanks:* isolate for 800 meters/0.5 mile in all directions; also, consider initial evacuation for 800 meters/0.5 mile in all directions. *On a small fire:* use dry chemical, CO_2, water spray or regular foam. *On a large fire:* use water spray, fog or regular foam. Do not scatter spilled material with high-pressure streams of water. Move containers from fire area if you can do it without risk. Dike fire-control water for later disposal. *Fire involving tanks:* from a secure, explosion-proof location, use water spray to cool exposed containers. If cooling streams are ineffective (venting sound increases in volume and pitch, tank discolors, or shows any signs of deforming), withdraw immediately to a secure position. Always stay away from tanks engulfed in fire. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode.

Disposal Method Suggested: It is the responsibility of chemical waste generators to determine the toxicity and physical properties and of a discarded chemical and to properly identify its classification and certification as a hazardous waste and to determine the disposal method. U.S. EPA guidelines for the classification determination are listed in 40 CFR Parts 261.3. Additionally, waste generators must consult and follow all regional, national, state and local hazardous waste laws to ensure complete and accurate classification and disposal methods.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- Food and Agricultural Organization of the United Nations (FAO), "*FAO Specifications for Plant Protection Products, Bifenox*, Rome, Italy (1994). http://www.fao.org/waicent/faoinfo/agricult/agp/agpp/pesticid/specs/docs/bife.doc

Bifenthrin B:0474

Use Type: Insecticide, Acaricide

CAS Number: 82657-04-3

Formula: $C_{23}H_{22}ClF_3O_2$

Synonyms: Biphenthrin; Caswell No. 463F; Cyclopropanecarboxylic acid,3-(2-chloro-3,3,3-trifluoro-1-propenyl)-2,2-dimethyl-,[2-methyl(1,1'-biphenyl)3-yl] methyl ester,*(Z)*-

Trade Names: BIFLEX®; BISTAR®; BRIGADE®; CAPTURE® Bifenthrin; DISCIPLINE®; DOUBLE THREAT®; EMPOWER®; FMC® 54800; FMC® 58000; TALSTAR®; TALSTAR LAWN & TREE®; TORANT®; ZIPAK®

Chemical class: Pyrethroid

EPA/OPP PC Code: 128825

California DPR Chemical Code: 2300

HSDB Number: 6568

UN/NA & ERG Number: UN2588 (Pesticide, solid, poisonous, n.o.s.)/151; UN2902 (Pesticide, liquid, poisonous, n.o.s.)/151

RTECS® Number: GZ12278000

Uses: A broad-spectrum insecticide. Registered to control cone worms, seed bugs, seed worms and other insects and mites on rangeland, forests and right-of-ways. It is also used to control household and lawn pests. A U.S. EPA restricted Use Pesticide (RUP).

U.S. Maximum Allowable Residue Levels for Bifenthrin [(40CFR180.442(a)(1)]: Almond, hulls 2.0 ppm; artichoke, globe 1.0 ppm; banana (there are no U.S. registrations as of April 30, 2003) 0.1 ppm; beet, garden, roots 0.45 ppm; beet, garden, tops 15 ppm; brassica, head and stem, subgroup 5A, except cabbage 0.6 ppm; brassica, leafy greens, subgroup 5B, 3.5 ppm; bushberry subgroup 13-07B, 1.8 ppm; cabbage 4.0 ppm; caneberry subgroup 13A, 1.0 ppm; cattle, fat 1.0 ppm; cattle, meat byproducts 0.10 ppm; cattle, meat 0.5 ppm; coriander, dried leaves 25 ppm; coriander, leaves 6.0 ppm; coriander, seed 5.0 ppm; corn, field, forage 3.0 ppm; corn, field, grain 0.05 ppm; corn, field, stover 5.0 ppm; corn, pop, grain 0.05 ppm; corn, pop, stover 5.0 ppm; corn, sweet, forage 3.0 ppm; corn, sweet, kernel plus cob with husk removed 0.05 ppm; corn, sweet, stover 5.0 ppm; eggplant 0.05 ppm; egg 0.05 ppm; fruit, citrus, group 10, 0.05 ppm; goat, fat 1.0 ppm; goat, meat byproducts 0.10 ppm; goat, meat 0.5 ppm; grain, aspirated fractions 70 ppm; grape 0.2 ppm; groundcherry 0.5 ppm; herb subgroup 19A, 0.05 ppm; hog, fat 1.0 ppm; hog, meat byproducts 0.10 ppm; hog, meat 0.5 ppm; hop, dried cones 10.0 ppm; horse, fat 1.0 ppm; horse, meat byproducts 0.10 ppm; horse, meat 0.5 ppm; leafy petioles subgroup 4B, 3.0 ppm; lettuce, head 3.0 ppm; mayhaw 1.4 ppm; milk, fat (reflecting 0.1 ppm; ppm in whole milk 1.0 ppm; nut, tree, group 14, 0.05 ppm; okra 0.50 ppm; pea and bean, dried shelled, except soybean, subgroup 6C, 0.15 ppm; pea and bean, succulent shelled, subgroup 6B, 0.05 ppm; peanut 0.05 ppm; pear 0.5 ppm; pepino 0.5 ppm; pepper, bell 0.5 ppm; pepper, nonbell 0.5 ppm; pistachio 0.05 ppm; poultry, fat 0.05 ppm; poultry, meat byproducts 0.05 ppm; poultry, meat 0.05 ppm; radish, tops 4.5 ppm; rapeseed, seed 0.05 ppm; sheep, fat 1.0 ppm; sheep, meat byproducts 0.1 ppm; sheep, meat 0.5 ppm; soybean, hulls 0.50 ppm; soybean, refined oil 0.30 ppm; soybean, seed 0.2 ppm; spinach 0.2 ppm; strawberry 3.0 ppm; tomato 0.15 ppm; turnip, greens 3.5 ppm; vegetable, cucurbit, group 9, 0.4 ppm; vegetable, legume, edible podded, subgroup 6A, 0.6 ppm; vegetable, root, subgroup 1B except sugar beet and garden beet 0.10 ppm; vegetable, tuberous and corm, subgroup 1C, 0.05 ppm. [*(40CFR180.442(a)(2)*]: a tolerance of 0.05 ppm is established for residues of bifenthrin as follows: (i) in or on all food/feed items (other than those covered by a higher tolerance as a result of use on growing crops) in food/feed handling establishments. (ii) The insecticide may be present as a residue from application in food handling establishments, including food service, manufacturing and processing establishments, such as restaurants, cafeterias, supermarkets, bakeries, breweries, dairies, meat slaughtering and packing plants, and canneries, feed handling establishments including feed manufacturing and processing establishments, in accordance with the following prescribed conditions: (A) application shall be limited to general surface and spot and/or crack and crevice treatment in food/feed handling establishments where food/feed and food/feed products are held, processed, prepared and served. General surface application may be used only when the facility is not in operation provided exposed food/feed has been covered or removed from the area being treated. Spot and/or crack and crevice application may be used while the facility is in operation provided exposed food/feed is covered or removed from the area being treated prior to application. Spray concentration shall be limited to a maximum of 0.06 percent active ingredient. Contamination of food/feed or food/feed contact surfaces shall be avoided. (B) To ensure safe use of the insecticide, its label and labeling shall conform to that registered with the U.S. Environmental Protection Agency and shall be used in accordance with such label and labeling.

Human toxicity (long-term)[101]***:*** Intermediate–10.50 ppb, Health Advisory

Fish toxicity (threshold)[101]***:*** Extra high–0.06197 ppb, MATC (Maximum Acceptable Toxicant Concentration)

Regulatory Authority and Advisory Information: Carcinogenicity[83]: EPA Group C, possible human carcinogen
Acute Oral Category: 2, WARNING
Health Advisory: Nerve Toxin (S!), Developmental Toxin: Developmental/Reproductive Toxin (TRI); Endocrine disruptor (S!)
EPCRA Section 313 Form R *de minimis* concentration reporting level: 1.0%

Description: Off white to pale tan waxy substance. Faint, sweet odor. Molecular weight = 422.9; Specific gravity (H_2O:1) = 1.2125 @ 20 °C; Boiling point = (decomposes); Freezing/Melting point = 51 °C; 57 – 63 °C; Vapor pressure = 1.8×10^{-7} mmHg; Flash point = 165 °C(oc). Practically insoluble in water; solubility = <0.1 mg/L.

Incompatibilities: May react violently with strong oxidizers, bromine, 90% hydrogen peroxide, phosphorus trichloride, silver powders or dust. Incompatible with silver compounds, lime and ordinary soaps. Mixture with some silver compounds forms explosive salts of silver oxalate.

Permissible Exposure Limits in Air: NIOSH(2) IDLH = 5,000 ppm
OSHA PEL: 5 mg/m^3 TWA
NIOSH REL: 5 mg/m^3 TWA
ACGIH TLV®[1]: 5 mg/m^3 TWA
STEL set by HSE[33] = 10 mg/m^3.

Determination in Air: Collection by impinger or fritted bubbler, analysis by gas-liquid chromatography/ultraviolet. See NIOSH IV, Method #5008[18], as pyrethroid.

Permissible Concentration in Water: Acceptable Daily Intake (ADI) =0.02 mg/kg as pyrethroid. Runoff from spills or fire control may cause water pollution.

Determination in Water: Log K_{ow} = >6.0. Values above 3.0 are likely to bioaccumulate in aquatic organisms.

Routes of Entry: Inhalation, ingestion, dermal and/or eye contact.

Harmful Effects and Symptoms

Short Term Exposure: May cause irritation of the skin, eyes, and respiratory tract. Skin sensitizer. Overexposure may cause tremors and staggered gait. LD_{50} (oral, rat) = 53–210 mg/kg; LD_{50} (dermal, rat) = >2 g/kg.

Long Term Exposure: Fluorides may cause bone disease (pain and tenderness of the bones); mottled teeth in children. May be a nerve poison. A suspected carcinogen and endocrine disputer.

Points of Attack: Bones, central nervous system; endocrine system (suspected).

Medical Surveillance: This chemical is a suspected or known human carcinogen. Exposed persons should contact a physician for advice regarding the possible long term health effects and advice for medical monitoring. Before beginning employment and at regular times after that, the following are recommended: Employees should be screened for history of certain medical conditions which might place the employee at increased risk from pyrethroid exposure. Chronic respiratory disease: In persons with chronic respiratory disease, especially asthma, the inhalation of pyrethroids might cause exacerbation of symptoms due to its sensitizing properties. Lung function tests. These may be normal if the person is not having an attack at the time of the test. Consider chest x-ray if lung symptoms are present. Skin disease: Pyrethroids can cause dermatitis which may be allergic in nature. Persons with pre-existing skin disorders may be more susceptible to the effects of this agent. Evaluation by a qualified allergist, including exposure history and testing, may help diagnose allergy. Any employee developing the above-listed conditions should be referred for further medical examination[9].

First Aid: If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least 15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately. Give artificial respiration if victim is not breathing. *Do not* use mouth-to-mouth method if victim ingested or inhaled the substance; give artificial respiration with the aid of a pocket mask equipped with a one-way valve or other proper respiratory medical device. Administer oxygen if breathing is difficult. Remove and isolate contaminated clothing and shoes. In the case of contact with substance, immediately flush skin or eyes with running water for at least 20 minutes. For minor skin contact, avoid spreading material on unaffected skin. Keep victim warm and quiet. Effects of exposure (inhalation, ingestion or skin contact) to substance may be delayed. Ensure that medical personnel are aware of the material(s) involved and take precautions to protect themselves. *Do not induce vomiting when formulations containing petroleum solvents are ingested*. Otherwise, give large quantities of water and induce vomiting. Do not make an unconscious person vomit.

Personal Protective Methods: Applicators and other handlers must wear: Coveralls worn over long-sleeved shirt and long pants; Chemical-resistant gloves such as DuPont™ Tychem® suit fabrics, barrier laminate, or Viton®; Chemical-resistant footwear plus socks; Protective eye wear; Chemical-resistant headgear for overhead exposure; Chemical-resistant apron when cleaning equipment, mixing, or loading[83]. Agricultural Use/Engineering Controls: When handlers use closed systems, enclosed cabs, or aircraft in a manner that meets the requirements listed in the Worker Protection Standard (WPS) for agricultural pesticides, 40 CFR 170.240(d)(4-6), the handler PPE requirements may be reduced or modified as specified in the Worker Protection Standard. Firefighters should wear NIOSH approved self-contained breathing apparatus and full protective clothing.

Respirator Selection: NIOSH/OSHA *for pyrethrum*: *50 mg/m^3:* CcrOv95 (APF = 10) [any air-purifying half-mask respirator equipped with an organic vapor cartridge(s) in combination with an N95, R95, or P95 filter. The following filters may also be used: N99, R99, P99, N100, R100, P100]; or Sa (APF = 10) (any supplied-air respirator). *125 mg/m^3:* Sa:Cf (APF = 25) (any supplied-air respirator operated in a continuous-flow mode); or PaprOvHie (APF = 25) (any air-purifying full facepiece respirator equipped with an organic vapor cartridge in combination with a high-efficiency particulate filter). *250 mg/m³:* CcrFOv100 (APF = 50) [any air-purifying full facepiece respirator equipped with organic vapor cartridge(s) in combination with an N100, R100, or P100 filter]; or PaprTOvHie (APF = 50) [any powered, air-purifying respirator with a tight-fitting face-piece and organic vapor cartridge(s) in combination with a high-efficiency particulate filter]; or SCBAF (APF = 50) (any self-contained breathing apparatus with full facepiece); or SaF (APF = 50) (any supplied-air respirator with a full facepiece). *5000 mg/m³:* SaF:Pd,Pp (APF = 2000) (any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode). *Emergency or planned entry into unknown concentrations or IDLH conditions:* SCBAF:Pd,Pp (APF = 10,000) (any self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode); or SaF:Pd,Pp:ASCBA (APF = 10,000) (any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary self-contained breathing apparatus operated in a pressure-demand or other positive-pressure mode). *Escape:* GmFOv100 (APF = 50) [any air-purifying, full facepiece respirator (gas mask) with a chin-style, front- or back-mounted organic vapor canister having an N100, R100, or P100 filter]; or SCBAE (any appropriate escape-type, self-contained breathing apparatus). *Note:* Substance reported to cause eye irritation or damage; may require eye protection.

Storage: Color Code-Blue: Health Hazard/Poison. Store in a secure poison location at temperature <35 °C and away from alkaline materials. Prior to working with this chemical you should be trained on its proper handling and storage. Store in tightly closed containers in a cool, well-ventilated area. Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: Pesticides, solid, toxic/poisonous, n.o.s require a shipping label of "poisonous materials" and fall in Hazard Class 6.1. Technical name required.

Spill Handling: First, remove all sources of ignition. Evacuate persons not wearing protective equipment from area of spill or leak until clean up is complete. Ventilate area of spill or leak. Use water spray to reduce vapor. Absorb liquids in vermiculite, dry sand, earth, or a similar material and deposit in sealed containers. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable.

Fire Extinguishing: Hazardous decomposition includes oxides of carbon and hydrogen fluoride and hydrogen chloride gases. *On a small fire:* use dry chemical, CO_2 or water spray. *On a large fire:* use water spray, fog or regular foam. Move containers from fire area if you can do it without risk. Dike fire-control water for later disposal; do not scatter the material. Use water spray or fog; do not use straight streams. *Fire involving storage or vehicular tanks:* isolate for 800 meters/0.5 mile in all directions; also, consider initial evacuation for 800 meters/0.5 mile in all directions. Fight fire from maximum distance or use unmanned hose holders or monitor nozzles. Do not get water inside containers. Cool containers with flooding quantities of water until well after fire is out. Withdraw immediately in the case of rising sound from venting safety devices or discoloration of tank. ALWAYS stay away from tanks engulfed in fire. For massive fire, use unmanned hose holders or monitor nozzles; if this is impossible, withdraw from area and let fire burn. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies.

Disposal Method Suggested: Incineration would be an effective disposal procedure where permitted. If an efficient incinerator is not available, the product should be mixed with large amounts of combustible material and contact with the smoke should be avoided. In accordance with 40CFR165, follow recommendations for the disposal of pesticides and pesticide containers.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- EXTOXNET, Extension Toxicology Network, "Pesticide Information Profile, Bifenthrin," Oregon State University, Corvallis, OR (September 1995). http://extoxnet.orst.edu/pips/bifenthr.htm
- USEPA, Office of Pesticide Programs, Pesticide Residue Limits, "Bifenthrin, " 40 CFR 180.442. http//www.epa.gov/cgi-bin/oppsrch
- Johnson, M.; Luukinen, B.; Gervais, J.; Buhl, K.; Stone, D., *Bifenthrin Technical Fact Sheet*; National Pesticide Information Center, Oregon State University Extension Services, Corvallis OR (2010)

Bitertanol B:0555

Use Type: Fungicide

CAS Number: 55179-31-2

Formula: $C_{20}H_{23}N_3O_2$

Synonyms: β-[(1,1'-Biphenyl)-4-yloxy]-α-(1,1-dimethylethyl)-1*H*-1,2,4-triazole-1-ethanol; 1*H*-1,2,4-Triazole-1-ethanol, β-[(1,1'-biphenyl)-4-yloxy]-α-(1,1-dimethylethyl)-

Trade Names: BAYCOR®; BAY KWG 0599®; BAYMAT-SPRAY®; BILOXAZOL®; KWG 0599®; SIBUTOL®, (with Fuberidazole)

Chemical class: Azole; Triazole

EPA/OPP PC Code: 117801

UN/NA & ERG Number: UN2811/154

RTECS® Number: XZ4803050

EC Number: 259-513-5

Uses: A fungicide used to control a variety of diseases. Used as control for prunes when drying. Not currently registered in the U.S. or EU countries[115] (pending). Used in many European, South American, Far Eastern and African countries, a well as in Australia for use on beans (all types) and various ornamentals. More than 20 global suppliers[97].

Regulatory Authority and Advisory Information: Acute Oral Category: 3, CAUTION
Health Advisory: Endocrine disruptor (S!)

Description: Colorless crystalline solid. Aromatic odor. Slightly soluble in water; solubility = 5 ppm @ 20 °C. Molecular weight 337.48; Freezing/Melting point = 126 °C; Vapor pressure 10^{-5} mmHg @ 20 °C.

Incompatibilities: The triazoles are sensitive to heat, friction, and impact. Sensitivity varies with the type of substitution to the triazole ring. Metal chelated and halogen substitution of the triazol ring make for a particularly heat-sensitive material. Azido and nitro derivatives have been employed as high explosives. No matter the derivative these materials should be treated as explosives[88].

Determination in Water: Log K_{ow} = >4.0. Values greater than 3.0 may bioaccumulate in marine organisms.

Routes of Entry: Ingestion, dermal and/or eye contact.

Harmful Effects and Symptoms

Short Term Exposure: Poisonous if swallowed. Contact may irritate skin and cause eye irritation and possible severe injury. Avoid inhalation. LD_{50} (oral, rat) = >5 g/kg; LD_{50} (dermal, rat) = >5 g/kg.

Long Term Exposure: May impair fertility in humans.

Points of Attack: May cause harm to the unborn child.

Medical Surveillance: In addition to comprehensive initial medical and work histories emphasizing reproductive experience and menstrual history, patient should have physical examination and testing of genito-urinary tract, sperm count, motility and morphology. If required, other tests, such as serum testosterone, serum follicle stimulating hormone (FSH), and serum lutenizing hormone (LH), may be indicated.

First Aid: If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least 15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately. If this chemical contacts the skin, remove contaminated clothing and wash immediately with soap and water. Seek medical attention immediately. If this chemical has been inhaled, remove from exposure, begin rescue breathing (using universal precautions) if breathing has stopped, and CPR if heart action has stopped. Transfer promptly to a medical facility. When this chemical has been swallowed, get medical attention. Give large quantities of water and induce vomiting. Do not make an unconscious person vomit.

Personal Protective Methods: Wear positive-pressure self-contained breathing apparatus (SCBA). Wear chemical protective clothing that is specifically recommended by the manufacturer. DuPont™ Tychem® Suit Fabrics is recommended by one government source[88]. It may provide little or no thermal protection. Structural firefighters' protective clothing provides limited protection in fire situations ONLY; it is not effective in spill situations where direct contact with the substance is possible.

Respirator Selection: Where the neat (undiluted) test chemical is weighed and diluted, wear a NIOSH-approved half-face respirator equipped with a combination filter cartridge, i.e. organic vapor/acid gas/HEPA (specific for organic vapors, HCl, acid gas, SO_2 and a high-efficiency particulate filter)[88]. Wherever and whenever workplace conditions warrant respirator use, a respiratory protection program must be followed that meets one or more of the following government standards: OSHA's 29 CFR 1910.134, ANSI Z88.2, or European Standard EN 149.

Storage: Color Code-Blue: Health Hazard/Poison. Store in a secure poison location. Refrigerate. Prior to working with this chemical you should be trained on its proper handling and storage. Store in tightly closed containers in a cool, well-ventilated area. Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: Toxic, solids, organic, n.o.s. require a label of “poisonous materials.” This material falls in Hazard Class 6.1 and Packing Group III.

Spill Handling: For solids, isolate spill or leak area in all directions for at least 25 meters/75 feet. Increase, in the downwind direction, as necessary.First, remove all sources of ignition. Evacuate persons not wearing protective equipment from area of spill or leak until clean up is complete. Do not touch damaged containers or spilled material unless wearing appropriate protective clothing. Stop leak if you can do it without risk. Prevent entry into waterways, sewers, basements or confined areas. Cover with plastic sheet to prevent spreading. Absorb or cover with dry earth, sand or other non-combustible material and transfer to containers. If you spill this chemical, you should dampen the solid spill material with water, then transfer the dampened material to a suitable container. Use absorbent paper dampened with water to pick up any remaining material. Seal your contaminated clothing and the absorbent paper in a vapor-tight plastic bag for eventual disposal. Wash all contaminated surfaces with a soap and water solution. Do not reenter the contaminated area until the Safety Officer (or other responsible person) has verified that the area has been properly cleaned. Do not allow water to get inside containers. Ventilate area after clean up is complete. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable.

Fire Extinguishing: Hazardous decomposition includes toxic oxides of nitrogen and carbon. *Fire involving storage or vehicular tanks:* isolate for 800 meters/0.5 mile in all directions; also, consider initial evacuation for 800 meters/0.5 mile in all directions. *Small fire:* dry chemical, carbon dioxide or water spray. *Large fire:* dry chemical, carbon dioxide, alcohol-resistant foam or water spray. Move containers from fire area if you can do it without risk. Dike fire-control water for later disposal; do not scatter the material. *Fire involving tanks or car/trailer loads:* fight fire from maximum distance or use unmanned hose holders or monitor nozzles. Do not get water inside containers. Cool containers with flooding quantities of water until well after fire is out. Withdraw immediately in the case of rising sound from venting safety devices or discoloration of tank. Always stay away from tanks engulfed in fire.

Disposal Method Suggested: Consult with environmental regulatory agencies for guidance on acceptable disposal practices. Contact a licensed disposal facility about surplus and non-recyclable solutions. Burn in a chemical incinerator equipped with an afterburner and scrubber. Extra care must be exercised as the material in an organic solvent is highly flammable. In accordance with 40CFR165, follow recommendations for the disposal of pesticides and pesticide containers. Containers must be disposed of properly by following package label directions or by contacting your local or federal environmental control agency, or by contacting your regional EPA office. Incineration or permanganate oxidation.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- USEPA, *Report of the Food Quality Protection Act (FQPA) Tolerance Reassessment Progress and Risk Management Decision (TRED) for Bitertanol*, EPA 738-R-05-015, Washington DC (November 2005)

Bromacil B:0640

Use Type: Herbicide

CAS Number: 314-40-9; *(alt.)* 154670-12-9

Formula: $C_9H_{13}BrN_2O_2$

Synonyms: Bromacil 1.5; Bromazil; 5-Bromo-3-*sec*-butyl-6-methyluracil; 5-Bromo-6-methyl-3-(1-methylpropyl)-2,4-(1H,3H)-pyrimidinedione; 5-Bromo-6-methyl-3-(1-methylpropyl)-2,4(1H,3H)-pyrimidinedione; Cynogan; 2,4(1H,3H)-Pyrimidinedione, 5-bromo-6-methyl-3-(1-methylpropyl)-; Uracil, 5-Bromo-3-*sec*-butyl-6-methyl

Trade Names: BOREA®; BOROCIL EXTRA®; α-BROMACIL 80 WP®; BROMAX®; CROPTEX ONYX®; CYNOGEN®; DuPont™ HERBICIDE 976®; EEREX®; FENOCIL®; HERBICIDE 976®; HIBOR; HYDON®; HYVAR®; HYVAR-X®; HYVAR X BROMACIL®; HYVAR X-L®; HYVAR X WEED KILLER®; HYVAR X-WS®; ISOCIL®; KROVAR®; NALKIL®; ROUT®; URAGAN®; URAGON®; UROX®; UROX B WATER SOLUBLE CONCENTRATE WEED KILLER®; UROX HX GRANULAR WEED KILLER®; WEED-BROOM® (mixture of DSMA, Bromacil & 2,4-D)

Chemical class: Uracil

EPA/OPP PC Code: 012301

California DPR Chemical Code: 83

HSDB Number: 1522

UN/NA & ERG Number: UN3077(solid)/171

RTECS® Number: YQ9100000

EC Number: 206-245-1

Uses: Bromacil is used primarily for the control of annual and perennial grasses and broadleaf weeds, both nonselectively on noncrop lands and selectively for weed-control in citrus and pineapple crops. The top five applications in California for which this is used are oranges, lemons, grapefruit, and right-of-ways and landscapes. A limit of 0.1 mg/kg of agricultural products is set in several countries[35]. Not approved for use in EU countries.

US. Maximum Allowable Residue Levels for Bromacil (40 CFR 180.210): fruit, citrus 0.1 ppm; pineapple 0.1 ppm.

Human toxicity (long-term)[101]: Low–90.00 ppb, Health Advisory

Fish toxicity (threshold)[101]: Very low–6485.34001 ppb, MATC (Maximum Acceptable Toxicant Concentration)

Regulatory Authority and Advisory Information:

Carcinogenicity[83]: EPA Group C, possible human carcinogen; ACGIH A3 Confirmed animal carcinogen with unknown relevance to humans

California Proposition 65 Chemical: Bromacil, lithium salt, developmental (5/18/ 1999)

Health Advisory: Mutagen, Developmental/Reproductive Toxin

Acute Oral Category: 3, CAUTION

Potential Ground Water Pollutant [California FAC Section 13149)

Safe Drinking Water Act: Priority List (55FR1470)

EPCRA Section 313 Form R *de minimis* concentration reporting level: 1.0%

Description: Bromacil is a noncombustible colorless, crystalline solid. It may be commercially available in granular, water-soluble, wettable powder or as a flammable liquid formulation (in ethanol or methanol). Molecular weight = 261.12; Specific gravity (H_2O:1) = 1.55 @ 25 °C; Boiling point = (sublimes); Freezing/Melting point = 158.3 °C (sublimes); Vapor pressure = 0.0008 mmHg @ 25 °C (NIOSH); 3.1×10^{-7} mmHg[83]; Flash point (*in ethanol or methanol*) = 44 °C. Hazard Identification (based on NFPA-704 M Rating System): Health 1, Flammability 1, Reactivity 0; (*in ethanol or methanol*): Health 1, Flammability 2, Reactivity 0. Solid material is highly soluble in water. Commercial formulations use carrier solvents that may alter the physical properties shown.

Incompatibilities: Aqueous solution is a weak acid. Incompatible with strong acids, oxidizers, heat. Decomposes slowly in strong acids. Emits toxic fumes of nitrogen oxides and bromine and when heated to decomposition

Permissible Exposure Limits in Air: Conversion factor: 1 ppm = 10.68 mg/m^3 @ 25 °C & 1 atm

OSHA PEL: None

NIOSH REL: 1 ppm/10 mg/m^3 TWA

ACGIH 10 mg/m^3 TWA, confirmed animal carcinogen with unknown relevance to humans.

No Protective Action Criteria (PAC) available.

Determination in Air: Filter; none; Gravimetri; NIOSH Methods (IV) #0500, Particulates NOR (total).[18].

Permissible Concentration in Water: Federal Drinking Water Guidelines: 70 ppb[14]. State Drinking Water Guidelines: Arizona 80 μg/L; Maine 70 μg/L.

Determination in Water: Log K_{ow} = <2.0. Unlikely to bioaccumulate in marine organisms.

Routes of Entry: Inhalation, ingestion, skin and/or eye contact

Harmful Effects and Symptoms

Short Term Exposure: Irritates the eyes, skin, upper respiratory system, lungs. Inhalation can cause irritation, coughing and wheezing. LD_{50} (oral, rat) = <5000 mg/kg; LD_{50} (dermal, rat) = >5 g/kg.

Long Term Exposure: Has caused thyroid affects in animals

Points of Attack: Eyes, skin, respiratory system, thyroid

Medical Surveillance: Preliminary medical exam to detect chronic diseases of central nervous system, liver, heart, kidneys, lung and skin, as well as endocrinological or immunological disturbances, should protect susceptible individuals. Periodical medical exams of internal organs, skin and eyes are important to avoid chronic occupational intoxications. They should include lab and patch tests when necessary[83]. Before beginning employment and at regular times after that, for those with frequent or potentially high exposures, the following is recommended: Lung function tests. Thyroid function tests. Consider x-ray following acute overexposure.

First Aid: If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least 15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately. If this chemical contacts the skin, remove contaminated clothing and wash immediately with soap and water. Seek medical attention immediately. If this chemical has been inhaled, remove from exposure, begin rescue breathing (using universal precautions) if breathing has stopped, and CPR if heart action has stopped. Transfer promptly to a medical facility. When this chemical has been swallowed, get medical attention. Give large quantities of water and induce vomiting. Do not make an unconscious person vomit.

Personal Protective Methods: Reacts with the following kinds of absorbents: Mineral- and Clay-Based[88]. Wear protective gloves and clothing to prevent any reasonable probability of dermal and/or eye contact. Safety equipment suppliers/manufacturers can provide recommendations on the most protective glove/clothing material for your operation. All protective clothing (suits, gloves, footwear, headgear) should be clean, available each day, and put on before work. Contact lenses should not be worn when working with this chemical. Wear splash- or dust-proof chemical goggles (depending on physical state of material) and face shield unless full facepiece respiratory protection is worn. Employees should wash immediately with soap when skin is wet or contaminated. Provide emergency showers and eyewash.

Respirator Selection: *At any concentrations above the NIOSH REL, or where there is no REL, at any detectable concentration:* SCBAF: Pd,Pp (APF = 10,000) (any NIOSH/MSHA- or European Standard EN 149-approved self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode); or SaF: Pd,Pp: ASCBA (APF = 10,000) (any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary, self-contained breathing apparatus operated in a pressure-demand or other positive-pressure mode).

Storage: Color Code-Blue: Health Hazard/Poison. Store in a secure poison location. Color Code-Green: General storage may be used. Prior to working with bromacil you should be trained on its proper handling and storage. Store in tightly closed containers in a cool, well-ventilated area away from strong acids; oxidizers, heat and open flame. Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: Environmentally hazardous substances, solid or liquid, usually fall in Hazard Class 9.

Spill Handling: Evacuate and restrict persons not wearing protective equipment from area of spill or leak until clean up is complete. Absorb liquid containing bromacil in vermiculite, dry sand, earth, or similar material. Collect powdered material in the most convenient and safe manner and deposit in sealed containers. Ventilate area of spill or leak after clean up is complete. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable. Soil Adsorption Index K_{oc} = 32.

Fire Extinguishing: Bromacil may burn, but does not readily ignite; may be ignited by heat or open flame. Dust may cause an explosion. As an immediate precautionary measure, isolate spill or leak area in all directions for at least 50 meters/150 feet for liquids and at least 25 meters/75 feet for solids. *Fire involving storage or vehicular tanks:* isolate for 800 meters/0.5 mile in all directions; also, consider initial evacuation for 800 meters/0.5 mile in all directions. *On a small fire:* use dry chemical, CO_2, water spray or regular foam. *On a large fire:* use water spray, fog or regular foam. Do not scatter spilled material with high-pressure streams of water. Move containers from fire area if you can do it without risk. Dike fire-control water for later disposal. *Fire involving tanks:* from a secure, explosion-proof location, use water spray to cool exposed containers. If cooling streams are ineffective (venting sound increases in volume and pitch, tank discolors, or shows any signs of deforming), withdraw immediately to a secure position. Always stay away from tanks engulfed in fire. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode.

Disposal Method Suggested: Bromacil should be incinerated in a unit operating @ 850 °C equipped with gas scrubbing equipment.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- USEPA, Office of Pesticide Programs, Pesticide Residue Limits, “Bromacil ”, 40 CFR 180.210. http://www.epa.gov/cgi-bin/oppsrch
- New Jersey Department of Health and Senior Services, “Hazardous Substance Fact Sheet: Bromacil,” Trenton, NJ (August 1992, rev. July 1998). http://www.state.nj.us/health/eoh/rtkweb/0251.pdf
- EXTOXNET, Extension Toxicology Network, “Pesticide Information Profile, Bromacil,” Oregon State University, Corvallis, OR (June 1996) http://ace.orst.edu/info/extoxnet/pips/bromacil
- USEPA, *R.E.D. FACTS, Bromacil*, EPA 738-F-96-013, Washington DC (August 1996)

Bromadiolone B:0650

Use Type: Rodenticide

CAS Number: 28772-56-7

Formula: $C_{30}H_{23}BrO_4$

Synonyms: 2H-1-Benzopyran-2-one, 3-(3-[4'-bromo(1,1'-biphenyl)-4-yl]-3-hydroxy-1-phenylpropyl-4-hydroxy-; Bromadialone; 3-[3-(4'-bromo(1,1'-biphenyl)-4-yl)3-hydroxy-1-phenylpropyl]-4-hydroxy-2H-1-benzopyran-2-one;3-[3-(4'-Bromobiphenyl)-4-yl]3-hydroxy-1-phenylpropyl)-4-hydroxy-coumarin; 3-[α-(ρ-(ρ-Bromophenyl)-β-hydroxyphenethyl)benzyl]-4-hydroxy-coumarin; Coumarin, 3-[3-(4'-bromo-1,1'-biphenyl-4-yl)-3-hydroxy-1-phenylpropyl]-4-hydroxy-; Coumarin, 3-[α-(ρ-(ρ-bromophenyl)-β-hydroxyphenethyl) benzyl]-4-hydroxy-

Trade Names: BOLDO®; BOOT HILL®; BROMONE®; CANADIEN 2000®; CONTRAC®; HAWK®; LM-637®; MAKI®; RAT ARREST®; RAT FREE®; RATIMUS®; RENTOKIL DEADLINE®; SLAYMOR®; SUPER-CAID®; SUPER-ROZOL®; SUP'ORATS®; TERMUS®

Chemical class: Coumarin

EPA/OPP PC Code: 112301; (208500 & 214600 use code No. 112001)

California DPR Chemical Code: 2135

HSDB Number: 6458

UN/NA & ERG Number: UN3027/151; UN3026/151 (liquid)

RTECS® Number: GN4934700

EC Number: 206-245-1

Uses: Bromadiolone is used as an anticoagulant rodenticide and used as bait for rodent control against house mice, roof rats and warfarin-resistant Norway rats. It is also authorized by USDA for use in official establishments operating under the Federal meat, poultry, shell egg grading and egg products inspection program.

Regulatory Authority and Advisory Information: Acute Oral Category: 1, DANGER–POISON

Superfund/EPCRA 302 Extremely Hazardous Substances: TPQ = 100/10,000 lb (45.4/4540 kg)

CERCLA Reportable Quantity (RQ): 100 lb (45.4 kg)

Description: Bromadiolone is white to off-white (yellowish) powder. Molecular weight = 527.44[83]; Boiling point = (decomposes); Freezing/Melting point = 199–210 °C[83]. Hazard Identification (based on NFPA-704 M Rating System): Health 4, Flammability 1, Reactivity 0. Low solubility in water.

Incompatibilities: Aqueous solution is a weak acid. May cause metal corrosion.

Permissible Exposure Limits in Air: Protective Action Criteria (PAC) Ver. 27[89]

PAC-1 0.091 mg/m^3

PAC-2: 1 mg/m^3

PAC-3: 3.4 mg/m^3

Permissible Concentration in Water: Runoff from spills or fire control may cause water pollution.

Determination in Water: Contaminant: potential groundwater. Log K_{ow} = >4.0. Values above 3.0 are likely to bioaccumulate in aquatic organisms. EU Drinking Water Guidelines (MAC) = 0.16 μg/L.

Routes of Entry: Ingestion, inhalation, skin and/or eye contact. Persons who are taking anticoagulants or are suffering from bleeding disorders must be protected from exposure.

Harmful Effects and Symptoms: The onset of the symptoms of poisoning may be delayed for a few days following ingestion. Typical symptoms of poisoning include increased bleeding. Coagulation problems may be detected by laboratory analyses only. Large exposures may cause excessive bleeding from minor cuts or abrasions, bleeding from the gums and/or blood in feces. Massive internal bleeding may result in shock. A victim with anemia and/or liver disease may have more severe and persistent poisoning that may be extremely difficult to control.

Short Term Exposure: Bromadiolone is very toxic by inhalation, contact with the skin and by ingestion. May cause eye irritation. Signs and symptoms of acute bromadiolone exposure: Bromadiolone is an anticoagulant. Hemorrhage is the most common effect and may be manifested by nose bleeding, gum bleeding, bloody stools and urine, ecchymoses (extravasations of blood into skin), and hemoptysis (coughing up of blood). Bruising is heightened. Abdominal and flank pains are also common. LD_{50} (oral, rat) = 490 μ/kg[9]; LD_{50} (dermal, rabbit) = >2000 μg/kg[9].

Long Term Exposure: May cause skin and eye irritation; gastroenteritis; inflammation of the stomach/intestinal mucous membranes. May cause liver or kidney damage.

First Aid: *Emergency Life-Support Procedures:* Acute exposure to this chemical may require decontamination and life support for the victims. Emergency personnel should wear protective clothing appropriate to the type and degree of contamination. Air-purifying or supplied-air respiratory equipment should also be worn, as necessary. Rescue vehicles should carry supplies such as plastic sheeting and disposable plastic bags to assist in preventing spread of contamination. Inhalation Exposure: 1. Move victims to fresh air. Emergency personnel should avoid self-exposure to this chemical. 2. Evaluate vital signs including pulse and respiratory rate, and note any trauma. If no pulse is detected, provide CPR. If not breathing, provide artificial respiration. If breathing is labored, administer oxygen or other respiratory support. 3. Obtain authorization and/or further instructions from the local hospital for administration of an antidote or performance of other invasive procedures. 4. RUSH to a health care facility. *Dermal/Eye Exposure:* 1. Remove victims from exposure. Emergency personnel should avoid self-exposure to this chemical. 2. Evaluate vital signs including pulse and respiratory rate, and note any trauma. If no pulse is detected, provide CPR. If not breathing, provide artificial respiration. If breathing is labored, administer oxygen or other respiratory support. 3. Remove contaminated clothing as soon as possible. 4. If eye exposure has occurred, eyes must be flushed with lukewarm water for at least 15 minutes. 5. Wash exposed skin areas twice with soap and water. 6. Obtain authorization and/or further instructions from the local hospital for administration of an antidote or performance of other invasive procedures. 7. RUSH to a health care facility.

Ingestion Exposure: 1. Evaluate vital signs including pulse and respiratory rate, and note any trauma. If no pulse is detected, provide CPR. If not breathing, provide artificial respiration. If breathing is labored, administer oxygen or other respiratory support. 2. Obtain authorization and/or further instructions from the local hospital for administration of an antidote or performance of other invasive procedures. 3. Vomiting may be induced with syrup of ipecac. If elapsed time since ingestion of bromadiolone is unknown or suspected to be greater than 30 minutes, do not induce vomiting and RUSH to health care facility. 4. ipecac should not be administered to children under 6 months of age. ***Warning:*** Syrup of ipecac should be administered only if victims are alert, have an active gag-reflex, and show no signs of impending seizure or coma. If ANY uncertainty exists, RUSH to health care facility. 4. The following dosages of ipecac are recommended: children up to 1 year old, 10 mL (1/3 oz); children 1 to 12 years old, 15 mL (1/2 oz); adults, 30 mL (1 oz). Ambulate (walk) the victims and give large quantities of water. If vomiting has not occurred after 15 minutes, ipecac may be re-administered. Continue to ambulate and give water to the victims. If vomiting has not occurred within 15 minutes after second administration of ipecac, administer activated charcoal. 4. Activated charcoal may be administered if victims are conscious and alert. Use 15 to 30 g (1/2 to 1 oz) for children, 50 to 100 g (1-3/4 to 3-1/2 oz) for adults, with 125 to 250 mL (1/2 to 1 cup) of water. 5. Promote excretion by administering a saline cathartic or sorbitol to conscious and alert victims. Children require 15 to 30 g (1/2 to 1 oz) of cathartic; 50 to 100 g (1-3/4 to 3-1/2 oz) is recommended for adults. 6. *RUSH* to a health care facility[83].

Personal Protective Methods: Reacts with the following kinds of absorbents: Cellulose-Based. Wear protective gloves and clothing to prevent any reasonable probability of dermal and/or eye contact. Safety equipment suppliers/manufacturers can provide recommendations on the most protective glove/clothing material for your operation. All protective clothing (suits, gloves, footwear, headgear) should be clean, available each day, and put on before work. Contact lenses should not be worn when working with this chemical. Wear dust-proof chemical goggles and face shield unless full facepiece respiratory protection is worn. Employees should wash immediately with soap when skin is wet or contaminated. Provide emergency showers and eyewash.

Respirator Selection: SCBA >0.091 mg/m^3. SCBAF: Pd,Pp (APF = 10,000) (any NIOSH/MSHA- or European Standard EN 149-approved self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode); or SaF: Pd,Pp: ASCBA (APF = 10,000) (any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary, self-contained breathing apparatus operated in a pressure-demand or other positive-pressure mode).

Storage: Color Code-Blue: Health Hazard/Poison. Store in a secure poison location. Prior to working with bromadiolone you should be trained on its proper handling and storage. Store in tightly closed containers in a cool, well-ventilated area. Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: Coumarin derivatives, solid, toxic, n. o. s. have a DOT label requirement of "poisonous materials." Hazard Class 6.1; Packing Group I, II.

Toxic solids, organic, n. o. s. requires a shipping label of "poisonous materials."Hazard Class is 6.1.

Spill Handling: Evacuate and restrict persons not wearing protective equipment from area of spill or leak until clean up is complete. Collect powdered material in the most convenient and safe manner and deposit in sealed containers. Ventilate area of spill or leak after clean up is complete. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable.

Do not touch spilled material; stop leak if you can do so without risk. Use water spray to reduce vapors. *Small spills:* absorb with sand or other non-combustible absorbent material and place into containers for later disposal. *Small dry spills:* with clean shovel place material into clean, dry container and cover; move containers from spill area. *Large spills:* dike far ahead of spill for later disposal.

Fire Extinguishing: Hazardous decomposition includes hydrogen bromide. This material may burn but does not ignite readily. *Small fires:* dry chemicals, carbon dioxide; water spray or foam. *Large fires:* water spray, fog or foam. Move container from fire area if you can do so without risk. Fight fire from maximum distance. Dike fire-control water for later disposal; do not scatter the material. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies. From a secure, explosion-proof location, use water spray to cool exposed containers. If cooling streams are ineffective (venting sound increases in volume and pitch, tank discolors, or shows any signs of deforming), withdraw immediately to a secure position. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- New Jersey Department of Health and Senior Services, “Hazardous Substance Fact Sheet, Bromadiolone, Trenton, NJ (July 2000). http://www.state.nj.us/health/eoh/rtkweb/2179.pdf
- USEPA, “Chemical Profile: Bromadiolone,” Washington DC, Chemical Emergency Preparedness Program (November 30, 1987)

Bromoxynil B:0735

Use Type: Herbicide

CAS Number: 1689-84-5

Formula: $C_7H_3Br_2NO$; $C_{15}H_{17}Br_2NO$ (octanoate)

Synonyms: Bensonitrile, 3,5-dibromo-4-hydroxy-; Benzonitrile, 3,5-dibromo-4-hydroxy-; Butilchlorofos; Caswell No. 119; 2,6-Dibromo-4-cyanophenol; 2,6-Dibromo-4-hydroxybenzonitrile; 2,6-Dibromo-4-phenylcyanide; 3,5-Dibromo-4-hydroxybenzonitrile; 3,5-Dibromo-4-hydroxyphenyl cyanide; ENT 20,852; 4-Hydroxy-3,5-dibromobenzonitrile

Trade Names: BRIOTRIL®; BRUCIL®; BRITTOX®; BROMINAL®; BROMINEX®; BROMINAL®; BROMINAL ME-4®; BROMINIL®; BROMILIL PLUS®; Bromox 2E; BROMOTRIL®; BROMOXYNIL NITRILE HERBICIDE®; BRONATE®; BROXYNIL®; BUCTRIL® Bromoxynil; BUCTRIL® GEL HERBICIDE (octanoate); BUCTRIL® 4EC GEL (mixture of bromoxynil octanoate + bromoxynil heptanoate); BUCTRIL INDUSTRIAL®; CHIPCO BUCTRIL®; CHIPCO CRAB-KLEEN®; FLAGON®, 400 EC; HOBANE®; LABUCTRIL®; LITAROL®; M&B 10064®; MB 10064®; MB 10731® (octanoate); M&B 10731®; ME4 BROMINAL®; MERIT®; MEXTROL-BIOX®; MOXY 2E®; NCR CE EE DOV7® (octanoate); NU-LAWN WEEDER®; OXYTRIL M®; PARDNER®; SABRE®; TORCH®

Chemical class: Hydroxybenzonitrile

EPA/OPP PC Code: 035301; 035302 (octanoate)

California DPR Chemical Code: 2429

HSDB Number: 1523

UN/NA & ERG Number: UN2588 (Pesticide, solid, poisonous, n.o.s.)/151; UN2902 (Pesticide, liquid, poisonous, n.o.s.)/151

RTECS® Number: DI3150000

EC Number: 216-882-7 [*Annex I Index No.:* 608-006-00-0]

Uses: A U.S. EPA restricted Use Pesticide (RUP). For post-emergent control of broadleaf weeds. Used on alfalfa, garlic, corn, sorghum, flax, cereals, turf and on pasture and rangelands.

Human toxicity (long-term)[101]: Intermediate–10.50 ppb, Health Advisory; (octanoate) Very low–140.00 ppb, Health Advisory.

Fish toxicity (threshold)[101]: Low–283.24412 ppb, MATC (Maximum Acceptable Toxicant Concentration); (octanoate) High–4.40230 ppb, MATC (Maximum Acceptable Toxicant Concentration).

U.S. Maximum Allowable Residue Levels for Bromoxynil [40CFR 180.324(a)(1)]: Alfalfa, forage 0.1 ppm; alfalfa, hay 0.5 ppm; barley, grain 0.05 ppm; barley, hay 9.0 ppm; barley, straw 4.0 ppm; corn, field, forage 0.3 ppm; corn, field, grain 0.05 ppm; corn, field, stover 0.2 corn, pop, grain 0.05 ppm; corn, pop, stover 0.2 flax, seed 0.1 ppm; garlic 0.1 ppm; grain, aspirated fractions 1.2 ppm; grass, forage 18 grass, hay 5.0 ppm; oat, forage 0.3 ppm; oat, grain 0.05 ppm; oat, hay 9.0 ppm; oat, straw 4.0 ppm; onion, bulb 0.1 ppm; peppermint, hay 0.1 ppm; rye, forage 1.0 ppm; rye, grain 0.05 ppm; rye, straw 2.0 ppm; sorghum, grain, forage 0.8 ppm; sorghum, grain, grain 0.2 ppm; sorghum, grain, stover 0.2 ppm; spearmint, hay 0.1 ppm; wheat, forage 1.0 ppm; wheat, grain 0.05 ppm; wheat, hay 4.0 ppm; wheat, straw 2.0 ppm. **[*40CFR 180.324(a)(2)*]**: cattle, fat 1 ppm; cattle, meat byproducts 3.5 ppm; cattle, meat 0.5 ppm; cotton, gin byproducts 7.0 ppm; cotton, hulls 5.0 ppm; cotton, undelinted seed 1.5 ppm; egg 0.05 ppm; goat, fat 1 ppm; goat, meat byproducts 3.5 ppm; goat, meat 0.5 ppm; hog, fat 1 ppm; hog, meat byproducts 3.5 ppm; hog, meat 0.5 ppm; horse, fat 1 ppm; horse, meat byproducts 3.5 ppm; horse, meat 0.5 ppm; milk 0.4 ppm; poultry, fat 0.05 ppm; poultry, meat byproducts 0.3 ppm; poultry, meat 0.05 ppm; sheep, fat 1 ppm; sheep, meat byproducts 3.5 ppm; sheep, meat 0.5 ppm.

Regulatory Authority and Advisory Information: Carcinogenicity[83]: EPA Group C, possible human carcinogen

California Proposition 65 Chemical: Developmental toxin (10/1/1990)

Acute Oral Category: 2, WARNING

EPCRA Section 313 Form R *de minimis* concentration reporting level: 1.0% (also, octanoate)

U.S. DOT Regulated Marine Pollutant (49CFR172.101, Appendix B)

European/International Regulations: Hazard Symbol: T+, N; risk phrases: R25; R26; R43; R50/53; R63; safety phrases: S1/2; S27/28; S36/37; S45; S63; S60; S61 (see Appendix 1)

Description: Colorless to white crystalline solid or tan powder. Odorless (pure). Molecular weight = 276.93; Boiling point = (sublimes) 135 °C @ 0.15 mmHg[88]; Freezing/Melting point = 194–195 °C; 360 °C (sodium or potassium salt); Vapor pressure = 4.5×10^{-8} mmHg @ 20 °C. Hazard Identification (based on NFPA-704 M Rating System): Health 2, Flammability 0, Reactivity 0. Moderately soluble in water; solubility = 125 ppm @ 20 °C.

Incompatibilities: A weak acid; keep away from bases and alkalies. React with boranes, alkalies, aliphatic amines, amides, nitric acid, sulfuric acid. Keep away from oxidizers (chlorates, nitrates, peroxides, permanganates, perchlorates, chlorine, bromine, fluorine, etc) and strong acids.

Permissible Exposure Limits in Air: NIOSH REL: *Nitriles:* 2 ppm, Ceiling Concentration, not to be exceeded in any 15-minute work period.

Determination in Air: Bromoxynil/bromoxynil octanoate, NIOSH: #5010. See NIOSH Criteria Document 78-212 NITRILES[18]

Permissible Concentration in Water: State Drinking Water Guidelines: Florida 140 μg/L. Runoff from spills or fire control may cause water pollution.

Determination in Water: State Drinking Water Guidelines: Florida 140 μg/L. Log K_{ow} = >2.5. Values above 3.0 are likely to bioaccumulate in aquatic organisms.

Routes of Entry: Inhalation, dermal and/or eye contact.

Harmful Effects and Symptoms

Short Term Exposure: Contact may cause burns to skin and eyes. Because this material has a low vapor pressure, significant inhalation of vapors is unlikely at ordinary temperatures. May affect the iron metabolism, causing asphyxia. It is highly toxic. Forms cyanide in the body. Exposure results in headache, dizziness, rapid pulse, deep-rapid breathing, nausea, vomiting, unconsciousness, convulsions and sometimes death. May cause cyanosis (blue coloration of skin and lips caused by lack of oxygen). LD_{50} (oral, rat) = 80–190 mg/kg; LD_{50} (dermal, rat) = >2 g/kg.

Long Term Exposure: Chronic exposure over long periods may cause fatigue and weakness. Can cause same general symptoms as hydrogen cyanide but onset of symptoms is likely to be slower. May cause liver and kidney damage. May cause skin sensitization.

Points of Attack: Skin. In animals: liver, kidney damage. May be a nerve poison.

Medical Surveillance: Preliminary medical exam to detect chronic diseases of central nervous system, liver, heart, kidneys, lung and skin, as well as endocrinological or immunological disturbances, should protect susceptible individuals. Periodical medical exams of internal organs, skin and eyes are important to avoid chronic occupational intoxications. They should include lab and patch tests when necessary[83]. Comprehensive physical examination with emphasis on the genito-urinary tract analysis to include sperm count, motility and morphology. Other tests, such as serum testosterone, serum follicle stimulating hormone (FSH), and serum lutenizing hormone (LH), may be carried out if, in the opinion of a physician, they are indicated. Liver and kidney function tests. Evaluation by a qualified allergist, including exposure history and testing, may help diagnose allergy.

Personal Protective Methods: Wear positive-pressure self-contained breathing apparatus (SCBA). Wear chemical protective clothing that is specifically recommended by the manufacturer. It may provide little or no thermal protection. Structural firefighters' protective clothing provides limited protection in fire situations ONLY; it is not effective in spill situations where direct contact with the substance is possible[ERG]. Smoking, eating, and drinking before washing should be absolutely prohibited when any pesticide is being handled or used. Applicators and other handlers must wear: Coveralls worn over long-sleeved shirt and long pants; Chemical-resistant gloves such as DuPont™ Tychem® suit fabrics; Chemical-resistant footwear plus socks; Protective eye wear; Chemical-resistant headgear for overhead exposure; Chemical-resistant apron when cleaning equipment, mixing, or loading[83]. Agricultural Use/ Engineering Controls: When handlers use closed systems, enclosed cabs, or aircraft in a manner that meets the requirements listed in the Worker Protection Standard (WPS) for agricultural pesticides, 40 CFR 170.240(d)(4-6), the handler PPE requirements may be reduced or modified as specified in the Worker Protection Standard.

First Aid: Move victim to fresh air. Call 911 or emergency medical service. Give artificial respiration if victim is not breathing. Do not use mouth-to-mouth method if victim ingested or inhaled the substance; give artificial respiration with the aid of a pocket mask equipped with a one-way valve or other proper respiratory medical device. Administer oxygen if breathing is difficult. Remove and isolate contaminated clothing and shoes. In cases of contact with substance, immediately flush skin or eyes with running water for at least 20 minutes. For minor skin contact, avoid spreading material on unaffected skin. Keep victim warm and quiet. Effects of exposure (inhalation, ingestion or skin contact) to substance may be delayed. Ensure that medical personnel are aware of the material(s) involved and take precautions to protect themselves[ERG].

Respirator Selection: *Nitriles*: NIOSH, *10 ppm:* Sa (APF = 10) (any supplied-air respirator); *25 ppm:* Sa:Cf (APF = 25) (any supplied-air respirator operated in a continuous-flow mode); *50 ppm:* SCBAF (APF = 50) (any self-contained breathing apparatus with a full facepiece); or SaF (APF = 50) (any supplied-air respirator with a full facepiece); *250 ppm:* SaF:Pd,Pp (APF = 2000) (any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode). *Emergency or planned entry into unknown concentrations or IDLH conditions:* SCBAF:Pd,Pp (APF = 10,000) (any self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode); or SaF:Pd,Pp:ASCBA (APF = 10,000) (any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary self-contained breathing apparatus operated in a pressure-demand or other positive-pressure mode. *Escape*: GmFOv (APF = 50) [any air-purifying, full facepiece respirator (gas mask) with a chin-style, front- or back-mounted organic vapor canister] or SCBAE (any appropriate escape-type, self-contained breathing apparatus).

Storage: Color Code-Blue: Health Hazard/Poison. Store in a secure poison location. Prior to working with this chemical you should be trained on its proper handling and storage. Store in tightly closed containers in a cool, well-ventilated area away from strong alkalis (such as sodium hydroxide, sodium bicarbonate, etc.). Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: Pesticides, solid, toxic/poisonous, n.o.s require a shipping label of "poisonous materials" and fall in Hazard Class 6.1. Technical name required.

Spill Handling: Issue poison warning.

First: isolate in all directions (feet/meters) 100/30
Then: Protect persons downwind (miles/kilometers)
Day 0.1/0.2
Night 0.1/0.2

Large spills (From a large package or from many small packages)

First: isolate in all directions (feet/meters) 200/60
Then: Protect persons downwind (miles/kilometers)
Day 0.3/0.5
Night 0.5/0.8

Do not touch damaged containers or spilled material unless wearing appropriate protective clothing. Stop leak if you can do it without risk. Prevent entry into waterways, sewers, basements or confined areas. Cover with plastic sheet to prevent spreading. Absorb or cover with dry earth, sand or other non-combustible material and transfer to containers. Do not allow water to get inside containers. If a spill occurs, clean it up promptly. Don't wash it away. Instead, sprinkle the spill with sawdust, vermiculite, or kitty litter. Sweep it into a plastic garbage bag, and dispose of it as directed on the pesticide product label.

Fire Extinguishing: Hazardous decomposition includes toxic oxides of nitrogen and hydrogen bromide gas. *On a small fire:* use dry chemical, CO_2 or water spray. *On a large fire:* use water spray, fog or regular foam. Move containers from fire area if you can do it without risk. Dike fire-control water for later disposal; do not scatter the material. Use water spray or fog; do not use straight streams. *Fire involving storage or vehicular tanks:* isolate for 800 meters/0.5 mile in all directions; also, consider initial evacuation for 800 meters/0.5 mile in all directions. Fight fire from maximum distance or use unmanned hose holders or monitor nozzles. Do not get water inside containers. Cool containers with flooding quantities of water until well after fire is out. Withdraw immediately in the case of rising sound from venting safety devices or discoloration of tank. ALWAYS stay away from tanks engulfed in fire. For massive fire, use unmanned hose holders or monitor nozzles; if this is impossible, withdraw from area and let fire burn. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies.

Disposal Method Suggested: Do not discharge into drains or sewers. Dispose of waste material as hazardous waste using a licensed disposal contractor to an approved landfill. Incineration with effluent gas scrubbing is recommended. Consult with environmental regulatory agencies for guidance on acceptable disposal practices. If allowed, incineration with effluent gas scrubbing is recommended. Containers must be disposed of properly by following package label directions or by contacting your local or federal environmental control agency, or by contacting your regional EPA office.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- EXTOXNET, Extension Toxicology Network, "Pesticide Information Profile, Bromoxynil," Oregon State University, Corvallis, OR (June 1996). http://extoxnet.orst.edu/pips/bromoxyn.htm
- USEPA, Office of Pesticide Programs, Pesticide Residue Limits, "Bromoxynil," 40 CFR 180.324. http://www.epa.gov/pesticides/food/viewtols.htm
- USEPA, *R.E.D. FACTS, Bromoxynil,*, EPA 738-F-98-011, Washington DC (September 1998)

Bromoxynil octanoate B:0736

Use Type: Herbicide
CAS Number: 1689-99-2
Formula: $C_{15}H_{17}Br_2NO$
Synonyms: Bromoxynil octanoic acid ester; 2,6-Dibromo-4-cyanophenyl octanoate; 2,6-Dibromo-4-cyanophenyl ester, octanoic acid; 3,5-Dibromo-4-octanoyloxybenzonitrile; 4-Cyano-2,6-dibromophenyl octanoate; Octanoic acid ester of 3,5-dibromo-4-hydroxybenzonitrile
Trade Names: BROMINAL®-W; BUCTRIL® Bromoxynil octoate; NPH-1320®
Chemical class: Hydroxybenzonitrile
EPA/OPP PC Code: 035302
California DPR Chemical Code: 2163
HSDB Number: 7308
UN/NA&ERG Number: UN2588 (Pesticide, solid, poisonous, n.o.s.)/151; UN2902 (Pesticide, liquid, poisonous, n.o.s.)/151
RTECS® Number: DI3325000
EC Number: 216-885-3 [*Annex I Index No.:* 608-107-00-0]
Uses: A U.S. EPA restricted Use Pesticide (RUP). Herbicide used for alfalfa seedlings, barley, corn, flax, garlic, grasses, mint, oats, onions, popcorn, rye, sorghum, triticale, wheat. See also below.
U.S. Maximum Allowable Residue Levels for Bromoxynil octanate [40 CFR 180.324(a)(1)]: Alfalfa, seeding 0.1 ppm; barley, grain 0.1 ppm; barley, straw 0.1 ppm; canarygrass, annual, seed 0.1 ppm; corn, field, stover 0.1 ppm; corn, fodder (green) 0.1 ppm; corn, grain 0.1 ppm; corn, grain, field 0.1 ppm; corn, stover 0.1 ppm; flax, seed 0.1 ppm; flax, straw 0.1 ppm; garlic 0.1 ppm; grass, canary, annual, straw 0.1 ppm; mint hay 0.1 ppm; oat, forage 0.1 ppm; oat, grain 0.1 ppm; oat, straw 0.1 ppm; onion, dry bulb 0.1 ppm; rye, forage 0.1 ppm; rye, grain 0.1 ppm; rye, straw 0.1 ppm; sorghum, forage 0.1 ppm; sorghum, grain 0.1 ppm; sorghum, grain, stover 0.1 ppm; wheat, forage 0.1 ppm; wheat, grain 0.1 ppm; and wheat, straw 0.1 ppm. ***[40 CFR 180.324(a)(2)]:*** cattle, fat 1 ppm; cattle, meat byproducts 3.5 ppm; cattle, meat 0.5 ppm; cotton gin byproducts 7.0 ppm; cotton, hulls 5.0 ppm; cotton, undelinted seed 1.5 ppm; egg 0.05 ppm; goat, fat 1 ppm; goat, meat byproducts 3.5 ppm; goat, meat 0.5 ppm; hog, fat 1 ppm; hog, meat byproducts 3.5 ppm; hog, meat 0.5 ppm; horse, fat 1 ppm; horse, meat byproducts 3.5 ppm; horse, meat 0.5 ppm; milk 0.1 ppm; poultry, fat 0.05 ppm; poultry, meat byproducts 0.3 ppm; poultry, meat 0.05 ppm; sheep, fat 1 ppm; sheep, meat byproducts 3.5 ppm; and sheep, meat 0.5 ppm.
Regulatory Authority and Advisory Information: Carcinogenicity[83]: EPA Group C, possible human carcinogen (as bromoxynil)
California Proposition 65 Chemical: Developmental toxin (5/18/1999)
Health Advisory: Endocrine disruptor (Confirmed)
Acute Oral Category: 3, CAUTION
European/International Regulations: Hazard Symbol: T, N; risk phrases: R22; R23; R43; R50/53; R63; safety phrases: S1/2; S36/37; S45; S60; S61; S63 (see Appendix 1)
Description: Colorless (when pure) to off-white creamy, waxy solid. Molecular weight = 403.15; Specific gravity (H_2O:1) = 1.64 @ 20 °C; Boiling point = (decomposes); Freezing/Melting point = 45 °C; Vapor pressure = 4.8 × 10^{-6} mmHg. Slightly soluble in water; solubility = <1 mg/L @ 25 °C.
Incompatibilities: Keep away from alkalies and acids. Combustible; dust may form explosive mixture with air.
Permissible Exposure Limits in Air: NIOSH REL: *Nitriles:* 2 ppm, Ceiling Concentration, not to be exceeded in any 15-minute work period.
Determination in Air: Bromoxynil/bromoxynil octanoate, NIOSH: #5010. See NIOSH Criteria Document 78-212 NITRILES[18]
Determination in Water: Log K_{ow} = >5.0. Values above 3.0 are likely to bioaccumulate in aquatic organisms.
Routes of Entry: Skin, inhalation, ingestion
Harmful Effects and Symptoms
Short Term Exposure: May cause irritation of the eyes, skin, and respiratory tract. May cause contact dermatitis and skin sensitization. LD_{50} (oral, rat) = 250 mg/kg[9]; LD_{50} (dermal, rat) = >2 g/kg.
Long Term Exposure: May cause reproductive and fetal effects. May cause skin sensitization.
Points of Attack: Skin. Reproductive cells.
Medical Surveillance: In addition to comprehensive initial medical and work histories emphasizing reproductive experience and menstrual history, patient should have physical examination and testing of genito-urinary tract, sperm count, motility and morphology. If required, other tests, such as serum testosterone, serum follicle stimulating hormone (FSH), and serum lutenizing hormone (LH), may be indicated. Preliminary medical exam to detect chronic diseases of central nervous system, liver, heart, kidneys, lung and skin, as well as endocrinological or immunological disturbances, should protect susceptible individuals. Periodical medical exams of internal organs, skin and eyes are important to avoid chronic occupational intoxications. They should include lab and patch tests when necessary[83]. Evaluation by a qualified allergist, including exposure history and testing, may help diagnose allergy.
First Aid: If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least 15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately. Give artificial respiration if victim is not breathing. *Do not* use mouth-to-mouth method if victim ingested or inhaled the substance; give artificial respiration with the aid of a pocket mask equipped with a one-way valve or other proper respiratory medical device. Administer oxygen if breathing is difficult. Remove and isolate contaminated clothing and shoes. In cases of contact with substance, immediately flush skin or eyes with running water for at least 20 minutes. For minor skin contact, avoid spreading material on unaffected skin. Keep victim warm and quiet. Effects of exposure (inhalation, ingestion or skin contact) to substance may be delayed. Ensure that medical personnel are aware of the material(s) involved and take precautions to protect themselves.

Respirator Selection: *Nitriles*: NIOSH, *10 ppm:* Sa (APF = 10) (any supplied-air respirator); *25 ppm:* Sa:Cf (APF = 25) (any supplied-air respirator operated in a continuous-flow mode); *50 ppm:* SCBAF (APF = 50) (any self-contained breathing apparatus with a full facepiece); or SaF (APF = 50) (any supplied-air respirator with a full facepiece); *250 ppm:* SaF:Pd,Pp (APF = 2000) (any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode). *Emergency or planned entry into unknown concentrations or IDLH conditions:* SCBAF:Pd,Pp (APF = 10,000) (any self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode); or SaF:Pd,Pp:ASCBA (APF = 10,000) (any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary self-contained breathing apparatus operated in a pressure-demand or other positive-pressure mode. *Escape*: GmFOv (APF = 50) [any air-purifying, full facepiece respirator (gas mask) with a chin-style, front- or back-mounted organic vapor canister] or SCBAE (any appropriate escape-type, self-contained breathing apparatus).

Shipping: Pesticides, solid, toxic/poisonous, n.o.s require a shipping label of "poisonous materials" and fall in Hazard Class 6.1. Technical name required.

Spill Handling: Issue poison warning.
First: isolate in all directions (feet/meters) 100/30
Then: Protect persons downwind (miles/kilometers)
Day 0.1/0.2
Night 0.1/0.2

Large spills (from a large package or from many small packages)
First: isolate in all directions (feet/meters) 200/60
Then: Protect persons downwind (miles/kilometers)
Day 0.3/0.5
Night 0.5/0.8

Do not touch damaged containers or spilled material unless wearing appropriate protective clothing. Stop leak if you can do it without risk. Prevent entry into waterways, sewers, basements or confined areas. Cover with plastic sheet to prevent spreading. Absorb or cover with dry earth, sand or other non-combustible material and transfer to containers. Do not allow water to get inside containers. If a spill occurs, clean it up promptly. Don't wash it away. Instead, sprinkle the spill with sawdust, vermiculite, or kitty litter. Sweep it into a plastic garbage bag, and dispose of it as directed on the pesticide product label.

Fire Extinguishing: Containers may explode when heated. Hazardous decomposition includes toxic oxides of nitrogen and carbon, and hydrogen bromide gas. *On a small fire:* use dry chemical, CO_2 or water spray. *On a large fire:* use water spray, fog or regular foam. Move containers from fire area if you can do it without risk. Dike fire-control water for later disposal; do not scatter the material. Use water spray or fog; do not use straight streams. *Fire involving storage or vehicular tanks:* isolate for 800 meters/0.5 mile in all directions; also, consider initial evacuation for 800 meters/0.5 mile in all directions. Fight fire from maximum distance or use unmanned hose holders or monitor nozzles. Do not get water inside containers. Cool containers with flooding quantities of water until well after fire is out. Withdraw immediately in the case of rising sound from venting safety devices or discoloration of tank. ALWAYS stay away from tanks engulfed in fire. For massive fire, use unmanned hose holders or monitor nozzles; if this is impossible, withdraw from area and let fire burn. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies.

Disposal Method Suggested: Do not discharge into drains or sewers. Dispose of waste material as hazardous waste using a licensed disposal contractor to an approved landfill. Incineration with effluent gas scrubbing is recommended. Consult with environmental regulatory agencies for guidance on acceptable disposal practices. If allowed, incineration with effluent gas scrubbing is recommended. Containers must be disposed of properly by following package label directions or by contacting your local or federal environmental control agency, or by contacting your regional EPA office.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- United States National Library of Medicine, ChemIDplus Advanced, Bethesda, MD. http://chem.sis.nlm.nih.gov/chemidplus/rn/1689-99-2

Brucine B:0740

Use Type: Rodenticide
CAS Number: 357-57-3
Formula: $C_{23}H_{26}O_4 \cdot 4H_2O$
Synonyms: Brucina (Spanish); (-)Brucine; (-)Brucine dihydrate; Brucine hydrate; L-Brucine; Dimethoxy strychnine; 2,3-Dimethoxystrichnidin-10-one; 2,3-Dimethoxystrychnine; 10,11-Dimethoxystrychnine; 10,11-Dimethylstrychnine; Strychnidin-10-one, 2,3-dimethoxy-(9CI); Strychnine, 2,3-dimethoxy-
Trade Names: DOLCO MOUSE CEREAL®; PIED PIPER MOUSE SEED® (Brucine)
Chemical Class: Alkaloid
EPA/OPP PC Code: 059303
HSDB Number: 307
UN/NA & ERG Number: UN1570/152
RTECS® Number: EH8925000
EC Number: 206-614-7 [*Annex I Index No.:* 614-006-00-1]
Uses: Used in the manufacture of other chemicals, in perfumes, as a medication for animals, and as a poison for rodents

Regulatory Authority and Advisory Information: U.S. EPA Hazardous Waste Number (RCRA No.): P018
CERCLA Reportable Quantity (RQ): 100 lb (45.4 kg)
EPCRA Section 313 Form R *de minimis* concentration reporting level: 1.0%
European/International Regulations: (*anhydrous*) Hazard Symbol: T+; risk phrases: R26/28; R52/53; safety phrases: S1/2; S13; S45; S61
WGK (German Aquatic Hazard Class): 3-Severe hazard to waters

Description: Brucine is colorless to white, odorless, crystalline solid or powder. Very bitter taste. Molecular weight = 394.4[86]; 394.51[88]; Specific gravity (H_2O:1) = >1 @ 20 °C; Boiling point = (decomposes); Freezing/Melting point = 177.78[88]; 178 °C[86]. Vapor pressure = 5.8 × 10^{-16} mmHg @ 25 °C[86]; Hazard Identification (based on NFPA-704 M Rating System): Health 4, Flammability 1, Reactivity 0. Poor solubility in water; solubility = 1 g/1320 ml.

Incompatibilities: Reacts with strong oxidizers. Finely dispersed material in air may cause dust explosions.

Permissible Exposure Limits in Air: Protective Action Criteria (PAC) Ver. 27[89]
PAC-1: 0.1 mg/m^3
PAC-2: 1.1 mg/m^3
PAC-3: 36 mg/m^3

Determination in Air: Use OSHA Sampling Method 0405.

Determination in Water: Log K_{ow} =<1.0. Unlikely to bioaccumulate in marine organisms. Highly toxic to marine organisms with long-term chronic effects to the environment.

Routes of Entry: Inhalation, ingestion, eye and/or dermal and/or eye contact. Absorbed through the skin.

Harmful Effects and Symptoms

Short Term Exposure: Highly toxic if dust, vapor or powder is inhaled or if it is swallowed. Irritates the eyes and respiratory tract. Exposure can cause headache, nausea, vomiting, ringing in the ears, disturbed vision, restlessness, excitement, twitching and convulsions, seizures, breathing difficulties. An alkaloid and a narcotic. Severe poisoning can cause paralysis, unconsciousness, and death. The probable fatal dose in adult is estimated @ 1 g. LD_{50} (oral, rat) = 90–150 mg/kg[9]; 1 mg/kg[86]

First Aid: If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least 15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately. If this chemical contacts the skin, remove contaminated clothing and wash immediately with soap and water. Seek medical attention immediately. If this chemical has been inhaled, remove from exposure, begin rescue breathing (using universal precautions) if breathing has stopped, and CPR if heart action has stopped. Transfer promptly to a medical facility. When this chemical has been swallowed, get medical attention. Give large quantities of water and induce vomiting. Do not make an unconscious person vomit.

Personal Protective Methods: Reacts with the following kinds of absorbents: Mineral- and Clay-Based[88]. Wear positive-pressure self-contained breathing apparatus (SCBA). Dust mask; goggles or face shield; rubber gloves. Wear chemical protective clothing that is specifically recommended by the manufacturer. DuPont™ Tychem® Suit Fabrics is recommended by one government source[-NOAA]. It may provide little or no thermal protection. Structural firefighters' protective clothing provides limited protection in fire situations ONLY; it is not effective in spill situations where direct contact with the substance is possible.

Respirator Selection: SCBA >0.1 mg/m^3. Wherever and whenever workplace conditions warrant respirator use, a respiratory protection program must be followed that meets one or more of the following government standards: OSHA's 29 CFR 1910.134, ANSI Z88.2, or European Standard EN 149.

Spill Handling: For solids, isolate spill or leak area in all directions for at least 25 meters/75 feet. Increase, in the downwind direction, as necessary. Do not touch damaged containers or spilled material unless wearing appropriate protective clothing. Stop leak if you can do it without risk. Prevent entry into waterways, sewers, basements or confined areas. Cover with plastic sheet to prevent spreading. Absorb or cover with dry earth, sand or other non-combustible material and transfer to containers. Do not allow water to get inside containers.

Fire Extinguishing: Hazardous decomposition includes toxic oxides of nitrogen and carbon (monoxide and dioxide). *On a small fire:* use dry chemical, carbon dioxide or water spray. *On a large fire:* use water spray, fog or alcohol-resistant foam. Move containers from fire area if you can do it without risk. Dike fire-control water for later disposal. Use water spray or fog; do not scatter material using straight water jet streams. *Fire involving storage or vehicular tanks:* isolate for 800 meters/0.5 mile in all directions; also, consider initial evacuation for 800 meters/0.5 mile in all directions. Fight fire from maximum distance or use unmanned hose holders or monitor nozzles. Do not allow water to get inside containers. Cool containers with flooding quantities of water until well after fire is out. Withdraw immediately in the case of rising sound from venting safety devices or discoloration of tank. *Always* stay away from tanks engulfed in fire. For massive fire, use unmanned hose holders or monitor nozzles; if this is impossible, withdraw from area and let fire burn.

Disposal Method Suggested: Generators of waste containing this contaminant (≥100 kg/mo) must conform with EPA regulations governing storage, transportation, treatment, and waste disposal. To dispose of this material, contact a licensed professional waste disposal service. Containers must be disposed of properly by following package label directions or by contacting your local or federal environmental control agency, or by contacting your regional EPA office.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov

- EXTOXNET, Extension Toxicology Network, “Pesticide Information Profile, Brucine,” Oregon State University, Corvallis, OR (January 1999). http://www.state.nj.us/health/eoh/rtkweb/0270.pdf
- New Jersey Department of Health and Senior Services, "Hazardous Substance Fact Sheet: “Brucine,” Trenton, NJ (January 1999). http://www.state.nj.us/health/eoh/rtkweb/0270.pdf

Buprofezin B:0745

Use Type: Insecticide, Acaricide, Insect growth regulator
CAS Number: 69327-76-0
Formula: $C_{16}H_{23}N_3OS$
Synonyms: 2-*tert*-Butylimino-3-isopropyl-5-phenylperhydro-1,3,5-thidiazin-4-one; 4*H*-1,3,5-Thiadiazin-4-one, 2-[(1,1-dimethylethyl)imino] tetrahydro-3-(1-methylethyl)-5-phenyl-
Trade Names: APPLAUD®; NNI-750®
Chemical Class: Unclassified
EPA/OPP PC Code: 275100
California DPR Chemical Code: 3947
HSDB Number: 7610
UN/NA&ERG Number: UN3077(solid)/171
RTECS® Number: XI2865000
Uses: For insect control in food crops and greenhouse ornamentals.
U.S. Maximum Allowable Residue Levels for residues of buprofezin [40 CFR 180.511(a)]: in or on the following food commodities: Acerola 0.30 ppm; almond 0.05 ppm; almond, hulls 2.0 ppm; apricot 9.0 ppm; atemoya 0.30 ppm; avocado 0.30 ppm; banana 0.20 ppm; bean, snap, succulent 0.02 ppm; berry, low growing, subgroup 13-07G, 2.5 ppm; birida 0.30 ppm; canistel 0.90 ppm; cattle, fat 0.05 ppm; cattle, kidney 0.05 ppm; cattle, liver 0.05 ppm; cattle, meat 0.05 ppm; cattle, meat byproducts 0.05 ppm; cherimoya 0.30 ppm; citrus, dried pulp 7.5 ppm; citrus, oil 80 ppm; cotton, gin byproducts 20.0 ppm; cotton, undelinted seed 0.35 ppm; custard apple 0.30 ppm; feijoa 0.30 ppm; fruit, citrus, group 10, 2.5 ppm; fruit, pome, group 11, 4.0 ppm; fruit, stone, group 12, except apricot and peach 1.9 ppm; goat, fat 0.05 ppm; goat, kidney 0.05 ppm; goat, liver 0.05 ppm; goat, meat 0.05 ppm; goat, meat byproducts 0.05 ppm; grape 2.5 ppm; guave 0.30 ppm; hog, fat 0.05 ppm; hog, kidney 0.05 ppm; hog, liver 0.05 ppm; hog, meat 0.05 ppm; hog, meat byproducts 0.05 ppm; horse, fat 0.05 ppm; horse, kidney 0.05 ppm; horse, liver 0.05 ppm; horse, meat 0.05 ppm; horse, meat byproducts 0.05 ppm; llama 0.30 ppm; jaboticaba 0.30 ppm; lettuce, head 6.0 ppm; loganberry 0.30 ppm; lychee 0.30 ppm; mango 0.90 ppm; milk 0.01 ppm; okra 4.0 ppm; olive 3.5 ppm; olive, oil 4.8 papaya 0.90 ppm; passionfruit 0.30 ppm; peach 9.0 ppm; pepper, nonbell 4.0 ppm; pistachio 0.05 ppm; pulasan 0.30 ppm; radicchio 6.0 ppm; rambutan 0.30 ppm; sapodilla 0.90 ppm; sapote, black 0.90 ppm; sapote, mamey 0.90 ppm; sheep, fat 0.05 ppm; sheep, kidney 0.05 ppm; sheep, liver 0.05 ppm; sheep, meat 0.05 ppm; sheep, meat byproducts 0.05 ppm; soursop 0.30 ppm; Spanish lime 0.30 ppm; star apple 0.90 ppm; starfruit 0.30 ppm; sugar apple 0.30 ppm; vegetable, cucurbit, group 9, 0.50 ppm; vegetable, fruiting, group 8, except nonbell pepper 1.3 ppm; vegetable, leafy, except brassica, group 4, except head lettuce and radicchio 35 ppm; wax jambu 0.30 ppm.
Regulatory Authority and Advisory Information: Acute Oral Category: 3, CAUTION
Health Advisory: Mutagen
Description: White crystalline powder. Molecular weight = 305.44; Specific gravity (H_2O:1) = 1.178 @ 20 °C; Boiling point = 350 °C; Freezing/Melting point = 105–106 °C; Vapor pressure = 2 × 10^{-6} mmHg @ 25 °C; Flash point = °C. Very slightly soluble in water.
Incompatibilities: May react with strong oxidizers such as chlorates, peroxides, nitrates, etc. Dust may form explosive mixture with air.
Permissible Concentration in Water: Runoff from spills or fire control may cause water pollution.
Determination in Water: Log K_{ow} = >4.0. Values above 3.0 are likely to bioaccumulate in aquatic organisms.
Routes of Entry: Ingestion, inhalation, dermal contact; absorbed through the unbroken skin.
Harmful Effects and Symptoms
Short Term Exposure: Causes moderate eye, skin, and possibly respiratory irritation. Harmful if swallowed. LD_{50} (oral, rat) = >3 g/kg; LD_{50} (dermal, rat) = >5 g/kg.
Long Term Exposure: Ingestion of excessive amounts of buprofezin may induce subdued mood and diminished muscular coordination. May cause a slightly enlarged abdomen.
Points of Attack: May affect the chromosomes; breakdown of the DNA.
Medical Surveillance: Comprehensive physical examination with emphasis on the genito-urinary tract analysis to include sperm count, motility and morphology. Other tests, such as serum testosterone, serum follicle stimulating hormone (FSH), and serum lutenizing hormone (LH), may be carried out if, in the opinion of a physician, they are indicated.
First Aid: If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least 15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately. If this chemical contacts the skin, remove contaminated clothing and wash immediately with soap and water. Seek medical attention immediately. If this chemical has been inhaled, remove from exposure, begin rescue breathing (using universal precautions) if breathing has stopped, and CPR if heart action has stopped. Transfer promptly to a medical facility. When this chemical has been swallowed, get medical attention. Give large quantities of water and induce vomiting. Do not make an unconscious person vomit.
Personal Protective Methods: Applicators and other handlers must wear: Coveralls worn over long-sleeved shirt and long pants; Chemical-resistant gloves such as DuPont™ Tychem® suit fabrics, barrier laminate, or Viton®; Chemical-resistant footwear plus socks; Protective eye

wear; Chemical-resistant headgear for overhead exposure; Chemical-resistant apron when cleaning equipment, mixing, or loading[83]. Agricultural Use/Engineering Controls: When handlers use closed systems, enclosed cabs, or aircraft in a manner that meets the requirements listed in the Worker Protection Standard (WPS) for agricultural pesticides, 40 CFR 170.240(d)(4-6), the handler PPE requirements may be reduced or modified as specified in the Worker Protection Standard. Firefighters should wear NIOSH approved self-contained breathing apparatus and full protective clothing.

Respirator Selection: Wherever and whenever workplace conditions warrant respirator use, a respiratory protection program must be followed that meets one or more of the following government standards: OSHA's 29 CFR 1910.134, ANSI Z88.2, or European Standard EN 149.

Storage: Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: Environmentally hazardous substances, solid or liquid, usually fall in Hazard Class 9.

Spill Handling: First remove all sources of ignition. Evacuate persons not wearing protective equipment from area of spill or leak until clean up is complete. Do not dry sweep. Collect powdered material in the most convenient and safe manner and deposit in sealed containers. Ventilate area after clean up is complete. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable.

Fire Extinguishing: Decomposes at about 200 °C releasing toxic oxides of nitrogen, sulfur and carbon. This chemical is a combustible solid but does not readily ignite. As an immediate precautionary measure, isolate spill or leak area in all directions for at least 50 meters/150 feet for liquids and at least 25 meters/75 feet for solids. *Fire involving storage or vehicular tanks:* isolate for 800 meters/0.5 mile in all directions; also, consider initial evacuation for 800 meters/0.5 mile in all directions. *On a small fire:* use dry chemical, CO_2, water spray or regular foam. *On a large fire:* use water spray, fog or regular foam. Do not scatter spilled material with high-pressure streams of water. Move containers from fire area if you can do it without risk. Dike fire-control water for later disposal. *Fire involving tanks:* from a secure, explosion-proof location, use water spray to cool exposed containers. If cooling streams are ineffective (venting sound increases in volume and pitch, tank discolors, or shows any signs of deforming), withdraw immediately to a secure position. Always stay away from tanks engulfed in fire. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode.

Disposal Method Suggested: Do not discharge into drains or sewers. Dispose of waste material as hazardous waste using a licensed disposal contractor to an approved landfill. Consult with environmental regulatory agencies for guidance on acceptable disposal practices. Incineration with effluent gas scrubbing is recommended. Containers must be disposed of properly by following package label directions or by contacting your local or federal environmental control agency, or by contacting your regional EPA office.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- United States National Library of Medicine, ChemIDplus Advanced, Bethesda, MD. http://chem.sis.nlm.nih.gov/chemidplus/rn/69327-76-0

Butachlor B:0757

Use Type: Herbicide

CAS Number: 23184-66-9

Formula: $C_{17}H_{26}ClNO_2$

Synonyms: Butoxymethyl; *N*-(Butoxymethyl)-2-chloro-*N*-(2,6-diethylphenyl)acetamide; 2-Chloro-2',6'-diethyl-*N*-(butoxymethyl)acetanalide; *N*-(Butoxymethyl)-2-chloro-2',6'-diethylacetanilide;Acetanilide, 2-chloro-2',6'-diethyl-*N*-(butoxymethyl)-; Acetamide, *N*-(butoxymethyl)-2-chloro-*N*-(2,6-diethylphenyl)-

Trade Names: BUTANEX®; BUTANOX®; CP 53619®; HILTACHLOR®; LAMBAST®; MACHETE®; MACHETTE®; PILLARSET®; RASAYANCHLOR®; WEEDOUT®; VENDAVAL®

Chemical Class: Chloroacetamide

EPA/OPP PC Code: 112301

California DPR Chemical Code: 4056

HSDB Number: 6865

UN/NA&ERG Number: UN3082 (liquid)/171

RTECS® Number: AE1200000

EC Number: 245-477-8

Uses: Used for pre-emergence control of annual grasses, sedges and broadleaf weeds in rice crops. Used primarily in Asia, South America, Europe and Africa. Not registered for use in the U.S. Not approved for use in EU countries[115].

Human toxicity (long-term)[101]: Very low–259.00 ppb, Health Advisory

Fish toxicity (threshold)[101]: Intermediate–14.47908 ppb, MATC (Maximum Acceptable Toxicant Concentration)

Regulatory Authority and Advisory Information: Acute Oral Category: 3, CAUTION

Health Advisory: Mutagen
Marine Pollutant: IMDG
SARA 311/312: Acute Health Hazard
WGK (German Aquatic Hazard Class): No value assigned (estimated) 2-Hazard to waters.

Description: Light yellow or amber oily liquid. Molecular weight = 311.85; Specific gravity (H_2O:1) = 1.070 @ 4 °C; Freezing/Melting point –5 °C; Boiling point = (decomposes) 156 °C @ 0.66 mmHg; 196 °C @ 0.5 mmHg; Vapor pressure = 4.5×10^{-8} mmHg; Flash point = 100 °C. Hazard Identification (based on NFPA-704 M Rating System): Health 0, Flammability 1, Reactivity 1. Low solubility in water; solubility = 20 mg/L @ 20 °C

Incompatibilities: Slowly hydrolyzes in water, releasing ammonia and forming acetate salts.

Permissible Concentration in Water: State Drinking Water Guidelines: Florida 259 μg/L; Maine 26 μg/L. Runoff from spills or fire control may cause water pollution.

Determination in Water: Log K_{ow} = >4.0. Values above 3.0 are likely to bioaccumulate in aquatic organisms.

Harmful Effects and Symptoms

Short Term Exposure: Apprehension, anxiety, confusion, nervous excitation; dizziness; headache; numbness and weakness in limbs; muscle twitching, tremors; nausea and vomiting; slow, shallow respiration, bluish face; convulsions; loss of consciousness; breathing stops; death.

LD_{50} (oral, rat) = >1.5 g/kg; LD_{50} (dermal, rabbit) = >3 g/kg.

Points of Attack: May be fatal if inhaled, ingested, or absorbed through the skin.

Medical Surveillance: Preliminary medical exam to detect chronic diseases of central nervous system, liver, heart, kidneys, lung and skin, as well as endocrinological or immunological disturbances, should protect susceptible individuals. Periodical medical exams of internal organs, skin and eyes are important to avoid chronic occupational intoxications. They should include lab and patch tests when necessary[83].Medical observation is recommended for 24 to 48 hours following breathing overexposure, as pulmonary edema may be delayed. Cigarette smoking may exacerbate pulmonary injury and should be discouraged for at least 72 hours following exposure

First Aid: Speed in removing material from eyes and skin is of extreme importance. *Eyes:* Eye contact can cause dangerous amounts of these chemicals to be quickly absorbed through the mucous membrane into the bloodstream. Directly irrigate with large amounts of plain, tepid water or saline for 20 minutes, occasionally lifting the lower and upper lids. During this time, remove contact lenses, if easily removable without additional trauma to the eye. Get medical aid immediately. Have physician check for possible delayed damage. *Skin:* Get medical aid. Dermal contact can cause dangerous amounts of these chemicals to be absorbed into the bloodstream. Wearing the appropriate PPE equipment and respirator for organochlorine pesticides, immediately flush exposed skin, hair, and under nails with plain, running, tepid water for 20 minutes, then wash twice with mild soap. Shampoo hair promptly if contaminated; protect eyes. Do not scrub skin or hair, since this can increase absorption through the skin. Rinse thoroughly with water. Victims who are able and cooperative may assist with their own decontamination. Remove and double-bag contaminated clothing and personal belongings. Leather absorbs many organochlorines; therefore, items such as leather shoes, gloves, and belts should be discarded. If the skin is swollen or inflamed, cool affected areas with cold compresses. *Ingestion:* Call poison control. Loosen all clothing. Never give anything by mouth to an unconscious person. Get medical aid. Do NOT induce vomiting. The patient is at risk of central nervous system depression or seizures, which may lead to pulmonary aspiration during vomiting. If the victim is conscious and able to swallow, *administer an aqueous slurry of activated charcoal at 1 g/kg (usual adult dose 60–90 g, child dose 25–50 g). A soda can and straw may be of assistance when offering charcoal to a child. The efficacy of activated charcoal for some organochlorine poisoning (such as chlordane) is uncertain. If victim is *unconscious or having convulsions,* do nothing except keep victim warm. *Inhalation:* Get medical aid. Do not contaminate yourself. Wearing the appropriate PPE equipment and respirator for organochlorine pesticides, immediately remove the victim from the contaminated area to fresh air. For inhalation exposures, monitor for respiratory distress. If the victim is not breathing, administer artificial respiration. Do not use mouth-to-mouth method if victim ingested or inhaled the substance; give artificial respiration with the aid of a pocket mask equipped with a one-way valve or other proper respiratory medical device. If cough or breathing difficulty develops, evaluate for respiratory tract irritation, bronchitis, or pneumonitis. If breathing is difficult, administer 100% humidified supplemental oxygen through bag/mask apparatus until medical help arrives. Do not leave victim unattended

Respirator Selection: Wherever and whenever workplace conditions warrant respirator use, a respiratory protection program must be followed that meets one or more of the following government standards: OSHA's 29 CFR 1910.134, ANSI Z88.2, or European Standard EN 149.

Storage: Color Code-Blue: Health Hazard/Poison. Store in a secure poison location. Prior to working with this chemical you should be trained on its proper handling and storage. Store in tightly closed containers in a cool, well-ventilated area. Combustible material. Sources of ignition, such as smoking and open flames, are prohibited where this chemical is used, handled, or stored in a manner that could create a potential fire or explosion hazard. Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: Environmentally hazardous substances, solid or liquid, usually fall in Hazard Class 9.

Spill Handling: For liquids, isolate spill or leak area in all directions for at least 50 meters/150 feet. Increase, in the downwind direction, as necessary. Do not touch damaged containers or spilled material unless wearing appropriate protective clothing. Stop leak if you can do it without risk. Prevent entry into waterways, sewers, basements or confined areas. Cover with plastic sheet to prevent spreading. Absorb or cover with dry earth, sand or other non-combustible material and transfer to containers. Do not allow water to get inside containers.

Fire Extinguishing: Hazardous decomposition includes oxides of nitrogen and carbon and hydrogen chloride gas. As an immediate precautionary measure, isolate spill or leak area in all directions for at least 50 meters/150 feet for liquids and at least 25 meters/75 feet for solids. *Fire involving storage or vehicular tanks:* isolate for 800 meters/0.5 mile in all directions; also, consider initial evacuation for 800 meters/0.5 mile in all directions. *On a small fire:* use dry chemical, CO_2, water spray or regular foam. *On a large fire:* use water spray, fog or regular foam. Do not scatter spilled material with high-pressure streams of water. Move containers from fire area if you can do it without risk. Dike fire-control water for later disposal. *Fire involving tanks:* from a secure, explosion-proof location, use water spray to cool exposed containers. If cooling streams are ineffective (venting sound increases in volume and pitch, tank discolors, or shows any signs of deforming), withdraw immediately to a secure position. Always stay away from tanks engulfed in fire. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode.

Disposal Method Suggested: Do not discharge into drains or sewers. Dispose of waste material as hazardous waste using a licensed disposal contractor to an approved landfill. Consult with environmental regulatory agencies for guidance on acceptable disposal practices. If allowed, incineration with effluent gas scrubbing is recommended. Containers must be disposed of properly by following package label directions or by contacting your local or federal environmental control agency, or by contacting your regional EPA office.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- United States National Library of Medicine, *ChemIDplus Advanced*, Bethesda, MD. http://chem.sis.nlm.nih.gov/chemidplus/rn/23184-66-9

Butralin B:0805

Use Type: Herbicide; plant growth regulator
CAS Number: 33629-47-9
Formula: $C_{14}H_{21}N_3O_4$
Synonyms: Aniline, *N-sec*-butyl-4-*tert*-butyl-2,6-dinitro-; Benzenamine, 4-(1,1-dimethylethyl)-*N*-(1-methylpropyl)-2,6-dinitro-; Butalin; Butraline; *N-sec*-Butyl-4-*tert*-butyl-2,6-dinitroaniline; Dibutalin; 4-(1,1-Dimethylethyl)-*N*-(1-methylpropyl)-2,6-dinitrobenzenamine; Dimethyl-ethyl-*N*-(1-methylpropyl)-2,6-dinitrobenzeneamine[4-(1,1-)]; Rutralin
Trade Names: A-820®[C]; 72-A34®; AMCHEM 70-25®[C]; AMCHEM A-280®[C]; AMEX®[C]; AMEX 820®[C]; AMEXINE®[C]; NO CRAB®[C]; SECTOR®; STIFLE®; TAMEX®; ZITSAOSOL®
Chemical class: 2,6-Dinitroaniline
EPA/OPP PC Code: 106501
California DPR Chemical Code: 1756
HSDB Number: 7355
UN/NA & ERG Number: UN1596 (Dinitroanilines)/153; UN3082 (liquid)/171; UN3077(solid)/171
RTECS® Number: BW9500000
EC Number: 251-607-4

Uses: Not approved for use in EU countries[115]. Actively registered for use in the U.S. Butralin is used as a plant growth regulator on tobacco after the tobacco is topped. All tobacco is topped to stimulate desirable chemical and physical characteristics but it also stimulates the growth of suckers. All uses on food crops were canceled in January, 1991, and all uses on turf and ornamental grasses were voluntarily canceled in March, 1997. It may be used on food crops, broadleaf weeds and ornamentals in some countries. Butralin has been found effective in destroying opium poppy crops.

Human toxicity (long-term): Low–70.00 ppb, Health Advisory

Fish toxicity (threshold): Intermediate–42.17178 ppb, MATC (Maximum Acceptable Toxicant Concentration)

Regulatory Authority and Advisory Information: Health Advisory: Mutagen, Developmental/Reproductive Toxin, Skin irritant/sensitizer.
Acute Oral Category: 3, CAUTION
Marine pollutant, IMO/IMDG

Description: Butralin is a yellow-orange crystalline solid or liquid. Commercial product is available as an emulsifiable concentrate. Molecular weight = 295.34; Specific gravity (H_2O:1) = 1.05 @ 20 °C; Flash point = >100 °C; 65 °C (cc)[MSDS]. Henry's Law constant = 4.9×10^{-6} atm-m^3/mol @ 25 °C (est)[83]. Hazard Identification (based on NFPA-704 M Rating System): Health 2, Flammability 1, Reactivity 0. Slightly soluble in water; solubility = <1.0 ppm. Some formulations may contain petroleum distillate. Physical and toxicological properties may be affected by carrier solvents in commercial formulations.

Incompatibilities: Oxidizers (chlorates, nitrates, peroxides, permanganates, perchlorates, chlorine, bromine, fluorine, etc); strong acids

Permissible Concentration in Water: Runoff from spills or fire control may cause water pollution.

Determination in Water: Log K_{ow} = >4.5. Values above 3.0 are likely to bioaccumulate in aquatic organisms.

Routes of Entry: Inhalation, dermal contact, ingestion

Harmful Effects and Symptoms

Short Term Exposure: May cause irritation to the eyes, skin, or respiratory tract. May be toxic if ingested or upon dermal and/or eye contact. LD_{50} (oral, rat) = 1.5–2.5 g/kg; LD_{50} (dermal, rabbit) = 200 mg/kg[9].

Long Term Exposure: May cause reproductive and fetal effects.

Points of Attack: Reproductive cells. Chromosomes/DNA.

Medical Surveillance: Preliminary medical exam to detect chronic diseases of central nervous system, liver, heart, kidneys, lung and skin, as well as endocrinological or immunological disturbances, should protect susceptible individuals. Periodical medical exams of internal organs, skin and eyes are important to avoid chronic occupational intoxications. They should include lab and patch tests when necessary[83]. In addition to comprehensive initial medical and work histories emphasizing reproductive experience and menstrual history, patient should have physical examination and testing of genito-urinary tract, sperm count, motility and morphology. If required, other tests, such as serum testosterone, serum follicle stimulating hormone (FSH), and serum lutenizing hormone (LH), may be indicated.

First Aid: If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least 15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately. If this chemical contacts the skin, remove contaminated clothing and wash immediately with soap and water. Seek medical attention immediately. If this chemical has been inhaled, remove from exposure, begin rescue breathing (using universal precautions) if breathing has stopped, and CPR if heart action has stopped. Transfer promptly to a medical facility. When this chemical has been swallowed, get medical attention. Give large quantities of water and induce vomiting. Do not make an unconscious person vomit.

Personal Protective Methods: Dinitroanilines react with cellulose-based and expanded polymeric absorbents[88]. Applicators and other handlers must wear: Coveralls worn over long-sleeved shirt and long pants; Chemical-resistant gloves such as DuPont™ Tychem® suit fabrics, barrier laminate, or Viton®; Chemical-resistant footwear plus socks; Protective eye wear; Chemical-resistant headgear for overhead exposure; Chemical-resistant apron when cleaning equipment, mixing, or loading[83]. Agricultural Use/Engineering Controls: When handlers use closed systems, enclosed cabs, or aircraft in a manner that meets the requirements listed in the Worker Protection Standard (WPS) for agricultural pesticides, 40 CFR 170.240(d)(4-6), the handler PPE requirements may be reduced or modified as specified in the Worker Protection Standard. Firefighters should wear NIOSH approved self-contained breathing apparatus and full protective clothing.

Respirator Selection: For nuisance exposures use type P95 (US) or type P1 (EU EN 143) particle respirator. For higher-level use type OV/AG/P99 (US) or type ABEK-P2 (EU EN 143) respirator cartridges. Use respirators and components tested and approved under appropriate government standards such as NIOSH (US) or CEN (EU).

Storage: Color Code-Red Stripe: Flammability Hazard: Store separately from all other flammable materials. Prior to working with this chemical you should be trained on its proper handling and storage. Before entering confined space where this chemical may be present, check to make sure that an explosive concentration does not exist. Store in tightly closed containers in a cool, well-ventilated area away from chlorine compounds, oxidizing agents; and combustible materials. If this material contains a flammable carrier, sources of ignition, such as smoking and open flames, are prohibited where the chemical is handled, used, or stored. Use only non-sparking tools and equipment, especially when opening and closing containers. Wherever this chemical is used, handled, manufactured, or stored, use explosion-proof electrical equipment and fittings. Piping should be electrically bonded and grounded. Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: Dinitroanilines require a label of "poisonous materials." They usually fall into Hazard Group 6.1. Environmentally hazardous substances, solid or liquid, usually fall in Hazard Class 9.

Spill Handling: For dinitroaniline solids, isolate spill or leak area in all directions for at least 50 meters/150 feet. Increase, in the downwind direction, as necessary. *If tank, rail car or tank truck is involved in spill*, isolate for 800 meters/0.5 mile in all directions; also, consider initial evacuation for 800 meters/0.5 mile in all directions. Do not touch damaged containers or spilled material unless wearing appropriate protective clothing. Stop leak if you can do it without risk. Prevent entry into waterways, sewers, basements or confined areas. Cover with plastic sheet to prevent spreading. Absorb or cover with dry earth, sand or other non-combustible material and transfer to containers. Do not allow water to get inside containers.

Fire Extinguishing: Hazardous decomposition products include oxides of nitrogen and carbon. As an immediate precautionary measure, isolate spill or leak area in all directions for at least 50 meters/150 feet for liquids and at least 25 meters/75 feet for solids. *Fire involving storage or vehicular tanks:* isolate for 800 meters/0.5 mile in all directions; also, consider initial evacuation for 800 meters/0.5 mile in all directions. *On a small fire:* use dry chemical, CO_2, water spray or regular foam. *On a large fire:* use water spray, fog or regular foam. Do not scatter spilled material with high-pressure streams of water. Move containers from fire area if you can do it without risk. Dike fire-control water for later disposal. *Fire involving tanks:* from a secure, explosion-proof location, use water spray to cool exposed containers. If cooling streams are ineffective (venting sound increases in volume and pitch, tank discolors, or shows any signs of deforming), withdraw immediately to a secure position. Always stay away from tanks engulfed in fire. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode.

Disposal Method Suggested: Do not discharge into drains or sewers. Dispose of waste material as hazardous waste using a licensed disposal contractor to an approved landfill. Contact a licensed disposal facility about surplus and non-recyclable solutions. Burn in a chemical incinerator equipped with an afterburner and scrubber. Extra care must be exercised as the material in an organic solvent is highly flammable. Consult with environmental regulatory agencies for guidance on acceptable disposal practices. Incineration with effluent gas scrubbing is recommended. Containers must be disposed of properly by following package label directions or by contacting your local or federal environmental control agency, or by contacting your regional EPA office. Do not reuse container.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- USEPA, "Reregistration Eligibility Decision (RED), Butralin," Office of Prevention, Pesticides and Toxic Substances, Washington DC (May 1998). http://www.epa.gov/REDs/2075red.pdf

Butylate B:0860

Use Type: Herbicide

CAS Number: 2008-41-5

Formula: $C_{11}H_{23}NOS$

Synonyms: Bis(2-methylpropyl)carbamothioic acid-*S*-ethyl ester; Butilate; Diisobutylthiocarbamic acid-*S*-ethyl ester; Diisocarb; *S*-Ethyl *N,N*-diisobutylthiocarbamate; *S*-Ethyl bis(2-methylpropyl)carbamothioate; Ethyl-*N,N*-diisobutylthiocarbamate; *S*-Ethyldiisobutyl thiocarbamate; Ethyl-*N,N*-diisobutyl thiolcarbamate

Trade Names: ANELDA PLUS®; ANELDAZIN®; ANELIROX®; ATRA-BUTE®[C] Nov.1992; BUTILATE®; GENATE®[C] August 1994; R-1910®[C] Dec.1987; STAUFFER R-1910®[C] Dec.1987; SUTAN®[C] Sept.1994; SUTAZINE®[C] Dec.1987; TOMAHAWK®

Chemical class: Thiocarbamate

EPA/OPP PC Code: 041405

California DPR Chemical Code: 565

HSDB Number: 1714

UN/NA & ERG Number: UN3006 (liquid)/151; UN3082 (liquid)/171

RTECS® Number: EZ7525000

EC Number: 217-916-3

Uses: Classified as a General Use Pesticide (GUP) with applications limited to corn fields. Not approved for use in EU countries[115]. A selective herbicide for use on field corn, sweet corn, and popcorn to control grassy and broadleaf weeds and seeds in the soil prior to sowing a crop. Often applied in combination with atrazine and/or cyanazine.

U.S. Maximum Allowable Residue Levels for Butylate, Federal Register (67FR49689-49691, July 31, 2002): "By itself, butylate poses no risk concerns within the limits of the existing tolerances, which will remain in effect at 0.1 ppm for all registered commodities; however, the Agency intends to revise the commodity definitions in accordance with current Agency administrative practice."

Human toxicity (long-term)[101]: Very low–400.00 ppb, Health Advisory

Fish toxicity (threshold)[101]: Intermediate–22.61732 ppb, MATC (Maximum Acceptable Toxicant Concentration)

Regulatory Authority and Advisory Information:

Carcinogenicity[83]: EPA Group E, evidence of non-carcinogenicity for humans

Health Advisory: Nerve Toxin (S!), Severe eye irritant

Acute Oral Category: 3, CAUTION

Potential Ground Water Pollutant [California FAC Section 13145(d)/12811, inactive)

RCRA 40CFR268.48; 61FR15654, Universal Treatment Standards: Wastewater (mg/L), 0.003; Non-wastewater (mg/kg), 1.4

Description: Butylate is a clear liquid with an aromatic odor. Molecular weight = 217.38; Specific gravity (H_2O:1) = 0.938; Boiling point = >250 °C; 137.5 °C @ 21 mmHg; Freezing/Melting point = 138 °C; Vapor pressure = 1.3×10^{-2} mmHg; 170 mmHg @ 20 °C; Flash point 110 °C (oc). Low solubility in water; solubility = 44 mg/L.

Incompatibilities: Hydrolyzed by strong acids and alkalies. UV light causes derogation. Thermally stable up to 200 °C. Flammable gases are generated by the combination of thiocarbamates with aldehydes, nitrides, and hydrides. Thiocarbamates are incompatible with acids, peroxides, and acid halides.

Permissible Concentration in Water: Federal Drinking Water Standards: EPA 35 μg/L; State Drinking Water Guidelines: Florida 350 μg/L; Maine 350 μg/L; Wisconsin 400 μg/L.

Determination in Water: Analysis of butylate is by a gas chromatographic (GC) method applicable to the determination of certain nitrogen- and phosphorus-containing pesticides in water samples. In this method, approximately 1 L of sample is extracted with methylene chloride. The extract is concentrated and the compounds are separated using capillary column GC. Measurement is made using a nitrogen-phosphorus detector. The method detection limit has not been determined for butylate, but it is estimated that the detection limits for analytes included in this method are in the range of 0.1 to 2 μg/L. Log K_{ow} = >4.0. Values above 3.0 are likely to bioaccumulate in aquatic organisms.

Harmful Effects and Symptoms

Short Term Exposure: Can cause serious eye irritation. May cause skin and respiratory irritation. LD_{50} (oral, rat) = >3 g/kg; LD_{50} (dermal, rat) = >5 g/kg.

Long Term Exposure: An EPA Category I eye irritant. May be weakly neurotoxic.

Points of Attack: Eyes, Central nervous system. Possible mutagen. Reproductive cells.

Medical Surveillance: Preliminary medical exam to detect chronic diseases of central nervous system, liver, heart, kidneys, lung and skin, as well as endocrinological or immunological disturbances, should protect susceptible individuals. Periodical medical exams of internal organs, skin and eyes are important to avoid chronic occupational intoxications. They should include lab and patch tests when necessary[83]. Comprehensive physical examination with emphasis on the genito-urinary tract analysis to include sperm count, motility and morphology. Other tests, such as serum testosterone, serum follicle stimulating hormone (FSH), and serum lutenizing hormone (LH), may be carried out if, in the opinion of a physician, they are indicated.

First Aid: If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least 15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately. If this chemical contacts the skin, remove contaminated clothing and wash immediately with soap and water. Seek medical attention immediately. If this chemical has been inhaled, remove from exposure, begin rescue breathing (using universal precautions) if breathing has stopped, and CPR if heart action has stopped. Transfer promptly to a medical facility. When this chemical has been swallowed, get medical attention. Give large quantities of water and induce vomiting. Do not make an unconscious person vomit.

Personal Protective Methods: Reacts with the following absorbent materials: Cellulose-Based; Mineral- and Clay-Based; Dirt/Earth[88]. Applicators and other handlers must wear: Coveralls worn over long-sleeved shirt and long pants; Chemical-resistant gloves such as DuPont™ Tychem® suit fabrics, barrier laminate, or Viton®; Chemical-resistant footwear plus socks; Protective eye wear; Chemical-resistant headgear for overhead exposure; Chemical-resistant apron when cleaning equipment, mixing, or loading[83]. Agricultural Use/Engineering Controls: When handlers use closed systems, enclosed cabs, or aircraft in a manner that meets the requirements listed in the Worker Protection Standard (WPS) for agricultural pesticides, 40 CFR 170.240(d)(4-6), the handler PPE requirements may be reduced or modified as specified in the Worker Protection Standard. Firefighters should wear NIOSH approved self-contained breathing apparatus and full protective clothing.

Respirator Selection: *At any detectable concentration:* SCBAF: Pd,Pp (APF = 10,000) (any MSHA/NIOSH/MSHA- or European Standard EN 149-approved self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode); or SaF: Pd,Pp: ASCBA (APF = 10,000) (any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary, self-contained breathing apparatus operated in a pressure-demand or other positive-pressure mode). *Escape:* 100F (APF = 50) (any air-purifying, full facepiece respirator with an N100, R100, or P100 filter) or SCBAE (any appropriate escape-type, self-contained breathing apparatus). All respirators selected must be approved by NIOSH under the provisions of 42 CFR 84. The current listing of NIOSH-certified respirators can be found in the NIOSH/NPPTL Certified Equipment List, which is available on the NIOSH Web site.

Storage: Color Code-Blue: Health Hazard/Poison: Store in a tightly closed container in a dry, well-ventilated and secure poison location. Prior to working with this chemical you should be trained on its proper handling and storage. Where possible, automatically transfer material from other storage containers to process containers. Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: Thiocarbamate and Dithiocarbamate pesticides, solid, toxic require a label of "poisonous materials." This material usually falls in Hazard Class 6.1.

Spill Handling: Evacuate and restrict persons not wearing protective equipment from area of spill or leak until clean up is complete. Collect powdered material in the most convenient and safe manner and deposit in sealed containers. Ventilate area of spill or leak after clean up is complete. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable. Soil Adsorption Index (K_{oc}) = 400.

Fire Extinguishing: Hazardous decomposition includes oxides of nitrogen, sulfur, and carbon. *On a small fire:* use dry chemical, CO_2 or water spray. *On a large fire:* use water spray, fog or regular foam. Move containers from fire area if you can do it without risk. Dike fire-control water for later disposal; do not scatter the material. Use water spray or fog; do not use straight streams. *Fire involving storage or vehicular tanks:* isolate for 800 meters/0.5 mile in all directions; also, consider initial evacuation for 800 meters/0.5 mile in all directions. Fight fire from maximum distance or use unmanned hose holders or monitor nozzles. Do not get water inside containers. Cool containers with flooding quantities of water until well after fire is out. Withdraw immediately in the case of rising sound from venting safety devices or discoloration of tank. ALWAYS stay away from tanks engulfed in fire. For massive fire, use unmanned hose holders or monitor nozzles; if this is impossible, withdraw from area and let fire burn. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies.

Disposal Method Suggested: Hydrolysis and landfill: For each 2.265 kg of actual carbaryl, add 0.906 kg of flake caustic (sodium hydroxide) (this amount was stated to be a 50% excess over the minimum required) and allow about 24 hr for completion of the reaction. The first step of the degradation would be: aryl-O-CO-NHR + H_2O–NaOH → aryl-OH- + (HO-CO-NHR). The carbamic acid at the right would decompose to the amine and carbon dioxide in neutral solution, or to sodium carbonate in excess base. In excess base the phenol would be converted to the salt, that is, NaO-aryl. Phenolic decomposition products of some carbamate pesticides may, under some circumstances, persist in the environment and harm specific ecosystems. Hence, the hydrolysis should be followed by soil burial of the products in disposal. Containers: Group I (combustible) Containers from organic or metallo-organic pesticides (except organic mercury, lead, cadmium, or arsenic compounds) should be disposed of in pesticide incinerators or in specified landfill sites. Group II (Non-combustible) Containers from organic or metallo-organic pesticides (except organic mercury, lead, cadmium, or arsenic compounds) must first be triple-rinsed. Containers that are in good condition may be returned to the manufacturer or formulator of the pesticide product, or to a drum reconditioner for reuse with the same type of pesticide product, if such reuse is legal under Department of Transportation regulations [e.g. 49 CFR 173.28]. Containers that are not to be reused should be punctured. and transported to a scrap metal facility for recycling, disposal or burial in a designated landfill [40 CFR 165][UN].

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- USEPA, Office of Preventions, Pesticides and Toxic Substances, Reregistration Statement, "Butylate Facts," Washington DC (September 2001)
- EXTOXNET, Extension Toxicology Network, "Pesticide Information Profile, Butylate," Oregon State University, Corvallis, OR (June 1996). http://pmep.cce.cornell.edu/profiles/extoxnet/24d-captan/butylate-ext.htm
- USEPA, "Health Advisory: Butylate," Washington DC, Office of Drinking Water, August 1987
- USEPA, Office of Prevention, and Toxic Substances, *R.E.D. FACTS, Butylate*, EPA 738-F-93-104, Washington DC (September 1993)

C

Captafol C:0400

Use Type: Fungicide
CAS Number: 2425-06-1; 2939-80-2 (cis-)
Formula: $C_{10}H_9Cl_4NO_2S$
Synonyms: 4-Cyclohexene-1,2-dicarboximide, *N*-(1,1,2,2-Tetrachloroethyl)thiol-1*H*-Isoindole-1,3(2*H*)-dione,3A,4,7,7A-tetrahydro-2-(1, 1,2, 2-tetrachloroethyl) thio-; *N*-[(1,1,2,2-Tetrachloroethyl) thio]-4-cyclohexene-1, 2-dicarboximide *N*-[(1, 1, 2, 2-Tetrachloroethyl) thio]-4-cyclohexene-1,2-dicarboximide *N*-[(1,1,2,2-Tetrachloroehtyl)-thio]4-cyclohexene-1,2-dicarboximide; *N*-1,1,2,2-Tetrachloroethylmercapto-4-cyclohexene-1,2-carboximide; *N*-[(1, 1, 2, 2-Tetrachloroethyl) sulfenyl]-*cis*-4-cyclohexene-1, 2-dicarboximide; *N*-(1,1,2,2-Tetrachloroethylthio)-4-cyclohexene-1, 2-dicarboximide
Trade Names: CAPTATOL®; CAPTOFOL®; CRISFOLATAN®; DIFOLATAN®[C]; DIFOCAP®[C]; DIFOSAN®; FOLCID®; HAIPEN®; KENOFOL®; MERPAFOL®; ORTHO® 5865[C]; PILLARTAN®; SANSEAL®; SANSPOR®; SANTAR-SM®; SULFONIMIDE®; SULPHEIMIDE®
Chemical class: Phthalimide; Carboximide
EPA/OPP PC Code: 081701; 081702 (unspecified isomer)
California DPR Chemical Code: 292
HSDB Number: 340
UN/NA & ERG Number: UN2773 (Phthalimide derivative pesticides, solid, toxic)/151
RTECS® Number: GW4900000
EC Number: 219-363-3 [*Annex I Index No.:* 613-046-00-7]
Uses: Captafol is a General Use Pesticide and used for the control of practically all forms of fungal diseases except powdery mildew. It is also used as a seed protectorant on cotton, rice and peanut crops. Not registered for use in the U.S. or in EU countries[115]. There are 20 global suppliers[97].
U.S. Maximum Allowable Residue Levels for Captafol (40 CFR 180.267): in or on the following food commodities: onion, 0.1 ppm; potato, 0.5 ppm; and tomato, 15 ppm.
Human toxicity (long-term)[101]: 6.6 ppb, CHCL (Chronic Human Carcinogen Level)
Fish toxicity (threshold)[101]: High–1.75895 ppb, MATC (Maximum Acceptable Toxicant Concentration)
Regulatory Authority and Advisory Information:
Carcinogenicity[83]: EPA Group B2, Probable human carcinogen; NTP: 12th Report on Carcinogens, 2011: Reasonably anticipated to be a human carcinogen; GHS (1A, 1B) Known or presumed human carcinogen.
California Proposition 65 Chemical: Carcinogen (10/1/1988)
Acute Oral Category: 1, DANGER–POISON
Health Advisory: Nerve Toxin (S!), Mutagen, Developmental/Reproductive Toxin
European/International Regulations: Hazard Symbol: T, Xi, N; risk phrases: R43; R45(2); R50/53; safety phrases: S2; S53; S45; S60; S61 (see Appendix 1)
Description: Captafol is a colorless, white, or pale yellow crystalline solid. Weak, mercaptan odor (like sulfur). Commercial product is available as a wettable powder. Molecular weight = 349.09; Freezing/Melting point = 160–161 °C (dangerous decomposition); Vapor pressure = 8×10^{-6} mmHg @ 20 °C[9]. Practically insoluble in water; solubility = 1.6 ppm @ 20 °C. Physical and toxicological properties may be affected by carrier solvents in commercial formulations.
Incompatibilities: Reacts violently with bases, causing fire and explosion hazard. Not compatible with strong acids or acid vapor, oxidizers. Strong alkaline conditions contribute to instability. Attacks some metals. Imides react with azo- and diazo-compounds, generating toxic gases. Contact with organic imides and reducing agents releases flammable gases. Imides are extremely weak bases (weaker than water). They react as acids with strong bases, forming salts.
Permissible Exposure Limits in Air: OSHA PEL: None
NIOSH REL: 0.1 mg/m^3 TWA [skin]; Limit exposure to lowest feasible concentration. NIOSH considers this chemical to be a potential occupational carcinogen as defined by the OSHA carcinogen policy [29 CFR 1990].
ACGIH TLV®[1]: 0.1 mg/m^3 TWA [skin], not classifiable as a human carcinogen.
No Protective Action Criteria (PAC) available.
Australia: TWA 0.1 mg/m^3, 1993; Belgium: TWA 0.1 mg/m^3, 1993; Denmark: TWA 0.1 mg/m^3 [skin], 1999; France: VME 0.1 mg/m^3 [skin], carcinogen, 1993; Norway: TWA 0.1 mg/m^3, 1999; Switzerland: MAK-W 0.1 mg/m^3 [skin], 1999; United Kingdom: TWA 0.1 mg/m^3, carcinogen, 2000.
Permissible Concentration in Water: State Drinking Water Guidelines: Florida 100 μg/L. Runoff from spills or fire control may cause water pollution. Highly toxic to fish and other aquatic organisms.
Determination in Water: Log K_{ow} = >3.5. Values above 3.0 are likely to bioaccumulate in aquatic organisms.
Routes of Entry: Inhalation, ingestion, skin
Harmful Effects and Symptoms
Short Term Exposure: Irritates eyes, skin and respiratory tract. Captafol can affect you when breathed in and by passing through your skin. Because this material has a low vapor pressure, significant inhalation of vapors is unlikely at ordinary temperatures. Captafol may cause an asthma-like allergy. Future exposures can cause asthma attacks with shortness of breath, wheezing, cough, and/or chest tightness. Exposure can irritate the skin. It can

also cause a skin allergy to develop. Exposure to the sun (or other ultraviolet light) after exposure to captafol may cause severe rash with itching, swelling, and blistering. LD_{50} (oral, rat) = >5 g/kg.; LD_{50} (dermal, rat) = >5 g/kg.

Long Term Exposure: Repeated or prolonged contact cause skin sensitization, dermatitis, allergic conjunctivitis and periorbital edema. Repeated or prolonged inhalation exposure may cause asthma. The substance may have damaging effects on the liver and kidneys. Captafol is a probable carcinogen in humans. There is some evidence that it causes liver cancer in humans and it has caused kidney cancer in animals. Captafol may cause mutations. Handle with extreme caution. May cause tumors.

Points of Attack: Skin, respiratory system, liver and kidneys, chromosomes/DNA.

Medical Surveillance: This chemical is a suspected or known human carcinogen. Exposed persons should contact a physician for advice regarding the possible long term health effects and advice for medical monitoring. If symptoms develop or overexposure is suspected, the following may be useful: Liver and kidney function test; lung function test. Skin testing with dilute Captafol may help diagnose allergy, if done by a qualified allergist. In addition to comprehensive initial medical and work histories emphasizing reproductive experience and menstrual history, patient should have physical examination and testing of genito-urinary tract, sperm count, motility and morphology. If required, other tests, such as serum testosterone, serum follicle stimulating hormone (FSH), and serum lutenizing hormone (LH), may be indicated.

First Aid: If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least 15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately. If this chemical contacts the skin, remove contaminated clothing and wash immediately with soap and water. Seek medical attention immediately. If this chemical has been inhaled, remove from exposure, begin rescue breathing (using universal precautions) if breathing has stopped, and CPR if heart action has stopped. Transfer promptly to a medical facility. When this chemical has been swallowed, get medical attention. Give large quantities of water and induce vomiting. Do not make an unconscious person vomit.

Personal Protective Methods: *Clothing:* Avoid dermal contact with captafol. Wear protective gloves and clothing. Safety equipment suppliers/manufacturers can provide recommendations on the most protective glove/clothing material for your operation. All protective clothing (suits, gloves, footwear, headgear) should be clean, available each day, and put on before work. *Eye Protection:* Wear dust-proof goggles when working with powders or dust, unless full facepiece respiratory protection is worn. Use splash-proof chemical goggles and face shield when working with liquids containing captafol.

Respirator Selection: *At any detectable concentration:* SCBAF: Pd,Pp (APF = 10,000) (any NIOSH/MSHA- or European Standard EN 149-approved self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode); or SaF: Pd,Pp: ASCBA (APF = 10,000) (any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary, self-contained breathing apparatus operated in a pressure-demand or other positive- pressure mode). *Escape:* 100F (APF = 50) (any air-purifying, full facepiece respirator with and N100, R100, or P100 filter k-mounted organic vapor canister having a high-efficiency particulate filter); or SCBAE (any appropriate escape-type, self-contained breathing apparatus).

Storage: Color Code-Green: General storage may be used. Prior to working with captafol you should be trained on its proper handling and storage. Store in tightly closed containers in a cool, well-ventilated area away from heat, acids, acid fumes or strong oxidizers (such as peroxides, chlorates, perchlorates, nitrates and permanganates), since violent reactions occur. A regulated, marked area should be established where this chemical is handled, used, or stored in compliance with OSHA Standard 1910.1045. Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: Captafol fits the category of "Phthalimide derivative pesticides, solid, toxic." Commercial formulations use different carrier solvents which may change physical properties and affect Packing Group. It requires a shipping label of "poisonous materials." Hazard Class is 6.1.

Spill Handling: First remove all sources of ignition. Evacuate persons not wearing protective equipment from area of spill or leak until clean up is complete. Collect powdered material in the most convenient and safe manner and deposit in sealed containers. Ventilate area after clean up is complete. If Captafol is in liquid or slurry form, absorb it with vermiculite, dry sand, earth or a similar material. Dispose of the absorbing material in an approved facility. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable.

Fire Extinguishing: Captafol decomposes on heating, producing toxic and corrosive fumes, including hydrogen chloride and oxides of nitrogen and sulfur. This chemical is a noncombustible solid but it may be dissolved in a flammable liquid. Use dry chemical, carbon dioxide; water spray; or alcohol-resistant foam extinguishers. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies. From a secure, explosion-proof location, use water spray to cool exposed containers. If cooling streams are ineffective (venting sound increases in volume and pitch, tank discolors, or shows any signs of deforming), withdraw immediately to a secure position. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode.

Disposal Method Suggested: It is the responsibility of chemical waste generators to determine the toxicity and physical properties of a discarded chemical and to properly identify its classification and certification as a hazardous waste and to determine the disposal method. U.S. EPA guidelines for the classification determination are listed in 40 CFR Parts 261.3. Additionally, waste generators must consult and follow all regional, national, state and local hazardous waste laws to ensure complete and accurate classification and disposal methods. A report by the U.N. suggests "The hydrolysis products are not fungicidally active." All organic pesticides, whether of botanical or synthetic origin, can be destroyed by incineration equipped with scrubbers to remove acid wastes.

References:

- United States National Library of Med icine, National Institutes of Health, Hazardous Substance Data Bank (HSd B), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- USEPA, Office of Pesticide Programs, Pesticide Residue Limits, "Captafol", 40 CFR 180.267. http://www.epa.gov/pesticides/food/viewtols.htm
- EXTOXNET, Extension Toxicology Network, "Pesticide Information Profile, Captafol," Oregon State University, Corvallis, OR (September 1995). http://ace.orst.edu/info/extoxnet/pips/captafol.htm
- New Jersey department of Health and Senior Services and Senior Services, "Hazardous Substance Fact Sheet: Captafol," Trenton, NJ (April 1998). http://www.state.nj.us/health/eoh/rtkweb/0338.pdf
- United Nations Environmental Programme, United Nations. Treatment and disposal Method s for Waste Chemicals, Data Profile Series No. 5., p. 152, Geneva, Switzerland (December 1985)

Captan C:0410

Use Type: Fungicide

CAS Number: 133-06-2

Formula: $C_9H_8Cl_3NO_2S$

Synonyms: 4-Cyclohexene-1, 2-dicarboximide,*N*-[(trichloromethyl) mercapto; ENT 26538; 1H-Isoindole-1, 3(2H)-dione,3 a, 4, 7, 7a-tetrahydro-2-[(trichloromethyl) thiol]-; NCI-0077; *N*-Trichloromethylmercapto-4-cyclohexene-1, 2-dicarboximide; *N*-(Trichloromethylmercapto)-δ^4-tetrahydrophthalimide; *N*-Trichloromethylthiocyclohex-4-ene-1, 2-dicarboximide; *N*-Trichloromethylthio-*cis*-δ^4-cyclohexene-1, 2-dicarboximide; *N*-trichloromethylthiocyclohex-4-ene-1,2-dicarboximide; *N*-[(trichloromethyl)thio]-4-cyclohexene-1, 2-dicarboximide; *N*-[(trichloromethyl)thio]tetrahydrophthalimide; *N*-[(trichloromethyl)thio]-δ^4-tetrahydrophthalimide; *N*-trichloromethylthio-3a,4,7,7a-tetrahydrophthalimide

Trade Names: AACAPTAN®; AGROSOL S®[C]; AGROX® 2-WAY and 3-WAY[C]; AMERCIDE®; APRON®[C]; BEISTERGARD®; BANGTON®; BEAN SEED PROTECTANT®; CAPTANCAPTENEET® 26,538; CAPTAF®; CAPTAF®; CAPTAN® 50W; CAPTAN SC®; CAPTEX®; CRIPTAN®; ESSO® FUNGICIDE 406; FLIT® 406; FUNGUS BAN® TYPE II; FUNGICIDE 406®; GLYODEX® 37-22; GRANOX PFM®; GUSTAFSON CAPTAN 30-DD; HEXACAP®; ISOTOX SEED TREATER® "D" and "F"; KAPTAN®; MALIPUR®; MERPAN®; MICRO-CHECK® 12; MIOSTAT®; NERACID®; ORTHOCIDE®; OSOCIDE®; POTATO SEED PIECE PROTECTANT®; SR 406®; STAUFFER CAPTAN®; TRIMEGOL®; VANICIDE®; VANICIDE® P-75; VANICIDE® 89; VANICIDE® 89RE; VANGARD® K; VANGUARD® K; VONDCAPTAN®

Chemical class: Thiophthalimide

EPA/OPP PC Code: 081301

California DPR Chemical Code: 104

HSDB Number: 951

UN/NA & ERG Number: UN3077 (solid)/171; UN3082 (liquid)/171

RTECS® Number: GW5075000

EC Number: [*Annex I Index No.:* 613-044-00-6]

Uses: Most uses of captan on food crops in the United States have been canceled since 1989. It is still used in apple production, almonds and strawberries. It is often applied to packing and shipping boxes for fruits and vegetables. Captan is rapidly degraded in natural soil by chemical as well as biologic means (estimated half-life, days to weeks). It is also used as a preservative for awnings, draperies and leather, as a root dip and seed treatment. It is also added to paints, wallpaper paste, plastic and leather goods. There are over 320 federally registered pesticide products that contain captan.

U.S. Maximum Allowable Residue Levels for Captan [40 CFR 180.103(a)]: almond 0.25 ppm; almond, hulls 75.0 ppm; animal feed, nongrass, group 18, 0.05 ppm; apple 25.0 ppm; apricot 10.0 ppm; blueberry 20.0 ppm; caneberry, subgroup 13A, 25.0 ppm; cherry, sweet 50.0 ppm; cherry, tart 50.0 ppm; cotton, undelinted seed 0.05 ppm; dill, seed 0.05 ppm; flax, seed 0.05 ppm; grape 25.0 ppm; grain, cereal, forage, fodder and straw, group 16, 0.05 ppm; grain, cereal, group 15, 0.05 ppm; grass, forage 0.05 ppm; grass, hay 0.05 ppm; nectarine 25.0 ppm; okra 0.05 ppm; peach 15.0 ppm; peanut 0.05 ppm; peanut, hay 0.05 ppm; pear 25.0 ppm; plum, prune, fresh 10.0 ppm; rapeseed, forage 0.05 ppm; rapeseed, seed 0.05 ppm; safflower, seed 0.05 ppm; sesame, seed 0.05 ppm; strawberry 20.0 ppm; sunflower, seed 0.05 ppm; vegetable, brassica leafy, group 5, 0.05 ppm; vegetable, bulb, group 3, 0.05 ppm; vegetable, cucurbit, group 9, 0.05 ppm; vegetable, foliage of legume, group 7, 0.05 ppm; vegetable, fruiting, group 8, 0.05 ppm; vegetable, leafy, except brassica, group 4, 0.05 ppm; vegetable, leaves of root and tuber, group 2, 0.05 ppm; vegetable, legume, group 6, 0.05 ppm; vegetable, root and tuber, group 1, 0.05 ppm; ***captan and its metabolite 1,2,3,6-tetrahydrophthalimide (THPI), measured***

***at THPI* [*40 CFR 180.103(b)*]** cattle, fat 0.15 ppm; cattle, meat 0.20 ppm; cattle, meat byproducts 0.30 ppm; goat, fat 0.15 ppm; goat, meat 0.20 ppm; goat, meat byproducts 0.30 ppm; hog, fat 0.15 ppm; hog, meat 0.20 ppm; hog, meat byproducts 0.30 ppm; horse, fat 0.15 ppm; horse, meat 0.20 ppm; horse, meat byproducts 0.30 ppm; milk 0.10 ppm; sheep, fat 0.15 ppm; sheep, meat 0.20 ppm; sheep, meat byproducts 0.30 ppm.

Human toxicity (long-term)*[101]*: Very low–145.83333 ppb, CHCL (Chronic Human Carcinogen Level)

Fish toxicity (threshold)*[101]*: Intermediate–25.36705 ppb, MATC (Maximum Acceptable Toxicant Concentration).

Regulatory Authority and Advisory Information:

Carcinogenicity: EPA, Likely to be carcinogenic to humans following prolonged, high-level exposures; EU GHS Category 2: Suspected human carcinogen; IARC, Group 3 not classifiable as to its carcinogenicity in humans

California Proposition 65 Chemical: Cancer (1/1/1990)

Health Advisory: Severe eye irritant, Nerve Toxin (S!), Mutagen, Developmental/Reproductive Toxin

Acute Oral Category: 3, CAUTION

Clean Air Act: Hazardous Air Pollutants (Title I, Part A, Section 112)

Clean Water Act: Section 311 Hazardous Substances/RQ 40CFR117.3 (same as CERCLA, see below); Section 313 Water Priority Chemicals (57FR41331, 9/9/92)

Reportable Quantity (RQ): 10 lb (4.54 kg)

EPCRA Section 313 Form R *de minimis* concentration reporting level: 1.0%

European/International Regulations: Hazard Symbol: T, Xi, N; risk phrases: R23; R40; R41; R43; R50; safety phrases: S1/2; S26; S29; S36/37/39; S45; S61 (see Appendix 1)

Description: Captan, when pure, is a colorless crystalline solid. The technical grade is a cream to yellow powder with a strong odor. It is commonly dissolved in water for use as a spray; however, it may be dissolved in a flammable or combustible "carrier." Molecular weight = 300.59; Specific gravity (H_2O:1) = 1.678; Boiling point = (decomposes) > 173 °C; Freezing/Melting point = 172.5 °C. Hazard Identification (based on NFPA-704 M Rating System): Health 3, Flammability 2, Reactivity 0. Very slightly soluble in water; solubility = 0.0003% @ 25 °C. Physical and toxicological properties may be affected by the carrier solvents used in commercial formulations.

Incompatibilities: Incompatible with tetraethyl pyrophosphate, parathion. Keep away from strong alkaline materials (e. g., hydrated lime) as captan may become unstable. May react with water, releasing hydrogen chloride gas. Corrosive to metals in the presence of moisture. Imides react with azo- and diazo-compounds, generating toxic gases. Contact with organic imides and reducing agents releases flammable gases. Imides are extremely weak bases (weaker than water). They react as acids with strong bases, forming salts.

Permissible Exposure Limits in Air: OSHA PEL: None

NIOSH REL: Carcinogen 5 mg/m^3 TWA; Limit exposure to lowest feasible concentration. NIOSH considers this chemical to be a potential occupational carcinogen as defined by the OSHA carcinogen policy [29 CFR 1990].

ACGIH TLV®[1]: 5 mg/m^3 TWA, inhalable fraction [sensitizer]; confirmed animal carcinogen with unknown relevance to humans.

Protective Action Criteria (PAC) Ver. 27[89]

PAC-1: 15 mg/m^3
PAC-2: 29 mg/m^3
PAC-3: 400 mg/m^3

Determination in Air: OSHA versatile sampler-2; Reagent; High-pressure liquid chromatography/Ultraviolet detection; IV NIOSH Method #5601[18].

Permissible Concentration in Water: State Drinking Water Guidelines: Arizona 91 μg/L; Florida 250 μg/L; California 1.5 μg/L; Maine 146 μg/L. A no-adverse-effect level of drinking water has been calculated by NAS/NRC as 0.35 mg/L.

Determination in Water: Log K_{ow} = 2.35 2.8. Values above 3.0 are likely to bioaccumulate in aquatic organisms.

Routes of Entry: Dermal contact, inhalation of dust, ingestion

Harmful Effects and Symptoms

Short Term Exposure: The substance is a severe eye irritant and will irritate the skin (50 mg/kg/day). LD_{50} (oral, rat) = >2000 to 9000 mg/kg; LD_{50} (dermal, rat) = >5 g/kg.

Long Term Exposure: Repeated or prolonged contact with skin may cause skin allergy to develop. Once this occurs, even very small future exposures can cause itching and a skin rash. Exposure may cause tumors, mutations or damage the developing fetus; however, this needs further study. Animal studies have found the development of cancer in animals. Whether captan is a human cancer hazard may require further study.

Points of Attack: Eyes, skin, respiratory system, gastrointestinal tract, liver, kidneys. Cancer Site in animals: duodenal tumors. May cause reproductive and fetal effects.

Medical Surveillance: This chemical is a suspected or known human carcinogen. Exposed persons should contact a physician for advice regarding the possible long term health effects and advice for medical monitoring. Evaluation by a qualified allergist, including exposure history and testing, may help diagnose allergy.

First Aid: If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least 15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately. Give artificial respiration if victim is not breathing. *Do not* use mouth-to-mouth method if victim ingested or inhaled the substance; give artificial respiration with the aid of a pocket mask equipped with a one-way valve or other proper respiratory medical device. Administer oxygen if breathing is difficult. Remove and isolate contaminated clothing and shoes. In cases of contact with substance, immediately flush skin or eyes with running water for at least 20 minutes. For minor skin contact, avoid spreading material on unaffected skin. Keep victim warm and quiet. Effects of exposure (inhalation, ingestion or skin contact) to substance may be delayed. Ensure that medical personnel are aware of the material(s) involved and take precautions to protect themselves.

Personal Protective Methods: Wear protective gloves and clothing to prevent any reasonable probability of dermal contact. Safety equipment suppliers/manufacturers can provide recommendations on the most protective glove/clothing material for your operation. All protective clothing (suits, gloves, footwear, headgear) should be clean, available each day, and put on before work. Contact lenses should not be worn when working with this chemical. Wear dust-proof chemical goggles and face shield unless full facepiece respiratory protection is worn. Employees should wash immediately with soap when skin is wet or contaminated. Provide emergency showers and eyewash.

Respirator Selection: SCBA: 15 mg/m^3. NIOSH: *At any detectable concentration:* SCBAF: Pd,Pp (APF = 10,000) (any NIOSH/MSHA- or European Standard EN 149-approved self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode); or SaF: Pd,Pp: ASCBA (APF = 10,000) (any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary, self-contained breathing apparatus operated in a pressure-demand or other positive-pressure mode). *Escape:* GmFOv (APF = 50) [any air-purifying, full facepiece respirator (gas mask) with a chin-style, front- or back-mounted organic vapor canister]; or SCBAE (any appropriate escape-type, self-contained breathing apparatus).

Storage: Color Code-Blue: Health Hazard/Poison. Store in a secure poison location. Prior to working with this chemical you should be trained on its proper handling and storage. Store in tightly closed containers in a cool, well-ventilated area away from water, heat and incompatible materials. Metal containers involving the transfer of this chemical should be grounded and bonded. Where possible, automatically pump liquid from drums or other storage containers to process containers. Drums must be equipped with self-closing valves, pressure vacuum bungs, and flame arresters. Use only non-sparking tools and equipment, especially when opening and closing containers of this chemical. Sources of ignition, such as smoking and open flames, are prohibited where this chemical is used, handled, or stored in a manner that could create a potential fire or explosion hazard. A regulated, marked area should be established where this chemical is handled, used, or stored in compliance with OSHA Standard 1910.1045.

Shipping: Environmentally hazardous substances, solid or liquid, usually fall in Hazard Class 9. STN: 49 611 67; Captan (agricultural insecticides, not elsewhere classified, liquid); 49 611 64; Captan (agricultural insecticides, not elsewhere classified, other than liquid); 49 611 10; Captan (insecticides, not elsewhere classified, other than agricultural).

Spill Handling: First remove all sources of ignition. Evacuate persons not wearing protective equipment from area of spill or leak until clean up is complete. Remove all ignition sources. Collect powdered material in the most convenient and safe manner and deposit in sealed containers. Absorb liquid containing this chemical in vermiculite, dry sand, earth, or similar material. Ventilate area after clean up is complete. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable. Soil Adsorption Index (K_{oc}) = 200.

Fire Extinguishing: Captan may burn, but does not ignite readily. Use dry chemical, carbon dioxide, or foam extinguishers. *Do not use water*. At high temperatures, captan decomposes and produces poisonous gases, including oxides of sulfur and nitrogen, hydrogen chloride and phosgene. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies. From a secure, explosion-proof location, use water spray to cool exposed containers. If cooling streams are ineffective (venting sound increases in volume and pitch, tank discolors, or shows any signs of deforming), withdraw immediately to a secure position. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode.

Disposal Method Suggested: Captan decomposes fairly readily in alkaline media (pH>8). It is hydrolytically stable at neutral or acid pH but decomposes when heated alone at its Freezing/Melting point. Alkaline hydrolysis is recommended.

References:

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- USEPA, Office of Pesticide Programs, Pesticide Residue Limits, "Captan", 40 CFR 180.103. http://www.epa.gov/cgi-bin/oppsrc
- EXTOXNET, Extension Toxicology Network, "Pesticide Information Profile, Captan," Oregon State University, Corvallis, OR (June, 1996). http://ace.orst.edu/info/extoxnet/pips/captan.htm
- USEPA, "Reregistration Eligibility Decision (RED) Facts, Captan," Office of Prevention, Pesticides and Toxic Substances, Washington, DC (September 1999). http://www.epa.gov/REDs/factsheets/0120fact.pdf
- USEPA, "Rebuttable Presumption Against Registration (RPAR) and Continued Registration of Pesticide Products Containing Captan," Federal Register, 45, No. 161, 54938-54986 (August 18, 1980)
- National Cancer Institute, Bioassay of Captan for Possible Carcinogenicity, Technical Report Series No. 15, Bethesda, MD (1977)

- Sax, N. I., Ed., “Dangerous Properties of Industrial Materials Report,” 1, No. 4, 93-94 (1981); and 3, No. 5, 80-84 (1983)
- New Jersey Department of Health and Senior Services and Senior Services, “Hazardous Substance Fact Sheet: Captan,” Trenton, NJ (August 1998). http://www.state.nj.us/health/eoh/rtkweb/0339.pdf

Carbaryl C:0430

Use Type: Insecticide, Nematicide, Plant growth regulator
CAS Number: 63-25-2
Formula: $C_{12}H_{11}NO_2$; $C_{10}H_7OOCNHCH_3$
Synonyms: Carbamic acid, methyl-, 1-naphthyl ester; Carbaryl, NAC; ENT 23969; Methylcarbamate 1-naphthalenol; Methylcarbamic acid, 1-naphthyl ester; *N*-Methyl-α-naphthylcarbamate; *N*-Methyl-1-naphthyl carbamate; *N*-Methyl-α-naphthylurethan; α-Naphthyl *N*-methylcarbamate; 1-Naphthylmethylcarbamate; 1-Naphthol; 1-Naphthyl *N*-Methylcarbamate; 1-Naphthyl *N*-methyl-carbamate
Trade Names: ADIOS®; ARILAT®; ARILATE®; ARYLAM®; BERCEMA NMC50®; BUGMASTER®[C]; CAPROLIN®; CARBAMEC®; CARBAMINE®; CARBATOX®; CARBAVUR®; CARBOMATE®; CARPOLIN®; COMPOUND 7744®; CARYLDERM®; CRAG SEVIN®; CRUNCH®; DENAPON®; DICARBAM®; DYNA-CARBYL®; EXPERIMENTAL INSECTICIDE 7744®; GAMONIL®; GERMAIN'S®; HEXAVIN®; KARBASPRAY®; KARBATOX®; KARBOSEP®; MENAPHAM®; MICROCARB®; MUGAN®; MURVIN®; NAC®; NMC® 50; OMS-29®; OMS 629®; OLTITOX®; PANAM®; POMEX®; PROSEVOR® 85; RAVYON®; SAVIT®[C]; SEPTENE®; SEFFEIN®; SEVIMOL®; SEVIN®; SEWIN®; SOK®; TERCYL®; THINSEC®; TORNADO®; TRICAR®; UNION CARBIDE 7,744®; VIOXAN®
Chemical class: Carbamate (N-methyl)
EPA/OPP PC Code: 056801
California DPR Chemical Code: 105
HSDB Number: 952
UN/NA & ERG Number: UN2757 (solid)/151
RTECS® Number: FC5950000
EC Number: 200-555-0; [*Annex I Index No.:* 006-011-00-7]
Uses: Carbaryl is one of the most widely used insecticides in agriculture, professional turf management and ornamental production, as well as in residential pet, lawn, and garden markets. It controls over 100 species of insects that infect citrus, cotton, nuts, and forest and ornaments trees, as well as poultry and livestock. Carbaryl also is used as a mosquito adulticide. It is available in a variety of formulations bait, dust, wettable powders, granules, dispersions and suspensions. Washington State, for example, has a Special Local Needs registration to control burrowing shrimp in oyster beds. A U.S. EPA restricted Use Pesticide (RUP). Banned for use in EU countries[115].
***U.S. Maximum Allowable Residue Levels for Carbaryl* [*40 CFR 180.169 (a)(1)*]:** alfalfa, forage 50 ppm; alfalfa, hay 75 ppm; almonds, hulls 50 ppm; apple, wet pomace 15 ppm; asparagus 15 ppm; banana 5.0 ppm; beet, sugar, roots 0.5 ppm; beet, sugar, tops 25 ppm; bushberry subgroup 13-07B, 3.0 ppm; cabbage 21 ppm; cactus, fruit 5.0 ppm; cactus, pads 12 ppm; canebery subgroup 13-07B, 12.0 ppm; citrus, oil 20 ppm; clover, forage 50 ppm; clover, hay 70 ppm; corn, field, forage 30 ppm; corn, field, grain 0.02 ppm; corn, field, stover 20 ppm; corn, pop, grain 0.02 ppm; corn, pop, stover 20 ppm; corn, sweet, forage 185 ppm; corn, sweet, kernel plus cob with husks removed 0.1 ppm; corn, sweet, stover 215 ppm; cranberry 3.0 ppm; dandelion, leaves 22 ppm; endive 10 ppm; flax, seed 0.5 ppm; fruit, citrus, group 10, 10 ppm; fruit, pome, group 11, 12 ppm; fruit, stone, group 12, 10 ppm; grain, aspirated fractions 70 ppm; grape 10 ppm; grape, raisin 12 ppm; grass, forage 100 ppm; grass, hay 15 ppm; leaf petiole subgroup 4B, 3.0 ppm; lettuce 10 ppm; millet, proso, grain 1.0 ppm; millet, proso, straw 20 ppm; nut, tree group 14, except walnut, 0.1 ppm; okra 4.0 ppm; olive 10 ppm; oyster 0.25 ppm; parsley, leaves 22 ppm; pea and bean, dried shelled, except soybean, subgroup 6C, 1.0 ppm; peanut 0.05 ppm; peanut, hay 20 ppm; pineapple 2.0 ppm; pistachio 0.1 ppm; rice, grain 15 ppm; rice, hulls 30 ppm; rice, straw 60 ppm; sorghum grain, forage 30 ppm; sorghum grain, grain 10 ppm; sorghum grain, stover 30 ppm; soybean, forage 15 ppm; soybean, hay 15 ppm; soybean, seed 0.5 ppm; spinach 22 ppm; strawberry 4.0 ppm; sunflower, seed 0.5 ppm; sweet potato, roots 0.2 ppm; trefoil, forage 15 ppm; trefoil, hay 25 ppm; vegetable, brassica, leafy, group 5, except cabbage, 10 ppm; vegetable, cucurbit, group 9, 3.0 ppm; vegetable, foliage of legume, subgroup 7A, except soybean, 60 ppm; vegetable, fruiting, group 8, 5.0 ppm; vegetable, leaves of root and tuber, group 2, except sugar beet tops, 75 ppm; vegetable, legume, edible podded, subgroup 6A, 10 ppm; vegetable, root and tuber, group 1, except sugar beet and sweet potato, 2.0 ppm; walnut 1.0 ppm; wheat, forage 30 ppm; wheat, grain 1.0 ppm; wheat, hay 30 ppm; wheat, straw 20 ppm. **[*40 CFR180.169(a)(2)*]** cattle, fat 0.5 ppm; cattle, meat 1.0 ppm; cattle, meat byproducts 3.0 ppm; goat, fat 0.5 ppm; goat, meat 1.0 ppm; goat, meat byproducts 3.0 ppm; hog, fat 0.5 ppm; hog, meat 1.0 ppm; hog, meat byproducts 3.0 ppm; horse, fat 0.5 ppm; horse, meat 1.0 ppm; horse, meat byproducts 3.0 ppm; milk 1.0 ppm; sheep, fat 0.5 ppm; sheep, meat 1.0 ppm; sheep, meat byproducts 3.0 ppm. **[*40 CFR180.169(a)(3)*]** including its metabolites 1-naphthol (naphthyl sulfate), 5,6-dihydro-dihydroxycarbaryl and 5-methoxy-6-hydroxycarbaryl, calculated as 1-naphthyl *N*-methylcarbamate in or on the food commodity: milk at 0.3 ppm. **[*40, CFR 180.169(a)(4)*]** fruit, pome: 10.0 ppm; ppm; pineapple: 2.0 ppm; ppm.
***Regional registration, as defined in section 180.1(n)* [*40CFR180.169(c)*]:** dillweed, fresh leaves: 0.2 ppm.
Human toxicity (long-term)*[101]*: Low–70.00 ppb, Health Advisory
Fish toxicity (threshold)*[101]*: Intermediate–27.39896 ppb, MATC (Maximum Acceptable Toxicant Concentration).
Regulatory Authority and Advisory Information:
Carcinogenicty: EPA, Likely to be carcinogenic to humans; EU GHS Category 2: Suspected human carcinogen.

California Proposition 65 Chemical: Cancer: (2/5/2010); Developmental/Reproductive toxin (male) (8/720/09)
Acute Oral Category: 2, WARNING
Health Advisory: Nerve Toxin, Mutagen, Developmental/Reproductive Toxin, Endocrine disruptor (S!)
Potential Ground Water Pollutant [California FAC Section 13145(d)/12811, active]
Air Pollutant Standard Set: Clean Air Act: Hazardous Air Pollutants (Title I, Part A, Section 112)
Clean Water Act: Section 311 Hazardous Substances/RQ 40CFR117.3 (same as CERCLA, see below); Section 313 Water Priority Chemicals (57FR41331, 9/9/92)
RCRA 40CFR268.48; 61FR15654, Universal Treatment Standards: Wastewater (mg/L), 0.006; Nonwastewater (mg/kg), 0.14
Reportable Quantity (RQ): 100 lb (45.4 kg)
EPCRA Section 313 Form R *de minimis* concentration reporting level: 1.0%
US DOT Regulated Marine Pollutant (49CFR172.101, appendix B)
European/International Regulations: Hazard Symbol: Xn, N; risk phrases: R20/22; R40; R50; safety phrases: S2; S36/37; S46; S61 (see Appendix 1)
WGK (German Aquatic Hazard Class): 3-Severe hazard to waters.

Description: Carbaryl is a white or grayish, odorless, crystalline solid; or various other forms including liquid and paste. Molecular weight = 201.22; Specific gravity (H_2O:1) = 1.228; Boiling point = 210 °C (decomposes below BP); Freezing/Melting point = 145 °C; Vapor pressure = $<4 \times 10^{-5}$ mmHg @ 25 °C; Flash point = about 200 °C. Hazard Identification (based on NFPA-704 M Rating System): Health 3, Flammability 1, Reactivity 0. Practically insoluble in water; solubility = 0.01%.

Incompatibilities: Carbamates are incompatible with reducing agents, strong acids, oxidizing acids, peroxides, and bases. Contact with active metals or nitrides causes the release of flammable, and potentially explosive, hydrogen gas.

Permissible Exposure Limits in Air:
OSHA PEL: 5 mg/m^3 TWA
NIOSH REL: 5 mg/m^3 TWA
ACGIH TLV®[1]: 5 mg/m^3 TWA; not classifiable as a human carcinogen
NIOSH IDLH: 100 mg/m^3
Protective Action Criteria (PAC) Ver. 27[89]
PAC-1: 1.5 mg/m^3
PAC-2: 100 mg/m^3
PAC-3: 600 mg/m^3
DFG MAK: 5 mg/m^3 measured as the, inhalable fraction TWA; Peak Limitation Category II(4) [skin].

Determination in Air: OSHA versatile sampler-2; Reagent; High-pressure liquid chromatography/Ultraviolet detection; IV NIOSH Method #5601; also NIOSH Method #5006[18].

Permissible Concentration in Water: Federal Drinking Water Guidelines: 70 ppb; State Drinking Water Guidelines: Arizona 700 μg/L; Maine 70 μg/L; Wisconsin 960 μg/L; Florida 700 μg/L; California 700 μg/L.

Determination in Water: Log K_{ow} = 2.36. Unlikely to bioaccumulate in marine organisms.

Routes of Entry: Inhalation, dermal contact or eye contact, skin absorption

Harmful Effects and Symptoms

Short Term Exposure: Carbaryl is an acetylcholinesterase inhibitor. Carbaryl irritates the eyes, skin, and respiratory tract. The hot liquid may cause severe skin burns. The signs and symptoms of exposure to carbaryl can be nausea, vomiting, mild abdominal cramping, dimness of vision, dizziness, headache, difficulty in breathing, and weakness. The substance may affect the nervous system, resulting in convulsions and respiratory failure. The effects may be delayed. Single doses of up to about 140 mg (0.005 oz) have been reported to cause no effect. However, a single dose of about 200 mg has caused stomach pain and excessive sweating. Individual responses may vary. Several milliliters (0.1 fluid oz) of an 80% solution of carbaryl has caused nausea, salivation, headache, tremors, and excessive tearing 500 ml (1 pint) of a 80% solution has resulted in death. LD_{50} (oral, rat) = <500 mg/kg; LD_{50} (dermal, rat, rabbit) = >2 g/kg.

Long Term Exposure: The major health problem associated with occupational exposure to carbaryl is related to its inhibition of the enzyme cholinesterase in the central, autonomic and peripheral nervous systems. The inhibition of cholinesterase allows acetylcholine to accumulate at these sites and thereby leads to over-stimulation of innervated organs. Carbaryl may affect the liver, kidneys and nervous system. It may cause mutations and be a teratogen in humans. There is limited evidence that it reduces fertility in both males and females. A neurotoxin. May cause birth defects. A skin sensitizer and may cause tumors.

Points of Attack: Respiratory system, central nervous system, cardiovascular system, skin, blood cholinesterase, reproductive system. Liver, kidneys.

Medical Surveillance: This chemical is a suspected or known human carcinogen. Exposed persons should contact a physician for advice regarding the possible long term health effects and advice for medical monitoring. Routine biological monitoring of pesticide applicators and field workers includes testing of plasma and red blood cell acetylcholinesterase levels (for enzyme poisoned by this chemical). These tests are normally accurate only if done within about two hours of exposure. If exposure stops, plasma levels return to normal in 1–2 weeks while red blood cell levels may be reduced for 1–3 months. When acetylcholinesterase enzyme levels are reduced by 25% or more below preemployment levels, risk of poisoning is increased, even if results are in lower ranges of "normal." Reassignment to work not involving carbamate pesticides is recommended until enzyme levels recover. Comprehensive physical examination with emphasis on the genito-urinary tract including testicle size and consistency in males. Semen analysis to include sperm count, motility and morphology. Other tests, such as serum testosterone, serum follicle stimulating hormone (FSH), and serum lutenizing hormone (LH), may be carried out if, in the opinion of a physician, they are indicated. NIOSH recommends that workers subject to carbaryl exposure have comprehensive preplacement medical examinations, with subsequent annual medical surveillance. Evaluation by a qualified allergist, including exposure history and testing, may help diagnose allergy.

First Aid: If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least 15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately. If this chemical contacts the skin, remove contaminated clothing and wash immediately with soap and water. Seek medical attention immediately. If this chemical has been inhaled, remove from exposure, begin rescue breathing (using universal precautions) if breathing has stopped, and CPR if heart action has stopped. Transfer promptly to a medical facility. When this chemical has been swallowed, get medical attention. Give large quantities of water and induce vomiting. Do not make an unconscious person vomit.

Personal Protective Methods: Wear protective gloves and clothing to prevent any reasonable probability of dermal contact. Safety equipment suppliers/manufacturers can provide recommendations on the most protective glove/clothing material for your operation. DuPont™ Tychem® suit fabrics[88]. All protective clothing (suits, gloves, footwear, headgear) should be clean, available each day, and put on before work. Contact lenses should not be worn when working with this chemical. Wear dust-proof chemical goggles and face shield unless full facepiece respiratory protection is worn. Employees should wash immediately with soap when skin is wet or contaminated. Provide emergency showers and eyewash.

Respirator Selection: SCBA > 1.5 mg/m^3 *At concentrations above the NIOSH REL, or where there is no REL, at any detectable concentration:* SCBAF:Pd,Pp (APF = 10,000): (any self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode); or SaF:Pd,Pp:ASCBA (APF = 10,000) (any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary self-contained positive-pressure breathing apparatus). *Escape*: GmFOv100 (APF = 50) [any air-purifying, full facepiece respirator (gas mask) with a chin-style, front- or back-mounted organic vapor canister having an N100, R100, or P100 filter]; or SCBAE (any appropriate escape-type, self-contained breathing apparatus).

Storage: Color Code-Blue: Health Hazard/Poison. Store in a secure poison location. Prior to working with this chemical you should be trained on its proper handling and storage. Store in tightly closed containers in a cool, well-ventilated area away from strong alkalis (such as sodium hydroxide, sodium bicarbonate, etc.).

Shipping: This is a solid toxic carbamate and should be labeled "poisonous materials." It falls into Hazard Class 6.1.

Spill Handling: For solids, isolate spill or leak area in all directions for at least 25 meters/75 feet. Increase, in the downwind direction, as necessary. Do not touch damaged containers or spilled material unless wearing appropriate protective clothing. Stop leak if you can do it without risk. Prevent entry into waterways, sewers, basements or confined areas. Cover with plastic sheet to prevent spreading. Absorb or cover with dry earth, sand or other non-combustible material and transfer to containers. Do not allow water to get inside containers.

Fire Extinguishing: Decomposition products include oxides of nitrogen and carbon. *On small fire:* use dry chemical powder, carbon dioxide, water spray, or foam. *On large fire:* use water spray, fog or alcohol-resistant foam. Do not scatter material using straight water jet streams. Dike fire-control water for later disposal; do not scatter the material. Move containers from fire area if you can do it without risk. *Fire involving storage or vehicular tanks:* isolate for 800 meters/0.5 mile in all directions; also, consider initial evacuation for 800 meters/0.5 mile in all directions. Fight fire from maximum distance or use unmanned hose holders or monitor nozzles. Do not allow water to get inside containers. Cool containers with flooding quantities of water until well after fire is out. Withdraw immediately in the case of rising sound from venting safety devices or discoloration of tank. *Always* stay away from tanks engulfed in fire. For massive fire, use unmanned hose holders or monitor nozzles; if this is impossible, withdraw from area and let fire burn.

Disposal Method Suggested: Do not discharge into drains or sewers. Dispose of waste material as hazardous waste using a licensed disposal contractor to an approved landfill. Consult with environmental regulatory agencies for guidance on acceptable disposal practices. Incineration with effluent gas scrubbing is recommended. Containers must be disposed of properly by following package label directions or by contacting your local or federal environmental control agency, or by contacting your regional EPA office.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- USEPA, Office of Pesticide Programs, Pesticide Residue Limits, "Carbaryl", 40 CFR 180.169. http://www.epa.gov/cgi-bin/oppsrch
- EXTOXNET, Extension Toxicology Network, "Pesticide Information Profile, Carbaryl," Oregon State University, Corvallis, OR (June 1996). http://ace.orst.edu/info/extoxnet/pips/carbaryl.htm
- National Institute for Occupational Safety and Health, Criteria for a Recommended Standard: Occupational Exposure to Carbaryl, NIOSH Document No. 77-107 (1977)
- Sax, N. I., Ed., "Dangerous Properties of Industrial Materials Report," 1, No. 5, 45-46 (1981) and 3, No. 6, 42-48 (1983)
- USEPA, "Health Advisory: Carbaryl," Washington DC, Office of Drinking Water (August 1987)

- New Jersey Department of Health and Senior Services and Senior Services, “Hazardous Substance Fact Sheet: Carbaryl,” Trenton, NJ (September 1996, rev. February 2002). http://www.state.nj.us/health/eoh/rtkweb/0340.pdf
- New York Department of Health and Senior Services and Senior Services, “Chemical Fact Sheet: Carbaryl,” Albany, NY, Bureau of Toxic Substance Assessment (March 1986)
- USEPA, Office of Prevention, and Toxic Substances, *IRED FACTS, Carbaryl*, Washington DC (Revised 10/22/04)

Carbendazim C:0434

Use Type: Fungicide

CAS Number: 10605-21-7

Formula: $C_9H_9N_3O_2$

Synonyms: BCM; Benzimidazole-2-carbamic acid, methyl ester; *N*-2-(Benzimidazolyl) carbamate; 2-Benzimidazolecarbamic acid, methyl ester; 1*H*-Benzimidazol-2-ylcarbamic acid methyl ester; BMC; Carbamic acid, 1*H*-benzimidazole-2-yl-, methyl ester; MBC; 2-(Methoxycarbonylamino)-benzimidazol; 2-(Methoxycarbonylamino)-benzimidazole; Methyl 1*H*-benzemedazol-2-yl carbamate; Methyl 2-benzimidazolecarbamate; Methyl benzimidazole-2-yl carbamate

Trade Names: ABACOL®; AIMCOZIM; BAS® 3460; BAS® 67054; BATTAL®; BAVISTIN®; BENDAZIM®; CARBATE®; CARBENDAZIME®; CARBENDAZOL®; CARBENDAZOLE®; CARBENDAZYM®; CARBENDOR; CEKUDAZIM®; CORBEL; CTR® 6669; CUSTOS®; DEFENSOR®; DELSENE®; DEROSAL®; E-965®; DERROPRENE®; EQUITDAZIN®; FUNGISOL®; HOE 17411®; LIGNASAN®; IMISOL®; KEMDAZIN®; MERGAL®; PILLARSTIN®; POLYPHASE®; RODAZIM®; STEMPOR®; SUPERCARB, TRITICOL®; TRITICOL®; U-32.104®

Chemical class: Benzimidazole; Carbamate ester-amine

EPA/OPP PC Code: 128872

California DPR Chemical Code: 2176

HSDB Number: 6581

UN/NA & ERG Number: UN3082 (liquid)/171; UN2757(solid)/151

RTECS® Number: DD6500000

EC Number: 234-323-0 [*Annex I Index No.:* 613-048-00-8]

Uses: Carbendazim is a systemic fungicide used as a drench to control a broad range of fungi in cereals, vegetables, oilseed rape, sugar beets, grapes, tomatoes, pome fruit and stone fruit. It is also used in post-harvest storage and as treatment in seed pre-planting, frequently in combination with other fungicides. In some areas, it has been used to combat Dutch elm disease.

Human toxicity (long-term)[101]***:*** High–7.00 ppb, Health Advisory

Fish toxicity (threshold)[101]***:*** High–1.44530 ppb, MATC (Maximum Acceptable Toxicant Concentration)

Regulatory Authority and Advisory Information:

Cancinogenicity: EPA Group C, Possible human carcinogen

Health Advisory: Nerve Toxin, Mutagen Reproductive Toxin, Endocrine disruptor (S!)

Acute Oral Category: 4, Caution

U.S. DOT Regulated Marine Pollutant (49CFR, Subchapter 172.101, Appendix B)

European/International Regulations: Hazard Symbol: T, N; risk phrases: R46; R60; R61; safety phrases: S50/S53; S53; S45; S60; S61 (see Appendix 1)

WGK (German Aquatic Hazard Class): 3-Severe hazard to waters

Description: Colorless crystalline solid or light-gray powder. Commercially supplied as dry concentrate that is mixed with water for spraying. Molecular weight = 191.21; Boiling point = decomposes; Specific gravity (H_2O:1) = 1.452; Freezing/Melting point = (decomposes) 300–305 °C; Vapor pressure 4.9×10^{-10} mmHg @ 20 °C. Slightly soluble in water; solubility = 5.8 ppm @ 24 °C; 4.8 ppm @ pH 7.

Determination in Water: Log K_{ow} = <1.5. Unlikely to bioaccumulate in marine organisms.

Incompatibilities: Carbamates are incompatible with reducing agents, strong acids, oxidizing acids, peroxides, bases, peroxies and hydroperoxides, and strong reducing agents such as hydrides. Contact with active metals or nitrides causes the release of flammable, and potentially explosive, hydrogen gas.

Permissible Concentration in Water: Runoff from spills or fire control may cause water pollution.

Determination in Water: Log K_{ow} = 1.5. Unlikely to bioaccumulate in marine organisms.

Routes of Entry: Skin absorption, ingestion, inhalation

Harmful Effects and Symptoms

Short Term Exposure: Eye pupils are small; blurred vision; eye watering; runny nose; cough; shortness of breath; salivation; nausea, stomach cramps, diarrhea, and vomiting; increased blood pressure; profuse sweating; hypermotility, hallucinations; agitation; tingling of the skin; slow heartbeat; convulsions; fluid in lungs; loss of consciousness; incontinence; breathing stops; death. Carbamate insecticides inhibit the cholinesterase activity of enzymes, causing accumulation of acetylcholine at synapses and altering the way in which nervous impulses are transmitted. However, within several hours carbamates spontaneously detach from the enzymes. LD_{50} (oral, rat) = >9000. Low toxicity.

Long Term Exposure: A potent acetylcholinesterase (AChE) inhibitor; cumulative effect is possible. This chemical may damage the nervous system with repeated exposure, resulting in convulsions, respiratory failure. May cause liver damage.

Points of Attack: Respiratory system, lungs, central nervous system, cardiovascular system, skin, eyes, plasma and red blood cell cholinesterase. May be a liver toxin.

Medical Surveillance: This chemical is a suspected or known human carcinogen. Exposed persons should contact a physician for advice regarding the possible long term health effects and advice for medical monitoring.

Medical observation is recommended for 24 to 48 hours after breathing overexposure, as pulmonary edema may be delayed. As first aid for pulmonary edema, consider administering a corticosteroid spray. Cigarette smoking may exacerbate pulmonary injury and should be discouraged for at least 72 hours following exposure. Routine biological monitoring of pesticide applicators and field workers includes testing of plasma and red blood cell acetylcholinesterase levels (for enzyme poisoned by this chemical). These tests are normally accurate only if done within about two hours of exposure. If exposure stops, plasma levels return to normal in 1–2 weeks while red blood cell levels may be reduced for 1–3 months. When acetylcholinesterase enzyme levels are reduced by 25% or more below pre-employment levels, risk of poisoning is increased, even if results are in lower ranges of "normal." Reassignment to work not involving organophosphate or carbamate pesticides is recommended until enzyme levels recover.

First Aid: Speed in removing material from eyes and skin is of extreme importance. *Eyes:* Eye contact can cause dangerous amounts of these chemicals to be quickly absorbed through the mucous membrane into the bloodstream. Immediately and gently flush eyes with plenty of warm or cold water (NO hot water) for at least 15 minutes, occasionally lifting the upper and lower eyelids. Get medical aid immediately. *Skin:* Get medical aid. Dermal contact can cause dangerous amounts of these chemicals to be absorbed into the bloodstream. Wearing the appropriate PPE equipment and respirator for carbamate pesticides, immediately flush skin with plenty of soap and water for at least 15 minutes while removing contaminated clothing and shoes. Shampoo hair promptly if contaminated; protect eyes. *Ingestion:* Call poison control. Loosen all clothing. Never give anything by mouth to an unconscious person. Get medical aid. Do NOT induce vomiting. * If conscious, alert, and able to swallow, rinse mouth and have victim drink 4 to 8 ounces of water. Check to see if poison control instructs you to use ipecac syrup, otherwise administer slurry of activated charcoal (2 oz in 8 oz of water). If victim is *UNCONSCIOUS OR HAVING CONVULSIONS,* do nothing except keep victim warm. **In some cases you may be specifically instructed by poison control to induce vomiting by way of 2 tablespoons of syrup of ipecac (adult) washed down with a cup of water.* Do NOT give activated charcoal before or with ipecac syrup. *Inhalation:* Get medical aid. Do not contaminate yourself. Wearing the appropriate PPE equipment and respirator for carbamate pesticides, immediately remove the victim from the contaminated area to fresh air. If the victim is not breathing, administer artificial respiration. Do not use mouth-to-mouth method if victim ingested or inhaled the substance; give artificial respiration with the aid of a pocket mask equipped with a one-way valve or other proper respiratory medical device. If breathing is difficult, administer oxygen through bag/mask apparatus until medical help arrives. Do not leave victim unattended. *Note to physician or authorized medical personnel.* Administer atropine, 2 mg (1/30 gr) intramuscularly or intravenously as soon as any local or systemic signs or symptoms of an intoxication are noted; repeat the administration of atropine every 3 to 8 minutes until signs of atropinization (mydriasis, dry mouth, rapid pulse, hot and dry skin) occur; initiate treatment in children with 0.05 mg/kg of atropine; repeat at 5 to 10 minute intervals. Watch respiration, and remove bronchial secretions if they appear to be obstructing the airway; intubate if necessary. *Medical note:* 2-PAMCI may be contraindicated in the case of some carbamate poisonings.

Personal Protective Methods: Wear protective gloves and clothing to prevent any reasonable probability of dermal contact. Safety equipment suppliers/manufacturers can provide recommendations on the most protective glove/clothing material for your operation. DuPont™ Tychem® suit fabrics[88]. All protective clothing (suits, gloves, footwear, headgear) should be clean, available each day, and put on before work. Contact lenses should not be worn when working with this chemical. Wear dust-proof chemical goggles and face shield unless full facepiece respiratory protection is worn. Employees should wash immediately with soap when skin is wet or contaminated. Provide emergency showers and eyewash.

Respirator Selection: *At concentrations above the NIOSH REL, or where there is no REL, at any detectable concentration:* SCBAF:Pd,Pp (APF = 10,000): (any self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode); or SaF:Pd,Pp:ASCBA (APF = 10,000) (any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary self-contained positive-pressure breathing apparatus). *Escape:* GmFOv100 (APF = 50) [any air-purifying, full facepiece respirator (gas mask) with a chin-style, front- or back-mounted organic vapor canister having an N100, R100, or P100 filter]; or SCBAE (any appropriate escape-type, self-contained breathing apparatus).

Storage: Color Code-Blue: Health Hazard/Poison. Store in a secure poison location. Prior to working with this chemical you should be trained on its proper handling and storage. Store in tightly closed containers in a cool, well-ventilated area away from strong alkalis (such as sodium hydroxide, sodium bicarbonate, etc.).

Shipping: Environmentally hazardous substances, solid or liquid, usually fall in Hazard Class 9.

Spill Handling: For solids, isolate spill or leak area in all directions for at least 25 meters/75 feet. Increase, in the downwind direction, as necessary. Do not touch damaged containers or spilled material unless wearing appropriate protective clothing. Stop leak if you can do it without risk. Prevent entry into waterways, sewers, basements or confined areas. Cover with plastic sheet to prevent spreading. Absorb or cover with dry earth, sand or other non-combustible material and transfer to containers. Do not allow water to get inside containers.

Fire Extinguishing: Decomposition products include oxides of nitrogen and carbon. *On small fire:* use dry chemical powder, carbon dioxide, water spray, or foam. *On* *large fire:* use water spray, fog or alcohol-resistant foam. Do not scatter material using straight water jet streams. Dike fire-control water for later disposal; do not scatter the material. Move containers from fire area if you can do it without risk. *Fire involving storage or vehicular tanks:* isolate for 800 meters/0.5 mile in all directions; also, consider initial evacuation for 800 meters/0.5 mile in all directions. Fight fire from maximum distance or use unmanned hose holders or monitor nozzles. Do not allow water to get inside containers. Cool containers with flooding quantities of water until well after fire is out. Withdraw immediately in the case of rising sound from venting safety devices or discoloration of tank. *Always* stay away from tanks engulfed in fire. For massive fire, use unmanned hose holders or monitor nozzles; if this is impossible, withdraw from area and let fire burn.

Disposal Method Suggested: Do not discharge into drains or sewers. Dispose of waste material as hazardous waste using a licensed disposal contractor to an approved landfill. Consult with environmental regulatory agencies for guidance on acceptable disposal practices. Incineration with effluent gas scrubbing is recommended. Containers must be disposed of properly by following package label directions or by contacting your local or federal environmental control agency, or by contacting your regional EPA office.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- United States National Library of Medicine, ChemIDplus Advanced, Bethesda, MD. http://chem.sis.nlm.nih.gov/chemidplus/rn/10605-21-7

Carbofuran C:0440

Use Type: Insecticide, Acaricide, Nematicide

CAS Number: 1563-66-2

Formula: $C_{12}H_{15}NO_3$

Synonyms: 7-Benzofuranol, 2,3-dihydro-2,2-dimethyl-, methylcarbamate; Carbamic acid, methyl-, 2,2-dimethyl-2,3-dihydrobenzofuran-7-yl ester; Carbofurano (Spanish); 2,3-Dihydro-2,2-dimethylbenzofuranyl-7-*N*-methylcarbamate; 2,3-Dihydro-2,2-dimethyl-7-benzofuranolmethylcarbamate; 2,3-Dihydro-2,2-dimethyl-7-benzofuranol-*N*-methylcarbamate; 2,3-Dihydro-2,2-dimethylbenzofuranyl-7-*N*-methylcarbamate; 2,3-Dihydro-2,2-dimethylbenzofuran-7-yl methylcarbamate; 2,2-Dimethyl-7-coumaranyl *N*-methylcarbamate; 2,2-Dimethyl-2,2-dihydrobenzofuranyl-7 *N*-methylcarbamate; 2,2-Dimethyl-2,3-dihydro-7-benzofuranyl-*N*-methylcarbamate; ENT 27,164; Methyl carbamic acid 2,3-dihydro-2,2-dimethyl-7-benzofuranyl ester; NSC 167822

Trade Names: A13-27164®; AU'ULTRAMICIN®; BAY 704143®; BAY 78537®; BRIFUR®; CARBODAN®; CARBOSIP 5G®; CRISFURAN®; CURETERR®; CHINUFUR®; D 1221®; DIAFURAN®; FMC 10242®; FURACARB®; FURADAN®; FURAN®; FURODAN®; KENFURAN®; KENOFURAN®; NEX®; NIA-10242; NIAGARA 10242; NIAGARA NIA-10242; PILLARFURAN®; RAMPART®; YALTOX®

Chemical class: Carbamate (N-methyl)

EPA/OPP PC Code: 090601

California DPR Chemical Code: 106

HSDB Number: 1530

UN/NA & ERG Number: UN2757 (solid)/151

RTECS® Number: FB9450000

EC Number: 006-026-00-9

EC Number: 216-353-0

Uses: Carbofuran is a broad-spectrum carbamate pesticide that kills insects, mites, and nematodes on contact or after ingestion. It is used against soil and foliar pests of field, fruit, vegetable, and forest crops. Carbofuran, granule form, is banned in the U.S. A U.S. EPA restricted Use Pesticide (RUP). Not approved for use in EU countries[115]. There are 40 global suppliers[97].[97]. According to the Ecological Incident Investigation System, carbofuran has been responsible for more avian deaths than any other pesticide.

U.S. Maximum Allowable Residue Levels for Carbofuran and its carbamate metabolite-2,3-dihydro-2,2-dimethyl-3-hydroxy-7-benzofuranyl- N-methylcarbamate, and its phenolic metabolites 2,3-dihydro-2,2-dimethyl-7-benzofuranol, 2,3-dihydro-2,2-dimethyl-3,-oxo-7-benzofuranol and 2,3-dihydro-2,2-dimethyl-3,7-benzofurandiol in or on the following raw agricultural commodities*[*40CFR 180.254(a)*]*: alfalfa, forage (of which not>5 ppm are carbamates) 10 ppm; alfalfa, hay (of which not>20 ppm are carbamates) 40 ppm; banana 0.1 ppm; barley, grain (of which not>0.1 ppm is carbamates) 0.2 ppm; barley, straw (of which not>1.0 ppm is carbamates) 5.0 ppm; beet, sugar, roots 0.1 ppm; beet, sugar, tops (of which not>1 ppm is carbamates) 2 ppm; coffee, bean, green 0.1 ppm; corn, forage (of which not>5 ppm are carbamates) 25 ppm; corn, grain (including popcorn) (of which not>0.1 ppm is carbamates) 0.2 ppm; corn, stover (of which not>5 ppm are carbamates) 25 ppm; corn, sweet, kernel plus cob with husks removed (of which not>0.2 ppm is carbamates) 1.0 ppm; cotton, undelinted seed (of which not>0.2 ppm; is carbamates) 1.0 ppm; cranberry (of which not>0.3 ppm is carbamates) 0.5 ppm; cucumber (of which not>0.2 ppm is carbamates) 0.4 ppm; grape (of which not>0.2 ppm is carbamates) 0.4 ppm; grape, raisin (of which not>1.0 ppm is carbamates) 2.0 ppm; grape, raisin, waste (of which not>3.0 ppm is carbamates) 6.0 ppm; melon (of which not>0.2 ppm is carbamates) 0.4 ppm; milk (of which not>0.02 ppm is carbamates) 0.1 ppm; oat, grain (of which not>0.1 ppm is carbamates) 0.2 ppm; oat, straw (of which not>1.0 ppm is carbamates) 5.0 ppm; pepper (of which not>0.2 ppm is carbamates) 1 ppm; potato (of which not>1 ppm is carbamates) 2 ppm; pumpkin (of which not>0.6 ppm is carbamates) 0.8 ppm; rice, grain 0.2 ppm; rice, straw (of which not>0.2 ppm is carbamates) 1 ppm; sorghum, forage (of which not>0.5 ppm is carbamates) 3 ppm; sorghum, grain, grain 0.1 ppm; sorghum, grain, stover (of which not>0.5 ppm is carbamates) 3 ppm; strawberry (of which not>0.2 ppm is carbamates) 0.5 ppm; soybean (of which not>0.2 ppm is carbamates) 1.0 ppm; soybean, forage (of which not>20.0 ppm are carbamates) 35.0 ppm; soybean, hay (of which not>20.0 ppm are carbamates) 35.0 ppm; squash (of which not>0.6 ppm is carbamates) 0.8 ppm; sugarcane, cane 0.1 ppm; sunflower, seed (of which not>0.5 ppm is carbamates) 1.0 ppm; wheat, grain (of which not>0.1 ppm is carbamates) 0.2 ppm; wheat, straw (of which not>1.0 ppm is carbamates) 5.0 ppm. ***Regional registration, as defined in section 180.1(n)* [*40CFR 180.254©)*]*:** in or on the following raw agricultural commodity: artichoke, globe (of which not>0.2 ppm is carbamates) 0.4 ppm; none canola, seed (of which not>0.2 ppm is carbamates) 1.0 ppm. **[*40 CFR 180.3(e)*]**: pesticide chemicals that cause related pharmacological effects will be regarded, in the absence of evidence to the contrary, as having an additive deleterious action. Many pesticide chemicals within the following groups have related pharmacological effects. Chlorinated organic pesticides, arsenic-containing chemicals, metallic dithiocarbamates, cholinesterase-inhibiting pesticides. Where residues from two or more chemicals in the same class are present in or on a raw agricultural commodity the tolerance for the total of such residues shall be the same as that for the chemical having the lowest numerical tolerance in this class, unless a higher tolerance level is specifically provided for the combined residues by a regulation in this part.

Human toxicity (long-term)[101]: Intermediate–40.00 ppb, MCL (Maximum Contaminant Level)

Fish toxicity (threshold)[101]: Intermediate–17.59989 ppb, MATC (Maximum Acceptable Toxicant Concentration)

Regulatory Authority and Advisory Information:

Carcinogenicity: EPA, Not likely to be carcinogenic in humans; ACGIH A4, not classified as a human carcinogen.

Acute Oral Category: 1, DANGER–POISON

Health Advisory: Nerve Toxin, Mutagen, Developmental/Reproductive Toxin

Potential Ground Water Pollutant [California FAC Section 13145(d)/12811, inactive]

Clean Water Act: Section 311 Hazardous Substances/RQ 40CFR117.3 (same as CERCLA, see below)

RCRA 40CFR268.48; 61FR15654, Universal Treatment Standards: Wastewater (mg/L), 0.006; Nonwastewater (mg/kg), 0.14

Safe Drinking Water Act: MCL, 0.04 mg/L; MCLG, 0.04 mg/L; Regulated chemical (47 FR 9352)

Superfund/EPCRA 302 Extremely Hazardous Substances: TPQ = 10/10,000 lb (4.54/4540 kg)

Reportable Quantity (RQ): 10 lb (4.54 kg)

EPCRA Section 313 Form R *de minimis* concentration reporting level: 1.0%

US DOT Regulated Marine Pollutant (49CFR172.101, appendix B)

Rotterdam Convention Annex III [Chemicals Subject to the Prior Informed Consent Procedure (PIC)] (as dustable powder formulations containing a combination of: Benomyl @ or>7%; carbofuran @ or>10%; thiram @ or>15%)

European/International Regulations: Hazard Symbol: T+, N; risk phrases: R26/28; R50/53; safety phrases: S1/2; S36/37; S45; S60; S61 (see Appendix 1)

WGK (German Aquatic Hazard Class): 3-Severe hazard to waters

Description: Carbofuran is white, odorless crystalline solid. Molecular weight = 221.28; Specific gravity (H_2O:1) = 1.18 @ 20 °C; Boiling point = 149 °C (decomposes); Freezing/Melting point = 151 °C; Vapor pressure = 3×10^{-6} mmHg @ 25 °C; 2×10^{-5} mmHg @ 33 °C. Hazard Identification (based on NFPA-704 M Rating System): Health 3, Flammability 0, Reactivity 0. Soluble in water; solubility = 0.07%

Incompatibilities: Carbamates are incompatible with reducing agents, strong acids, oxidizing acids, peroxides, and bases. Contact with active metals or nitrides causes the release of flammable, and potentially explosive, hydrogen gas.

Permissible Exposure Limits in Air: OSHA PEL: None

NIOSH REL: 0.1 mg/m^3 TWA

ACGIH TLV®[1]: 0.1 mg/m^3 TWA, inhalable fraction and vapor; BEI issued; not classifiable as a human carcinogen (2001)

Protective Action Criteria (PAC) Ver. 27[89]

PAC-1: 0.1 mg/m^3
PAC-2: 0.43 mg/m^3
PAC-3: 0.57 mg/m^3

Australia: TWA 0.1 mg/m^3, 1993; Belgium: TWA 0.1 mg/m^3, 1993; Denmark: TWA 0.1 mg/m^3, 1999; France: VME 0.1 mg/m^3, 1993; India: TWA 0.1 mg/m^3, 1993; Norway: TWA 0.1 mg/m^3, 1999; Poland: MAC (TWA) 0.1 mg/m^3, 1999; the Netherlands: MAC-TGG 0.1 mg/m^3, 2003; United Kingdom: TWA 0.1 mg/m^3, 2000; Argentina, Bulgaria, Columbia, Jordan, South Korea, New Zealand, Singapore, Vietnam: ACGIH TLV®: not classifiable as a human carcinogen.

Permissible Concentration in Water: EPA, Federal Drinking Water Standards: EPA 40 μg/L; State Drinking Water Standards: California 18 μg/L; State Drinking Water Guidelines: Arizona 36 μg/L; Maine 35 μg/L.

Determination in Water: Analysis of carbofuran is by a high-performance liquid chromatographic procedure used for the determination of N-methyl carbamoyloximes and N-methylcarbamates in drinking water (U.S. EPA 1984). In this method, the water sample is filtered and a 400 ∝l aliquot is injected into a reverse-phase HPLC column. Separation of compounds is achieved using gradient elution chromatography. After elution from the HPLC column, the compounds are hydrolyzed with sodium hydroxide. The methylamine formed during hydrolysis is reacted with *o*-phthalaldehyde (OPA) to form a fluorescent derivative which is detected using a fluorescence detector. The method detection limit has been estimated to be approximately 0.9 μg/L for carbofuran. Log K_{ow} = <2.0. Unlikely to bioaccumulate in marine organisms.

Routes of Entry: Inhalation, ingestion, dermal contact

Harmful Effects and Symptoms

Short Term Exposure: Moderately to highly hazardous, depending on formulation. Carbofuran may affect the nervous system, resulting in convulsions and respiratory failure. Acetylcholinesterase inhibitor. Exposure may result in death. The effects may be delayed and exposed personnel should be kept under medical observation. Symptoms include headache, giddiness, blurred vision, weakness; nausea, cramps, diarrhea, chest discomfort, sweating, contraction of pupils, tearing; salivation, blue lips, lungs and abdomen fill with fluid, convulsions, coma, loss of reflexes and sphincter control. This material is extremely poisonous. May be fatal if swallowed, inhaled, or absorbed through skin. Contact may burn skin or eyes. Probable lethal oral dose to humans 5 to 50 mg/kg or 7 drops to 1 teaspoon for 150 lb. person. LD_{50} (oral, rat) = <50 mg/kg.

Long Term Exposure: The major health problem associated with occupational exposure to carbaryl is related to its inhibition of the enzyme cholinesterase in the central, autonomic and peripheral nervous systems. The inhibition of cholinesterase allows acetylcholine to accumulate at these sites and thereby leads to over-stimulation of innervated organs. The signs and symptoms observed as a consequence of exposure to carbaryl in the workplace environment are manifestations of excessive cholinergic stimulation, e.g., nausea, vomiting, mild abdominal cramping, dimness of vision, dizziness, headache, difficulty in breathing, and weakness. Carbofuran may affect the immune system

Points of Attack: Central nervous system, peripheral nervous system, blood cholinesterase level.

Medical Surveillance: Routine biological monitoring of pesticide applicators and field workers includes testing of plasma and red blood cell acetylcholinesterase levels (for enzyme poisoned by this chemical). These tests are normally accurate only if done within about two hours of exposure. If exposure stops, plasma levels return to normal in 1−2 weeks while red blood cell levels may be reduced for 1−3 months. When acetylcholinesterase enzyme levels are reduced by 25% or more below preemployment levels, risk of poisoning is increased, even if results are in lower ranges of "normal." Reassignment to work not involving carbamate pesticides is recommended until enzyme levels recover.

First Aid: If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least 15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately. If this chemical contacts the skin, remove contaminated clothing and wash immediately with soap and water. Seek medical attention immediately. If this chemical has been inhaled, remove from exposure, begin rescue breathing (using universal precautions) if breathing has stopped, and CPR if heart action has stopped. Transfer promptly to a medical facility. When this chemical has been swallowed, get medical attention. Give large quantities of water and induce vomiting. Do not make an unconscious person vomit. Effects may be delayed; keep victim under observation.

Personal Protective Methods: Wear protective gloves and clothing to prevent any reasonable probability of dermal contact. Safety equipment suppliers/manufacturers can provide recommendations on the most protective glove/clothing material for your operation. DuPont™ Tychem® suit fabrics[88]. All protective clothing (suits, gloves, footwear, headgear) should be clean, available each day, and put on before work. Contact lenses should not be worn when working with this chemical. Wear dust-proof chemical goggles and face shield unless full facepiece respiratory protection is worn. Employees should wash immediately with soap when skin is wet or contaminated. Provide emergency showers and eyewash.

Respirator Selection: *At concentrations above the NIOSH REL, or where there is no REL, at any detectable concentration:* SCBAF:Pd,Pp (APF = 10,000): (any self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode); or SaF:Pd,Pp:ASCBA (APF = 10,000) (any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary self-contained positive-pressure breathing apparatus). *Escape*: GmFOv100 (APF = 50) [any air-purifying, full facepiece respirator (gas mask) with a chin-style, front- or back-mounted organic vapor canister having an N100, R100, or P100 filter]; or SCBAE (any appropriate escape-type, self-contained breathing apparatus).

Respirator Selection: SCBA > 0.1 mg/m^3. Wherever and whenever workplace conditions warrant respirator use, a respiratory protection program must be followed that meets one or more of the following requirements: OSHA's 29 CFR 1910.134, ANSI Z88.2, or European Standard EN 149.

Storage: Color Code-Blue: Health Hazard/Poison. Store in a secure poison location. Prior to working with this chemical you should be trained on its proper handling and storage. Store in tightly closed containers in a cool, well-ventilated area away from strong alkalis (such as sodium hydroxide, sodium bicarbonate, etc.).

Shipping: This is a solid toxic carbamate and should be labeled "poisonous materials." It falls into Hazard Class 6.1.

Spill Handling: For solids, isolate spill or leak area in all directions for at least 25 meters/75 feet. Increase, in the downwind direction, as necessary. Do not touch damaged containers or spilled material unless wearing appropriate protective clothing. Stop leak if you can do it without risk. Prevent entry into waterways, sewers, basements or confined areas. Cover with plastic sheet to prevent spreading. Absorb or cover with dry earth, sand or other non-combustible material and transfer to containers. Do not allow water to get inside containers.

Fire Extinguishing: Decomposition products include oxides of nitrogen and carbon. *On small fire*: use dry chemical powder, carbon dioxide, water spray, or foam. *On large fire:* use water spray, fog or alcohol-resistant foam. Do not scatter material using straight water jet streams. Dike fire-control water for later disposal; do not scatter the material. Move containers from fire area if you can do it without risk. *Fire* *involving storage or vehicular tanks:* isolate for 800 meters/0.5 mile in all directions; also, consider initial evacuation for 800 meters/0.5 mile in all directions. Fight fire from maximum distance or use unmanned hose holders or monitor nozzles. Do not allow water to get inside containers. Cool containers with flooding quantities of water until well after fire is out. Withdraw immediately in the case of rising sound from venting safety devices or discoloration of tank. *Always* stay away from tanks engulfed in fire. For massive fire, use unmanned hose holders or monitor nozzles; if this is impossible, withdraw from area and let fire burn.

Disposal Method Suggested: Do not discharge into drains or sewers. Dispose of waste material as hazardous waste using a licensed disposal contractor to an approved landfill. Consult with environmental regulatory agencies for guidance on acceptable disposal practices. Incineration with effluent gas scrubbing is recommended. Containers must be disposed of properly by following package label directions or by contacting your local or federal environmental control agency, or by contacting your regional EPA office.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.govEPA, Office of Pesticide Programs, Pesticide Residue Limits, "Carbofuran", 40 CFR 180.254. http://www.epa.gov/cgi-bin/oppsrch
- EXTOXNET, Extension Toxicology Network, "Pesticide Information Profile, Carbofuran," Oregon State University, Corvallis, OR (June 1996). ace. ace. orst. edu/info/extoxnet/pips/carbofur
- USEPA, "Chemical Profile: Carbofuran," Washington DC, Chemical Emergency Preparedness Program (November 30, 1987)
- New Jersey Department of Health and Senior Services and Senior Services, "Hazardous Substance Fact Sheet: Carbofuran," Trenton, NJ (April 1998). http://www.state.nj.us/health/eoh/rtkweb/0341.pdf
- USEPA, "Preliminary Determination to Cancel Registrations of Carbofuran Products," Federal Register 54, No. 15, 3744-3754 (January 25, 1989)

Carboxin C:0540

Use Type: Fungicide

CAS Number: 5234-68-4

Formula: $C_{12}H_{13}O_2NS$; $C_6H_2NHCO\text{-}C_5OSH_7$

Synonyms: Carbathiin; 5-Carboxanilido-2,3-dihydro-6-methyl-1, 4-oxathiin; Carboxine; DCMO; 2,3-Dihydro-5-carboxanilido-6-methyl-1,4-oxathiin; 2,3-Dihydro-6-methyl-1, 4-oxathiin-5-carboxanilide; 5,6-Dihydro-2-methyl-1, 4-oxathiin-3-carboxanilide; 5,6-Dihydro-2-methyl-*N*-phenyl-1,4-oxathiin-3-carboxamide; 2,3-Dihydro-6-methyl-5-phenylcarbamoyl-1,4-oxathiin; DMOC; NSC 263492; 1, 4-Oxathiin-3-carboxamide,5,6-dihydro-2-methyl-n-phenyl; 1,4-Oxathiin-3-carboxanilide,5,6-dihydro-2-methyl; 1,4-Oxathiin-3-carboxanilide,5,6-dihydro-2-methyl-; 1,4-Oxathiin-2,3-dihydro-5-carboxanilido-6-methyl-

Trade Names: CADAN®; CARBOXIN OXATHION PESTICIDE®; CASWELL No. 165 A®; D-735®; F-735®; FLO PRO V SEED PROTECTANT®[C]; KEMIKAR®; OXALIN®; PADAN®; SANVEX®; THIOBEL®; VEGETOX®; VITAFLO®; VITAVAX® 200FF; V 4X®

Chemical class: Carboxamide; Oxathiin

EPA/OPP PC Code: 090201

California DPR Chemical Code: 1755

HSDB Number: 1532

UN/NA & ERG Number: UN2588 (Pesticide, solid, poisonous, n.o.s.)/151; UN2902 (Pesticide, liquid, poisonous, n.o.s.)/151

RTECS® Number: RP4550000

EC Number: 226-031-1

Uses: Carboxin is a General Use Pesticide (GUP) and is used as a seed protectant. It is often used in combination with other fungicides such as thiram or captan. Carboxin is a systemic anilide fungicide. It is used as a seed treatment for control of smut, rot, and blight on barley, oats, rice, cotton, vegetables, corn and wheat. It is also used to control fairy rings on turf grass. Carboxin may be used to prevent the formation of these diseases or may be used to cure existing plant diseases. Also used as a wood preservative.

U.S. Maximum Allowable Residue Levels for Carboxin (40 CFR 180.301): barley, grain 0.2 ppm; barley, straw 0.2 ppm; bean,dry, seed 0.2 ppm; bean, forage 0.5 ppm; bean, hay 0.5 ppm; bean, straw 0.5 ppm; bean, succulent 0.2 ppm; canola, seed 0.03 ppm; cattle, fat 0.1 ppm; cattle, meat 0.1 ppm; cattle, meat byproducts 0.1 ppm; corn, forage 0.2 ppm; corn, fresh, including sweet corn, kernel plus cob with husks removed 0.2 ppm; corn, grain 0.2 ppm; corn, stover 0.2 ppm; cotton, undelinted seed 0.2 ppm; egg 0.01 ppm; goat, fat 0.1 ppm; goat, meat 0.1 ppm; goat, meat byproducts 0.1 ppm; hog, fat 0.1 ppm; hog, meat 0.1 ppm; hog, meat byproducts 0.1 ppm; horse, fat 0.1 ppm; horse, meat 0.1 ppm; horse, meat byproducts 0.1 ppm; milk 0.01 ppm; oat, forage 0.5 ppm; oat, seed 0.2 ppm; oat, straw 0.2 ppm; onion, dry bulb 0.2 ppm; peanut 0.2 ppm; peanut, hay 0.2 ppm; poultry, fat 0.1 ppm; poultry, meat 0.1 ppm; poultry, meat byproducts 0.1 ppm; rice, grain 0.2 ppm; rice, straw 0.2 ppm; safflower, seed 0.2 ppm; sheep, fat 0.1 ppm; sheep, meat 0.1 ppm; sheep, meat byproducts 0.1 ppm; sorghum, forage 0.2 ppm; sorghum, grain, 0.2 ppm; sorghum, grain, stover 0.2 ppm; soybean 0.2 ppm; wheat, forage 0.5 ppm; wheat, grain 0.2 ppm; and wheat, straw 0.2 ppm.

Human toxicity (long-term)[101]: Extra high–0.91 ppb, Health Advisory

Fish toxicity (threshold)[101]: High–1.06008 ppb, MATC (Maximum Acceptable Toxicant Concentration)

Regulatory Authority and Advisory Information:

Carcinogenicity: EPA, Not likely to be carcinogenic to humans.

Health Advisory: Mutagen

Toxicity (oral) Category: 3, CAUTION

EPCRA Section 313 Form R *de minimis* concentration reporting level: 1.0%

European/International Regulations: Hazard Symbol: Xi, Xn, N; risk phrases: R21/22; R36/37/38; R20/21/22; R43; R50/53; safety phrases: S1/2; S26; S36; S36/37, S60; S61 (see Appendix 1)

Description: Carboxin is a white crystalline solid. Usually dissolved in water. Molecular weight = 235.32; Specific gravity (H_2O:1) = 1.7; Freezing/Melting point = 91.5–92.5 °C (depending on crystal structure); Vapor pressure = 1.78×10^{-7} mmHg; Flash point = 200 °C. Moderately soluble in water; solubility = 10 g/100 mL.

Incompatibilities: Aqueous solution is a strong acid; keep away from bases and strong oxidizers. Will corrode metals in the presence of moisture and may release explosive hydrogen gas.

Permissible Concentration in Water: Federal Drinking Water Standards: EPA 700 μg/L

Determination in Water: Analysis of carboxin is by a gas chromatographic (GC) method applicable to the determination of certain nitrogen-phosphorus containing pesticides in water samples. In this method, approximately 1 liter of sample is extracted with methylene chloride. The extract is concentrated and the compounds are separated using capillary column GC. Measurement is made using a nitrogen-phosphorus detector. The method detection limit has not been determined for carboxin but it is estimated that detection limits for analyses included in this method are in the range of 0.1 to 2 μg/L. Log K_{ow} = <2.5. Unlikely to bioaccumulate in marine organisms.

Harmful Effects and Symptoms

Short Term Exposure: Contact with eyes or skin may cause irritation or injury. Inhalation should be avoided; use NIOSH- or CEN (UK)-approved air-purifying respirators for pesticides. May be harmful if swallowed. Because this material has a low vapor pressure, significant inhalation of vapors is unlikely at ordinary temperatures. May be an acetylcholinesterase inhibitor. LD_{50} (oral, rat) = >500–2500 mg/kg[14]; LD_{50} (dermal, rat) = >1 g/kg.

Long Term Exposure: A possible mutagen. May cause reproductive and fetal effects. May cause liver and kidney effects.

Points of Attack: Liver, kidney, skin. Reproductive cells.

Medical Surveillance: In addition to comprehensive initial medical and work histories emphasizing reproductive experience and menstrual history, patient should have physical examination and testing of genito-urinary tract, sperm count, motility and morphology. If required, other tests, such as serum testosterone, serum follicle stimulating hormone (FSH), and serum lutenizing hormone (LH), may be indicated.

First Aid: If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least 15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately. Give artificial respiration if victim is not breathing. *Do not* use mouth-to-mouth method if victim ingested or inhaled the substance; give artificial respiration with the aid of a pocket mask equipped with a one-way valve or other proper respiratory medical device. Administer oxygen if breathing is difficult. Remove and isolate contaminated clothing and shoes. In cases of contact with substance, immediately flush skin or eyes with running water for at least 20 minutes. For minor skin contact, avoid spreading material on unaffected skin. Keep victim warm and quiet. Effects of exposure (inhalation, ingestion or skin contact) to substance may be delayed. Ensure that medical personnel are aware of the material(s) involved and take precautions to protect themselves.

Personal Protective Methods: Wear protective gloves and clothing to prevent any reasonable probability of dermal contact. Safety equipment suppliers/manufacturers can provide recommendations on the most protective glove/clothing material for your operation. All protective clothing (suits, gloves, footwear, headgear) should be clean, available each day, and put on before work. Contact lenses should not be worn when working with this chemical. Wear dust-proof chemical goggles and face shield unless full facepiece respiratory protection is worn. Employees should wash immediately with soap when skin is wet or contaminated. Provide emergency showers and eyewash.

Respirator Selection: Engineering controls should be used wherever feasible to maintain airborne concentrations of this chemical below the prescribed exposure limit. Respirators and protective equipment are less effective than engineering controls, and should be used only in non-routine or emergency situations which may result in exposure concentrations in excess of the TWA environmental limit. *At any concentrations above the NIOSH REL, or where there is no REL, at any detectable concentration:* SCBAF: Pd,Pp (APF = 10,000) (any NIOSH/MSHA- or European Standard EN 149-approved self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode); or SaF: Pd,Pp: ASCBA (APF = 10,000) (any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary, self-contained breathing apparatus operated in a pressure-demand or other positive- pressure mode).

Storage: Color Code-Blue: Health Hazard: Store in a tightly closed container in a dry, well-ventilated and secure poison location. Prior to working with this chemical you should be trained on its proper handling and storage. Where possible, automatically transfer material from other storage containers to process containers.

Shipping: Pesticides, solid, toxic/poisonous, n.o.s require a shipping label of "poisonous materials" and fall in Hazard Class 6.1. Technical name required.

Spill Handling: First remove all sources of ignition. Evacuate persons not wearing protective equipment from area of spill or leak until clean up is complete. Remove all ignition sources. Collect powdered material in the most convenient and safe manner and deposit in sealed containers. Ventilate area after clean up is complete. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable.

Fire Extinguishing: Hazardous decomposition includes oxides of nitrogen and carbon. *On a small fire:* use dry chemical, CO_2 or water spray. *On a large fire:* use water spray, fog or regular foam. Move containers from fire area if you can do it without risk. Dike fire-control water for later disposal; do not scatter the material. Use water spray or fog; do not use straight streams. *Fire involving storage or vehicular tanks:* isolate for 800 meters/0.5 mile in all directions; also, consider initial evacuation for 800 meters/0.5 mile in all directions. Fight fire from maximum distance or use unmanned hose holders or monitor nozzles. Do not get water inside containers. Cool containers with flooding quantities of water until well after fire is out. Withdraw immediately in the case of rising sound from venting safety devices or discoloration of tank. ALWAYS stay away from tanks engulfed in fire. For massive fire, use unmanned hose holders or monitor nozzles; if this is impossible, withdraw from area and let fire burn. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies.

Disposal Method Suggested: Dissolve or mix the material with a combustible solvent and burn in a chemical incinerator equipped with an afterburner and scrubber. All federal, state, and local environmental regulations must be observed.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- USEPA, Office of Pesticide Programs, Pesticide Residue Limits, "Carboxin", (40 CFR 180.301). http://www.epa.gov/cgi-bin/oppsrch
- EXTOXNET, Extension Toxicology Network, "Pesticide Information Profiles, Carboxin," Oregon State University Corvallis, OR (June 1996). ace.orst.edu/info/extoxnet/pips/carboxin
- USEPA, "Health Advisory: Carboxin," Washington DC, Office of Drinking Water (August 1987)
- USEPA, *R.E.D. FACTS,Carboxin*, EPA 738-F-96-013, Washington DC (September 2004)

Cartap hydrochloride C:0555

Use Type: Insecticide

CAS Number: 15263-52-2; 22042-59-7

Formula: $C_7H_{15}N_3O_2N_2S_2Cl$; $C_7H_{16}ClN_3O_2S_2$

Synonyms: 1,3-Bis(carbamoylthio)-2-(*N,N*-dimethylamino)propane hydrochloride; Carbamothioic acid-*S,S'*-[2-(Dimethylamino)-1,3-propanediyl]ester, monohydrochloride; Cartap monohydrochloride; *S,S'*-[2-(Dimethylamino)trimethylene]bis(thiocarbamate)hydrochloride; Thiocarbamic acid-*S,S*-[2-(dimethylamino) trimethylene]ester hydrochloride

Trade Names: CADAN®; CALDAN®; KRITAP®; NTD 2®; PADAN®; PATAP®; SANVEX®; THIOBEL®; TI-1258®; VEGETOX®

Chemical class: Nereistoxin insecticide

EPA/OPP PC Code: 041415

HSDB Number: 6583

UN/NA & ERG Number: UN2811/154

RTECS® Number: FD1225000

EC Number: 239-309-2 [*Annex I Index No.:* 616-017-00-7]

Uses: Cartap hydrochloride is used to control chewing and sucking insects on many crops, including rice, potatoes, cabbage and other vegetables, soy beans, peanuts, sunflowers, maize, sugar beet, wheat, pearl barley, pome fruit, stone fruit, citrus fruit, vines, chestnuts, ginger, tea, cotton, and sugar cane. Not currently registered in the U.S. or registered for use in EU countries[115]. There are approximately 15 global suppliers[97].

Regulatory Authority and Advisory Information:

Health Advisory: Mutagen, Developmental/Reproductive Toxin.

Acute Oral Category: 2, WARNING

U.S. DOT Regulated Marine Pollutant (49CFR, Subchapter 172.101, Appendix B)

European/International Regulations: Hazard Symbol: Xn, N; risk phrases: R21/22; R50/R53; safety phrases: S60; S61 (see Appendix 1)

Description: Colorless solid or powder. Mild odor. Molecular weight = 273.826; Specific gravity (H_2O:1) = 1.42 @ 20°C; Freezing/Melting point = 180°C. Hazard Identification (based on NFPA-704 M Rating System): Health 1, Flammability 0, Reactivity 0. Soluble in water.

Incompatibilities: When heated to decomposition or on contact with acids or acid fumes, may produce highly toxic carbon oxides, hydrogen chloride gas, nitrogen oxides, sulfur oxides; deadly phosgene gas may be formed. Attacks, copper, iron, zinc; and may cause pitting of some other metals.

Routes of Entry: Inhalation, skin, ingestion

Harmful Effects and Symptoms:

Short Term Exposure: Eye pupils are small; blurred vision; eye watering; runny nose; cough; shortness of breath; salivation; nausea, stomach cramps, diarrhea, and vomiting; increased blood pressure; profuse sweating; hypermotility, hallucinations; agitation; tingling of the skin; slow heartbeat; convulsions; fluid in lungs; loss of consciousness; incontinence; breathing stops; death. Carbamate insecticides inhibit the cholinesterase activity of enzymes, causing accumulation of acetylcholine at synapses and altering the way in which nervous impulses are transmitted. However, within several hours carbamates spontaneously detach from the enzymes. LD_{50} (oral, rat) = 250 – 340 mg/kg; LD_{50} (dermal, rat) = >1000 mg/kg.

Long Term Exposure: A potent acetylcholinesterase (AChE) inhibitor; cumulative effect is possible. This chemical may damage the nervous system with repeated exposure, resulting in convulsions, respiratory failure. May cause liver damage.

Points of Attack: Respiratory system, central nervous system, cardiovascular system, skin, eyes.

Medical Surveillance: Medical observation is recommended for 24 to 48 hours after breathing overexposure, as pulmonary edema may be delayed. As first aid for pulmonary edema, consider administering a corticosteroid spray. Cigarette smoking may exacerbate pulmonary injury and should be discouraged for at least 72 hours following exposure. Before employment and at regular times after that, the following are recommended: Plasma and red blood cell cholinesterase levels (tests for the enzyme poisoned by this chemical). If exposure stops, plasma levels return to normal in 1–2 weeks while red blood cell levels may be reduced for 1–3 months. When acetylcholinesterase enzyme levels are reduced by 25% or more below preemployment levels, risk of poisoning is increased, even if results are in lower ranges of “normal.” Reassignment to work not involving carbamate pesticides is recommended until enzyme levels recover. If symptoms develop or overexposure occurs, repeat the above tests as soon as possible and get an exam of the nervous system. Also consider complete blood count and chest x-ray following acute overexposure

First Aid: Speed in removing material from eyes and skin is of extreme importance. *Eyes:* Eye contact can cause dangerous amounts of these chemicals to be quickly absorbed through the mucous membrane into the bloodstream. Immediately and gently flush eyes with plenty of warm or cold water (NO hot water) for at least 15 minutes, occasionally lifting the upper and lower eyelids. Get medical aid immediately. *Skin:* Get medical aid. Dermal contact can cause dangerous amounts of these chemicals to be absorbed into the bloodstream. Wearing the appropriate PPE equipment and respirator for carbamate pesticides, immediately flush skin with plenty of soap and water for at least 15 minutes while removing contaminated clothing and shoes. Shampoo hair promptly if contaminated; protect eyes. *Ingestion:* Call poison control. Loosen all clothing. Never give anything by mouth to an unconscious person. Get medical aid. *Do NOT induce vomiting*. * If conscious, alert, and able to swallow, rinse mouth and have victim drink 4 to 8 ounces of water. Check to see if poison control instructs you to use ipecac syrup, otherwise administer slurry of activated charcoal (2 oz in 8 oz of water). If victim is *unconscious or having convulsions,* do nothing except keep victim warm. **In some cases you may be specifically instructed by poison control to induce vomiting by way of 2 tablespoons of syrup of ipecac (adult) washed down with a cup of water*. Do NOT give activated charcoal before or with ipecac syrup. *Inhalation:* Get medical aid. Do not contaminate yourself. Wearing the appropriate PPE equipment and respirator for carbamate pesticides, immediately remove the victim from the contaminated area to fresh air. If the victim is not breathing, administer artificial respiration. Do not use mouth-to-mouth method if victim ingested or inhaled the substance; give artificial respiration with the aid of a pocket mask equipped with a one-way valve or other proper respiratory medical device. If breathing is difficult, administer oxygen through bag/mask apparatus until medical help arrives. Do not leave victim unattended

Note to physician or authorized medical personnel. Administer atropine, 2 mg (1/30 gr) intramuscularly or intravenously as soon as any local or systemic signs or symptoms of an intoxication are noted; repeat the administration of atropine every 3 to 8 minutes until signs of atropinization (mydriasis, dry mouth, rapid pulse, hot and dry skin) occur; initiate treatment in children with 0.05 mg/kg of atropine; repeat at 5 to 10 minute intervals. Watch respiration, and remove bronchial secretions if they appear to be obstructing the airway; intubate if necessary. *Medical Note:* 2-PAMCI may be contraindicated in the case of some carbamate poisonings

Personal Protective Methods: Wear positive-pressure self-contained breathing apparatus (SCBA). Wear chemical protective clothing that is specifically recommended by the manufacturer. DuPont™ Tychem® Suit Fabrics is recommended by one government source[NOAA]. It may provide little or no thermal protection. Structural firefighters' protective clothing provides limited protection in fire situations ONLY; it is not effective in spill situations where direct contact with the substance is possible.

Respirator Selection: Wherever and whenever workplace conditions warrant respirator use, a respiratory protection program must be followed that meets one or more of the following requirements: OSHA's 29 CFR 1910.134, ANSI Z88.2, or European Standard EN 149.

Storage: Color Code-Blue: Health Hazard/Poison. Store in a secure poison location. Prior to working with cartap hydrochloride you should be trained on its proper handling and storage. Store in tightly closed containers in a cool, well-ventilated area.

Shipping: Toxic, solids, organic, n.o.s. require a label of “poisonous materials.” This material falls in Hazard Class 6.1 and Packing Group III.

Spill Handling: As an immediate precautionary measure, isolate spill or leak area in all directions for at least 50 meters/150 feet for liquids and at least 25 meters/75 feet for solids. Increase, in the downwind direction, as necessary, the isolation distance shown above. Eliminate all ignition sources (no smoking, flares, sparks or flames in immediate area). Do not touch damaged containers or spilled material unless wearing appropriate protective clothing. Stop leak if you can do it without risk. Prevent entry into waterways, sewers, basements or confined areas. Absorb or cover with dry earth, sand or other non-combustible material and transfer to containers. Do not get water inside containers.

Fire Extinguishing: Hazardous decomposition includes oxides of nitrogen sulfur and carbon and hydrogen chloride gas. *Fire involving storage or vehicular tanks:* isolate for 800 meters/0.5 mile in all directions; also, consider initial evacuation for 800 meters/0.5 mile in all directions. *Small fire:* dry chemical, carbon dioxide or water spray. *Large fire:* dry chemical, carbon dioxide, alcohol-resistant foam or water spray. Move containers from fire area if you can do it without risk. Dike fire-control water for later disposal; do not scatter the material. *Fire involving tanks or car/trailer loads:* fight fire from maximum distance or use unmanned hose holders or monitor nozzles. Do not get water inside containers. Cool containers with flooding quantities of water until well after fire is out. Withdraw immediately in the case of rising sound from venting safety devices or discoloration of tank. Always stay away from tanks engulfed in fire.

Disposal Method Suggested: Dissolve or mix the material with a combustible solvent and burn in a chemical incinerator equipped with an afterburner and scrubber. All federal, state, and local environmental regulations must be observed.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- United States National Library of Medicine, ChemIDplus Advanced, Bethesda, MD. http://chem.sis.nlm.nih.gov/chemidplus/rn/15263-52-2

Chloramben C:0600

Use Type: Herbicide

CAS Number: 133-90-4

Formula: $C_7H_5Cl_2NO_2$

Synonyms: 3-Amino-2,5-dichlorobenzoic acid; Benzoic acid, 3-amino-2,5-dichloro-; Chlorambed; Chlorambene; Chloramben, aromatic carboxylic acid; Chloramben benzoic acid herbicide; Benzoic acid, 3-amino-2,5-dichloro-; 3-Amino-2,6-dichlorobenzoic acid; 2,5-Dichloro-3-aminobenzoic acid; NCI-C00055

Trade Names: ACP-M-728®; AMBEN®; AMBIBEN®; AMIBEN®[C]; AMIBIN®; AMOBEN®; ORNAMENTAL WEEDER®[C]; VEGABEN®; VEGIBEN®[C]; WEEDONE® GARDEN WEEDER

Chemical class: Benzoic acid

EPA/OPP PC Code: 029901

California DPR Chemical Code: 2184 Not currently registered.

HSDB Number: 564 as Amiben

UN/NA & ERG Number: UN2588 (Pesticide, solid, poisonous, n.o.s.)/151; UN2902 (Pesticide, liquid, poisonous, n.o.s.)/151

RTECS® Number: DG1925000

EC Number: 205-123-5

Uses: A herbicide for grasses, and broadleaf weeds. Mostly used on soybeans, and also on corn, beans, asparagus, pumpkins, peanuts, sunflowers, peppers, cotton, sweet potatoes, squash, melons, hardwood trees, and some conifers. Not approved for use in EU countries[115]. Not registered for use in the U.S. There are 51 global suppliers[97].

Human toxicity (long-term)[101]: Very low–100.00 ppb, Health Advisory

Fish toxicity (threshold)[101]: Very low–1584.89319 ppb, MATC (Maximum Acceptable Toxicant Concentration)

Regulatory Authority and Advisory Information:

Acute Oral Category: 4, Caution

Clean Air Act: Hazardous Air Pollutants (Title I, Part A, Section 112)

Reportable Quantity (RQ): 1 lb (0.454 kg)

EPCRA Section 313 Form R *de minimis* concentration reporting level: 1.0%

Description: Chloramben is a colorless crystalline solid. Odorless. Molecular weight = 206.03; Freezing/Melting point = 200–201 °C; Vapor pressure = 6.8×10^{-3} mmHg @ 100 °C. Hazard Identification (based on NFPA-704 M Rating System): Health 3, Flammability 0, Reactivity 0. Highly soluble in water; solubility = 690 ppm @ 25 °C.

Incompatibilities: Rapidly decomposed by light. Strong acids and acid fumes

Permissible Exposure Limits in Air:

Protective Action Criteria (PAC) Ver. 27[89]

PAC-1: 11 mg/m^3

PAC-2: 120 mg/m^3

PAC-3: 690 mg/m^3

Permissible Concentration in Water: Federal Drinking Water Guidelines: 100 ppb[93] A lifetime health advisory of 0.105 mg/L has been determined by EPA (see reference below).

Determination in Water: Log K_{ow} = <2.0. Unlikely to bioaccumulate in marine organisms.

Routes of Entry: Inhalation, passes through the skin

Harmful Effects and Symptoms

Short Term Exposure: Contact with eyes or skin may cause irritation or injury. Inhalation should be avoided; use NIOSH- or CEN (UK)-approved air-purifying respirators for pesticides. May be harmful if swallowed. The available data on chloramben are very sparse. Much additional information is needed regarding its chronic toxicity, teratogenicity, and carcinogenicity before limits can be confidently set. No-observed-adverse-effect doses for chloramben were 15 mg/kg/day. Based on these data an ADI was calculated at 0.015 mg/kg/day. A mutagen and acetylcholinesterase inhibitor. LD_{50} (oral, rat) = 3750 mg/kg; 5500 mg/kg. Low toxicity.

Long Term Exposure: There is evidence that this chemical causes cancer in animals. It may cause cancer of the liver. Repeated exposure may cause skin rash with itching.

Points of Attack: Skin, liver. May cause reproductive and fetal effects.

Medical Surveillance: Preliminary medical exam to detect chronic diseases of central nervous system, liver, heart, kidneys, lung and skin, as well as endocrinological or immunological disturbances, should protect susceptible individuals. Periodical medical exams of internal organs, skin and eyes are important to avoid chronic occupational intoxications. They should include lab and patch tests when necessary[83]. Liver function tests. Examination by a qualified allergist.

First Aid: If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least 15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately. Give artificial respiration if victim is not breathing. *Do not* use mouth-to-mouth method if victim ingested or inhaled the substance; give artificial respiration with the aid of a pocket mask equipped with a one-way valve or other proper respiratory medical device. Administer oxygen if breathing is difficult. Remove and isolate contaminated clothing and shoes. In cases of contact with substance, immediately flush skin or eyes with running water for at least 20 minutes. For minor skin contact, avoid spreading material on unaffected skin. Keep victim warm and quiet. Effects of exposure (inhalation, ingestion or skin contact) to substance may be delayed. Ensure that medical personnel are aware of the material(s) involved and take precautions to protect themselves.

Personal Protective Methods: Wear protective gloves and clothing to prevent any reasonable probability of dermal contact. Safety equipment suppliers/manufacturers can provide recommendations on the most protective glove/clothing material for your operation. All protective clothing (suits, gloves, footwear, headgear) should be clean, available each day, and put on before work. Contact lenses should not be worn when working with this chemical. Wear dust-proof chemical goggles and face shield unless full facepiece respiratory protection is worn. Employees should wash immediately with soap when skin is wet or contaminated. Provide emergency showers and eyewash.

Respirator Selection: SCBA 11 mg/m^3. When thresholds for carcinogens that would protect 100% of the population had not been identified, NIOSH usually recommended that occupational exposures to carcinogens be limited to the lowest feasible concentration. To ensure maximum protection from carcinogens through the use of respiratory protection, NIOSH also recommended that only the most reliable and protective respirators be used. *At any detectable concentration:* SCBAF: Pd,Pp (APF = 10,000) (any NIOSH/MSHA- or European Standard EN 149-approved self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode); or SaF: Pd,Pp: ASCBA (APF = 10,000) (any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary, self-contained breathing apparatus operated in a pressure-demand or other positive-pressure mode). *Escape:* 100F (APF = 50) (any air-purifying, full facepiece respirator with and N100, R100, or P100 filter ck-mounted organic vapor canister having a high-efficiency particulate filter); or SCBAE (any appropriate escape-type, self-contained breathing apparatus).

Storage: Color Code-Blue: Health Hazard/Poison. Store in a secure poison location. Prior to working with chloramben you should be trained on its proper handling and storage. Store in a cool, dry place or a refrigerator, and avoid contact with strong acids, acid fumes and light. A regulated, marked area should be established where this chemical is handled, used, or stored in compliance with OSHA Standard 1910.1045.

Shipping: Pesticides, solid, toxic/poisonous, n.o.s require a shipping label of "poisonous materials" and fall in Hazard Class 6.1. Technical name required.

Spill Handling: First remove all sources of ignition. Evacuate persons not wearing protective equipment from area of spill or leak until clean up is complete. Remove all ignition sources. Collect powdered material in the most convenient and safe manner and deposit in sealed containers. Ventilate area after clean up is complete. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable.

Fire Extinguishing: Hazardous decomposition includes oxides of nitrogen and carbon and hydrogen chloride gas. *On a small fire:* use dry chemical, CO_2 or water spray. *On a large fire:* use water spray, fog or regular foam. Move containers from fire area if you can do it without risk. Dike fire-control water for later disposal; do not scatter the material. Use water spray or fog; do not use straight streams. *Fire involving storage or vehicular tanks:* isolate for 800 meters/0.5 mile in all directions; also, consider initial evacuation for 800 meters/0.5 mile in all directions. Fight fire from maximum distance or use unmanned hose holders or monitor nozzles. Do not get water inside containers. Cool containers with flooding quantities of water until well after fire is out. Withdraw immediately in the case of rising sound from venting safety devices or discoloration of tank. ALWAYS stay away from tanks engulfed in fire. For massive fire, use unmanned hose holders or monitor nozzles; if this is impossible, withdraw from area and let fire burn. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies.

Disposal Method Suggested: Chloramben is stable to heat, oxidation, and hydrolysis in acidic or basic media. The stability is comparable to that of benzoic acid. Wet oxidation or incineration are recommended disposal methods.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- National Cancer Institute, "Bioassay of Chloramben for Possible Carcinogenicity," Technical Report Series No. 25, Bethesda, MD (1977)

- EXTOXNET, Extension Toxicology Network, "Pesticide Information Profiles, Chloramben," Oregon State University Corvallis, OR (June 1996). ace.orst.edu/info/extoxnet/pips/chloramb
- Sax, N. I., Ed., "Dangerous Properties of Industrial Materials Report," 1, No. 3, 28-29, New York, Van Nostrand Reinhold Co. (1981). (As 3-Amino-2,5-Dichlorobenzoic Acid)
- USEPA, "Health Advisory: Chloramben." Washington DC, Office of Drinking Water (August 1987)
- New Jersey Department of Health and Senior Services, Hazardous Substance Fact Sheet, Chloramben. Trenton, NJ (September, 1998). http://www.state.nj.us/health/eoh/rtkweb/0357.pdf

Chlordane C:0630

Use Type: Insecticide
CAS Number: 57-74-9; 12789-03-6 (technical grade chemical)
Formula: $C_{10}H_6Cl_8$
Synonyms: Chlordan; Clordano (Spanish); Cortilan-Neu; Dichlorochlordene; ENT 9,932; ENT 25,552-x; 4,7-Methanoindan, 1,2,3,4,5,6,7,8 ,8-octachloro-2,3,3a,4,7,7a-hexahydro-; 4,7-Methano-1H-indene,1,2,4,5,6,7,8,8-octachloro-2,3,3a,4,7, 7a-hexahydro-; 4,7-Methanoindan, 1,2,4,5,6,8,8-octachloro 3a,4,7,7a-tetrahydro; NCI-C00099; Octachlor; Octachlorodihydrodicyclopentadiene; 1,2,4,5, 6,7,8,8-Octachloro-2,3,3a,4,7,7a-hexahydro-4,7-methanoindene; 1,2,4,5,6,7,8,8-Octachloro-2,3,3a,4,7,7a-hexahydro-4,7-methano-1H-indene; 1,2,4,5,6,7,8,8-Octachloro-3a,4,7,7a-hexahydro-4,7-methylene indane; Octachloro-4,7-methanohydroindane; Octachloro-4,7-methanotetrahydroindane; 1,2,4,5,6,7,8,8-Octachloro-4,7-methano-3a,4,7,7a-tetrahydroindane; 1,2,4,5,6,7,8,8-Octachloro-3a,4,7,7a-tetrahydro-4,7-methanoindan; 1,2,4,5,6,7,8,8-Octachloro-3a,4,7,7a-tetrahydro-4,7-methanoindane; 1,2,4,5,6,7,10,10-Octachloro-4,7,8,9-tetrahydro-4,7-methyleneindane
TradeNames:ASPON-CHLORDANE®;BELT®;CD68®; CHLORINDAN®; CHLOR KIL®; CHLORODANE®; CORODANE®; CHLORTOX®; DOWCHLOR®[C]; DOW-KLOR®[C]; GOLD CREST®[C]; KILEX LINDANE®; HCS 3260®; KYPCHLOR®; M 140®; M 410®; NIRAN®; OCTACHLOR®; OKTATERR®; OMS 1437®; ORTHO-KLOR®[C]; SD 5532®; SHELL SD-5532®[C]; SYNKLOR®; TAT®; TAT CHLOR® 4; TERMEX®; TOPICHLOR® 20; TOPICLOR®; TOXICHLOR®; VELSICOL® 1068[C]
Chemical class: Organochlorine
EPA/OPP PC Code: 058201, 058202 (technical grade)
California DPR Chemical Code: 130
HSDB Number: 802
UN/NA & ERG Number: UN2761 (solid)/151; UN2996 (liquid)/151; UN2995 (Organochlorine pesticides, liquid, toxic, flammable, flash point not <23 °C)/131
RTECS® Number: PB9800000
EC Number: 200-349-0 [*Annex I Index No.:* 602-047-00-8]
Uses: Not approved for use in EU countries[115]. Since 1988, the use and commercial production of chlordane (except for export) has been prohibited in the United States and other countries. The only commercial use still permitted is for fire ant control in power transformers. Chlordane is a broad-spectrum insecticide of the group of polycyclic chlorinated hydrocarbons called cyclodiene insecticides. Chlordane has been used extensively since the 1950s for termite control, as an insecticide for homes and gardens, and as a control for soil insects during the production of crops such as corn. Both the uses and the production volume of chlordane have decreased extensively since the issuance of a registration suspension notice for all food crops and home and garden uses of chlordane by the U.S. Environmental Protection Agency. However, significant commercial use of chlordane for termite control continues. Special groups at risk include children as a result of milk consumed; fishermen and their families because of the high consumption of fish and shellfish, especially freshwater fish; persons living downwind from treated fields; and persons living in houses treated with chlordane pesticide control agents.
Human toxicity (long-term)[101]: High–2.00 ppb, MCL (Maximum Contaminant Level)
Fish toxicity (threshold)[101]: Extra high–0.04936 ppb, MATC (Maximum Acceptable Toxicant Concentration)
Regulatory Authority and Advisory Information:
Carcinogenicity: EPA Group B2, Probable human carcinogen; EU GHS Category 2: Suspected human carcinogen.
California Proposition 65 Chemical: Cancer (1/1/1988)
Acute Oral Category: 2, WARNING
Health Advisory: Nerve Toxin, Endocrine disruptor (confirmed), Mutagen, Reproduction Hazard
Persistent Organic Pollutants (UN)
Clean Air Act: Hazardous Air Pollutants (Title I, Part A, Section 112)
Clean Water Act: Section 311 Hazardous Substances/RQ 40CFR117.3 (same as CERCLA, see below); 40CFR423, appendix A, Priority Pollutants; Section 313 Water Priority Chemicals (57FR41331, 9/9/92); Toxic Pollutant (Section 401.15) as technical mixture and metabolites
U.S. EPA Hazardous Waste Number (RCRA No.): U036
RCRA Toxicity Characteristic (Section 261.24), Maximum Concentration of Contaminants, regulatory level, 0.03 mg/L
RCRA 40CFR268.48; 61FR15654, Universal Treatment Standards: Wastewater (mg/L), (alpha- and gamma-isomers) 0.0033; Nonwastewater (mg/kg), 0.26
RCRA 40CFR264, appendix 9; TSD Facilities Ground Water Monitoring List. Suggested test method(s) (PQL μg/L): 8080 (0.1); 8250 (10)
Safe Drinking Water Act: MCL, 0.002 mg/L; MCLG, zero; Regulated chemical (47 FR 9352)
Superfund/EPCRA 302 Extremely Hazardous Substances: TPQ = 1000 lb (454 kg)
Reportable Quantity (RQ): 1 lb (0.454 kg)

EPCRA Section 313 Form R *de minimis* concentration reporting level: 1.0%

US DOT Regulated Marine Pollutant (49CFR172.101, appendix B), severe pollutant

Rotterdam Convention Annex III [Chemicals Subject to the Prior Informed Consent Procedure (PIC)] and POPs: Annex A (Elimination)

European/International Regulations: (*57-74-9*) Hazard Symbol: Xn, N; risk phrases: R21/22; R40; R50/53; safety phrases: S2; S36/37; S60; S61 (see Appendix 1)

Description: Chlordane is a colorless, or light-yellow or amber, thick liquid. It has a pungent, chlorine-like odor. *Warning:* Odor generally provides inadequate warning of hazardous concentrations. Formulations include dusts, emulsifiable concentrates, granules, oil solutions, and wettable powders. The solid is not flammable[86]. Molecular weight = 409.78; Specific gravity (H_2O:1) = 1.6 @ 25 °C; Boiling point = 175 °C; Freezing/Melting point = 104–107 °C; Vapor pressure = 0.00001 mmHg; Practically insoluble in water; solubility = 0.0001%. The *commercial grade* of chlordane is a noncombustible liquid, but may be utilized in flammable solutions: Flash point = 56 °C has been found in the literature, but his may vary depending on the carrier used. Hazard Identification (based on NFPA-704 M Rating System): *(in a flammable solution such as n-hexane)* Health 3, Flammability 3, Reactivity 0; (*dry*) Health 3; Flammability 1; Reactivity 0. Practically insoluble in water.

Incompatibilities: Contact with strong oxidizers may cause fire and explosions. High heat and contact with alkaline solutions cause decomposition with the production of toxic fumes including chlorine, phosgene, hydrogen chloride. Attacks iron, zinc, plastics, rubber and coatings.

Permissible Exposure Limits in Air: The NIOSH(2) IDLH level = 100 mg/m^3

OSHA PEL: 0.5 mg/m^3 TWA [skin]

NIOSH REL: 0.5 mg/m^3 TWA [skin]. NIOSH considers this chemical to be a potential occupational carcinogen as defined by the OSHA carcinogen policy [29 CFR 1990]. See *NIOSH Pocket Guide*, Appendix A.

ACGIH TLV®[1]: 0.5 mg/m^3 TWA [skin]; confirmed animal carcinogen with unknown relevance to humans

NIOSH IDLH: 100 mg/m^3

Protective Action Criteria (PAC) Ver. 27[89]

57-74-9

PAC-1: 4.5 mg/m^3
PAC-2: 50 mg/m^3
PAC-3: 500 mg/m^3

DFG MAK: 0.5 mg/m^3, inhalable fraction [skin]; Peak limitation II(8); Carcinogen Category 3B

Determination in Air: Filter/Chromosorb tube-102; Toluene; Gas chromatography/Electrochemical detection; NIOSH IV, Method #5510[18].

Permissible Concentration in Water: Federal Drinking Water Guidelines: 1.0 ppb[93]. The U.S. EPA recommends that a child should not drink water with more than 60 parts of chlordane per billion parts of drinking water (60 ppb) for longer than 1 day. To protect freshwater aquatic life: 0.0043 μg/L as a 24-hour average, not to exceed 2.4 μg/L at any time. To protect saltwater aquatic life: 0.0040 μg/L as a 24-hour average, never to exceed 0.09 μg/L. To protect human health: preferably zero. An additional lifetime cancer risk of 1 in 100,000 is presented by a concentration of 0.0046 μg/L[6]. The U.S. EPA[47] has found a lowest-observed-adverse-effect-level (LOAEL) of 0.045 mg/kg body weight/day which results in a lifetime health advisory of 2 μg/L. It is strongly advised not to let the chemical enter into the environment because it persists. The substance may cause long-term effects in the aquatic environment.

Determination in Water: EPA Method D3086. GC method with ECD for the determination of organochlorine pesticides in water and wastewater. Gas chromatography (EPA Method 608) or gas chromatography plus mass spectrometry (EPA Method 625). Log K_{ow} = <3.0. Unlikely to bioaccumulate in marine organisms.

Routes of Entry: Chlordane is absorbed well by the lungs and gastrointestinal tract and through intact skin. Exposure by any route can cause systemic effects.

Harmful Effects and Symptoms

Short Term Exposure: Significant chlordane exposure by any route disrupts the transmission of nerve impulses, resulting in central nervous system excitation, convulsions, and respiratory depression. Chlordane is absorbed well through intact skin. Early formulations contained impurities that were skin and mucous-membrane irritants. Common symptoms of chlordane poisoning include headache, nausea, excitability, confusion, and muscle tremors that may precede convulsions. Chlordane can irritate the eyes and skin and can cause burns on contact. Skin rash or acne may develop. Exposure can cause blurred vision, nausea, headache, abdominal pain and vomiting, Exposure at high levels may result in disorientation, tremors, convulsions, respiratory failure and death. Medical observation is indicated. Symptoms include increased sensitivity to stimuli, tremors, muscular incoordination, and convulsions with or without coma. Fatal oral dose to adult humans is between 6 and 60 g with onset of symptoms within 45 minutes to several hours after ingestion, although symptoms have occurred following very small doses either orally or by skin exposure. Some reports of delayed development of liver disease, blood disorders and upset stomach. Chlordane is considered to be borderline between a moderately and highly toxic substance. The LD_{50} (oral, rat) = 283 mg/kg.

Long Term Exposure: Chronic chlordane exposure can cause permanent alterations of nervous system function, including problems with memory, learning, thinking, sleeping, personality changes, depression, numbness in the extremities, headache, and sensory and perceptual changes. It has been suggested that chronic exposure can cause blood disorders, but these disorders were not shown to have an increased incidence in heavily exposed groups of workers. Besides blood disorders, jaundice has been reported in persons living in homes treated with chlordane for termite control, but liver-function tests were normal in workers who manufactured chlordane. Chronic exposures may be more serious for children because of their potential longer latency period. The U.S. EPA has determined that technical-grade chlordane is a likely human carcinogen. Chlordane is structurally similar to rodent carcinogens and chronic chlordane exposure can cause hepatocellular carcinoma in several strains of mice. *Reproductive and Developmental Effects:* The TERIS database states that no epidemiologic studies have reported birth defects among infants born to mothers exposed to chlordane during pregnancy. Chlordane is excreted in breast milk. Prenatal exposure to chlordane has been reported for a few cases of neuroblastoma, blood dyscrasias, and depressed cell-mediated immunity, but no direct link with the chemical was established. Chlordane induces liver enzymes and enhances metabolism of steroid hormones, including oral contraceptives; sterility has been reported in animals. May cause tumors.

Points of Attack: Central nervous system, eyes, lungs, liver, kidneys, skin. May cause reproductive and fetal effects.

Medical Surveillance: This chemical is a suspected or known human carcinogen. Exposed persons should contact a physician for advice regarding the possible long term health effects and advice for medical monitoring. Consider the points of attack in preplacement and periodic physical examinations. Liver and kidney function tests. Examination by a qualified allergist. Complete blood count

First Aid: Persons exposed only to chlordane vapor do not pose risks of secondary contamination to others. Persons whose skin or clothing is contaminated with liquid or powdered chlordane can cause secondary contamination by direct contact. *Inhalation:* Monitor for respiratory distress. If cough or breathing difficulty develops, evaluate for respiratory tract irritation, bronchitis, or pneumonitis. Administer 100% humidified supplemental oxygen if breathing is difficult. *Basic Decontamination:* Victims who are able and cooperative may assist with their own decontamination. Remove and double-bag contaminated clothing and personal belongings. Leather absorbs chlordane; therefore, items such as leather shoes, gloves, and belts should be discarded. If there has been direct contact with liquid or powdered chlordane, flush exposed skin, hair, and under nails with plain, running, tepid water for 20 minutes, then wash twice with mild soap. **Do not scrub**, since this can increase absorption through the skin. Rinse thoroughly with water. *Eyes:* Irrigate with large amounts of plain, tepid water or saline for 20 minutes, occasionally lifting the lower and upper lids. During this time, remove contact lenses, if easily removable without additional trauma to the eye. Keep victims (adults or children) warm and quiet to avoid triggering seizures and the complication of hypothermia. *Ingestion:* Do not induce vomiting. If the victim is conscious and able to swallow, administer an aqueous slurry of activated charcoal at 1 g/kg (usual adult dose 60–90 g, child dose 25–50 g). A soda can and straw may be of assistance when offering charcoal to a child. (The efficacy of activated charcoal for chlordane poisoning is uncertain.)

Note to physician or authorized medical personnel: In cases of respiratory compromise secure airway and respiration via endotracheal intubation. If not possible, perform cricothyroidotomy if equipped and trained to do so. To control metabolic acidosis, treat with sodium bicarbonate under medical base control (adult dose = 1 ampule; pediatric dose = 1 mEq/kg). Patients who are comatose, hypotensive, or have seizures or cardiac dysrhythmias should be treated according to advanced life support protocols. High concentrations of chlordane can increase cardiac irritability; use caution with cardiac or bronchial sensitizing agents

Personal Protective Methods: Wear protective gloves and clothing to prevent any reasonable probability of dermal contact. 8 hr (more than 8 hours of resistance to breakthrough $>0.1\,\mu g/cm^2/min$): CPF3™ suits, Trellchem HPS™ suits; **4 hr** (at least 4 but <8 hours of resistance to breakthrough >0.1 $0.1\,\mu g/cm^2/min$): Teflon™ gloves, suits, boots. Safety equipment suppliers/manufacturers can provide recommendations on the most protective glove/clothing material for your operation. All protective clothing (suits, gloves, footwear, headgear) should be clean, available each day, and put on before work. Contact lenses should not be worn when working with this chemical. When working with liquid, wear splash-proof chemical goggles and face shield unless full facepiece respiratory protection is worn. Employees should wash immediately with soap when skin is wet or contaminated. Provide emergency showers and eyewash.

Respirator Selection: SCBA PAC-1: 4.5 mg/m^3. NIOSH: *At any concentrations above the NIOSH REL, or where there is no REL, at any detectable concentration:* SCBAF: Pd,Pp (APF = 10,000) (any NIOSH/MSHA- or European Standard EN 149-approved self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode); or SaF: Pd,Pp: ASCBA (APF = 10,000) (any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary, self-contained breathing apparatus operated in a pressure-demand or other positive-ressure mode). *Escape:* GmFOv100 (APF = 50) [any air-purifying, full facepiece respirator (gas mask) with a chin-style, front- or back-mounted organic vapor canister having an N100, R100, or P100 filter]; or SCBAE (any appropriate escape-type, self-contained breathing apparatus).

Storage: Flammable material: (1) Color Code-Red: Flammability Hazard: Store in a flammable liquid storage area or approved cabinet away from ignition sources and corrosive and reactive materials. Store in tightly closed containers in a cool, well-ventilated area. Before entering confined space where this chemical may be present, check to make sure that an explosive concentration does not exist. Store in tightly closed containers in a cool, well-ventilated area away from heat and incompatible materials. Sources of ignition, such as smoking and open flames, are prohibited where this chemical is used, handled, or stored in a manner that could create a potential fire or explosion hazard. Metal containers involving the transfer of 5 gallons or more of this chemical should be grounded and bonded. Drums must be equipped with self-closing valves, pressure vacuum bungs, and flame arresters. Use only nonsparking tools and equipment, especially when opening and closing containers of this chemical. (2) Color Code-Blue: Health Hazard/Poison. Store in a secure poison location. Prior to working with chlordane you should be trained on its proper handling and storage. Chlordane must be stored to avoid contact with strong oxidizers (such as perchlorates, peroxides, permanganates, chlorates and nitrates), since violent reactions occur. Store in tightly closed containers in a cool, well-ventilated area away from heat. A regulated, marked area should be established where this chemical is handled, used, or stored in compliance with OSHA Standard 1910.1045.

Shipping: Organochlorine pesticides, liquid or solid (Nonflammable), require a "poisonous materials" label. They fall in Hazard Class 6.1. Organochlorine pesticides, liquid, toxic, flammable, flash point not <23 °C require both a "poisonous materials" and a "flammable material" label. They fall in Hazard Class 6.1. Labels 6.1, 3.

Spill Handling: Do not touch spilled material. Use water spray to reduce vapors. Stay upwind. Avoid breathing vapors. Wear positive-pressure breathing apparatus and full protective clothing. Evacuate and restrict persons not wearing protective equipment from area of spill or leak until clean up is complete. Remove all ignition sources. Ventilate area of spill or leak. *Small spills*: absorb liquids in vermiculite, dry sand, earth, peat, carbon, or a similar material and deposit in sealed containers. *Large spills*: dike far ahead of spill for later disposal. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable.

Fire Extinguishing: Hazardous decomposition may include oxides of carbon and chlorine, phosgene, hydrogen chloride gas. If the flammable or combustible commercial material catches fire: CAUTION: This material may have a very low flash point: Use of water spray when fighting fire may be inefficient. *Small fire:* dry chemical, CO_2, water spray or alcohol-resistant foam. *Large fire:* water spray, fog or alcohol-resistant foam. Move containers from fire area if you can do it without risk. Dike fire-control water for later disposal; do not scatter the material. Use water spray or fog; do not use straight streams. *Fire involving tanks or vehicular loads:* fight fire from maximum distance or use unmanned hose holders or monitor nozzles. Cool containers with flooding quantities of water until well after fire is out. Withdraw immediately in the case of rising sound from venting safety devices or discoloration of tank. ALWAYS stay away from tanks engulfed in fire. For massive fire, use unmanned hose holders or monitor nozzles; if this is impossible, withdraw from area and let fire burn. Vapors are heavier than air and will collect in low areas. Vapors may travel long distances to ignition sources and flashback. Vapors in confined areas may explode when exposed to fire. Storage containers and parts of containers may rocket great distances, in many directions. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies. From a secure, explosion-proof location, use water spray to cool exposed containers. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode.

For nonflammable solid or liquid: *On a small fire:* use dry chemical, CO_2 or water spray. *On a large fire:* use water spray, fog or regular foam. Move containers from fire area if you can do it without risk. Dike fire-control water for later disposal; do not scatter the material. Use water spray or fog; do not use straight streams. *Fire involving tanks or car/trailer loads:* if tank, rail car or tank truck is involved in a fire, isolate for 800 meters/0.5 mile in all directions; also, consider initial evacuation for 800 meters/0.5 mile in all directions. Fight fire from maximum distance or use unmanned hose holders or monitor nozzles. Do not get water inside containers. Cool containers with flooding quantities of water until well after fire is out. Withdraw immediately in the case of rising sound from venting safety devices or discoloration of tank. ALWAYS stay away from tanks engulfed in fire. For massive fire, use unmanned hose holders or monitor nozzles; if this is impossible, withdraw from area and let fire burn. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies.

Disposal Method Suggested: Generators of waste containing this contaminant (≥100 kg/mo) must conform with EPA regulations governing storage, transportation, treatment, and waste disposal. Chlordane is dehydrochlorinated in alkali to form "nontoxic" products, a reaction catalyzed by traces of iron, but the reaction is slow. The environmental hazards of the products are uncertain. Chlordane can be dechlorinated by sodium in isopropyl alcohol. The UN recommends incineration methods for disposal of chlordane. Containers must be disposed of properly by following package label directions or by contacting your local or federal environmental control agency, or by contacting your regional EPA office.

References:

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- EXTOXNET, Extension Toxicology Network, "Pesticide Information Profile, Chlordane," Oregon State University, Corvallis, OR (June 1996). ace.orst.edu/info/extoxnet/pips/chlordan
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- USEPA, Chlordane: Ambient Water Quality Criteria, Washington DC (1980)
- USEPA, Chlordane, Health and Environmental Effects Profile No. 35, Office of Solid Waste, Washington DC (April 30, 1980)
- Agency for Toxic Substances and Disease Registry, U. S. Department of Health and Human Services, Public Health Service, "Managing Hazardous Materials Incidents," Atlanta, GA (June 2003)
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- USEPA, "Chemical Profile: Chlordane," Washington DC, Chemical Emergency Preparedness Program (October 31, 1985)
- New Jersey Department of Health and Senior Services and Senior Services, "Hazardous Substance Fact Sheet: Chlordane," Trenton, NJ (April 1998). http://www.state.nj.us/health/eoh/rtkweb/0361.pdf
- New York State Department of Health, "Chemical Fact Sheet: Chlordane," Albany, NY, Bureau of Toxic Substance Assessment (March 1986)
- Agency for Toxic Substances and Disease Registry, U. S. Department of Health and Human Services, Public Health Service, "Managing Hazardous Materials Incidents," Atlanta, GA (June 2003)

Chlorethoxyfos C:0645

Use Type: Insecticide
CAS Number: 54593-83-8
Formula: $C_6H_{11}Cl_4O_3PS$
Synonyms: *O,O*-Diethyl *O*-(1,2,2,2-tetrachloroethyl) phosphorothioate; *O,O*-Diethyl *O*-(1,2,2,2-tetrachloroethyl) thionophosphate; Phosphorothioic acid, *O,O*-diethyl *O*-(1,2,2,2-tetrachloroethyl)ester
Trade Names: DPX-43898®; FORTRESS 2.5G; FORTRESS® 5G; SD 208304®
Chemical class: Organophosphate
EPA/OPP PC Code: 129006
California DPR Chemical Code: 5106 Not currently registered
HSDB Number: 7131
UN/NA & ERG Number: UN2783 (solid)/152; UN3018 (liquid)
RTECS® Number: TF6150000
Uses: Chlorethoxyfos is a restricted use organophosphate insecticide registered for use in the U.S. on field corn, seed corn, sweet corn, and popcorn for the control of corn rootworms, wireworms, cutworms, seed corn maggots, white grubs, and symphylans. A U.S. EPA restricted Use Pesticide (RUP). Not listed for use in EU countries[115].
U.S. Maximum Allowable Residue Levels for Chlorethoxyfos (40 CFR 180.486): in or on the following raw agricultural commodities: corn, field, forage 0.01 ppm; corn field, grain 0.01 ppm; corn, field, stover 0.01 ppm; corn, pop, grain 0.01 ppm; corn, pop, stover 0.01 ppm; corn, sweet, kernel plus cob with husks removed 0.01 ppm; corn, sweet, forage 0.01 ppm; and corn, sweet, stover (fodder) 0.01 ppm.
Human toxicity (long-term)[101]: High–4.20 ppb, Health Advisory
Fish toxicity (threshold): Extra high–0.40299 ppb, MATC (Maximum Acceptable Toxicant Concentration)
Regulatory Authority and Advisory Information:
Carcinogenicity: EPA Group D, Not classifiable as a human carcinogen.
Acute Oral Category: 1, DANGER–POISON
Health Advisory: Nerve Toxin
U.S. DOT 49CFR172.101, Inhalation Hazard Chemical as organophosphates
Marine pollutant (in bulk by water)
European/International Regulations: Hazard Symbol: T+, Xi, N; risk phrases: R26/27/28; R36; R50/53; safety phrases: S26, S28; S36/37, S38, S45, S60; S61 (see Appendix 1)
Description: Gray to reddish-brown granular solid or colorless liquid. Mild sulfur-like odor. Molecular weight = 335.89; 235.06 (P-); Specific gravity (H_2O:1) = 1.41; Boiling point = 110 °C; Freezing/Melting point = (decomposes) 112 °C; Flash point = 127.6 °C; Vapor pressure = 8 × 10^{-4} mmHg @ 25 °C. Hazard Identification (based on NFPA-704 M Rating System): Health 4, Flammability 1, Reactivity 0. Very low solubility in water; solubility < 1 mg/L @ 20 °C; (technical) 3 ppm. Physical and toxicological properties may be affected by the carrier solvents used in commercial formulations.
Incompatibilities: May react violently with antimony(V) pentafluoride. Incompatible with lead diacetate, magnesium, silver nitrate. In the presence of strong reducing agents such as hydrides, organophosphates form highly toxic and flammable phosphine gas. Contact with oxidizers can cause the release of toxic oxides of phosphorus.
Permissible Exposure Limits in Air: No standards have been set.
Determination in Air: OSHA versatile sampler-2; Toluene/Acetone; Gas chromatography/Flame ionization detection; NIOSH IV, Method #5600, Organophosphorus Pesticides[18].
Determination in Water: EAD Method 1657. The determination of organophosphorus pesticides in municipal and industrial wastewater by gas chromatography. Detection limit = 6.0 ng/L. Log K_{ow} = >4.5. Values above 3.0 are likely to bioaccumulate in aquatic organisms.
Routes of Entry: Inhalation, skin absorption, ingestion, skin and/or eye contact.
Harmful Effects and Symptoms
Organophosphates are highly toxic. Symptoms may develop rapidly, or there may be a delay of several hours following exposure before they become noticeable. The delay

tends to be longer in the case of some compounds that dissolve fats, lipids, oils and non-polar solvents such as toluene. Symptoms may increase in severity for more than a single day and last for several days. In severe cases of of organophosphate intoxication, respiratory failure may occur.

Short Term Exposure: Highly dangerous; can be fatal if inhaled, swallowed, or absorbed through the skin. Eye pupils are small; blurred vision; eye watering; runny nose; cough; shortness of breath; salivation; dizziness; nausea, stomach cramps, diarrhea, and vomiting; increased blood pressure; profuse sweating; hypermotility, hallucinations; irritability; tingling of the skin; drowsiness; slow heartbeat; convulsions; fluid in lungs; loss of consciousness; incontinence; breathing stops; death. Organophosphates inhibit the action of acetylcholinesterase enzymes, and alter the way in which nervous impulses are transmitted. The effects can last for hours, days, or much longer. The action of the enzymes is reestablished after new enzymes are formed. LD_{50} (oral, rat) = 2 mg/kg.

Long Term Exposure: Cholinesterase inhibitor; cumulative effect is possible. Organophosphates may damage the nervous system with repeated exposure, resulting in convulsions, respiratory failure. May be a neurotoxin; may cause liver damage. Chronic exposure may cause respiratory paralysis and death.

Points of Attack: Respiratory system, central nervous system, cardiovascular system, blood cholinesterase.

Medical Surveillance: Medical observation is recommended for 24 to 48 hours after breathing overexposure, as pulmonary edema may be delayed. Cigarette smoking may exacerbate pulmonary injury and should be discouraged for at least 72 hours following exposure. Routine biological monitoring of pesticide applicators and field workers includes testing of plasma and red blood cell acetylcholinesterase levels (for enzyme poisoned by this chemical). These tests are normally accurate only if done within about two hours of exposure. If exposure stops, plasma levels return to normal in 1–2 weeks while red blood cell levels may be reduced for 1–3 months. When acetylcholinesterase enzyme levels are reduced by 25% or more below preemployment levels, risk of poisoning is increased, even if results are in lower ranges of "normal." Reassignment to work not involving organophosphate pesticides is recommended until enzyme levels recover. Do not drink any alcoholic beverages before or during use as it promotes absorption of organophosphates.

First Aid: **Treatment for organophosphate poisoning consists of thorough decontamination, cardiorespiratory support, and administration of the antidotes atropine and pralidoxime. In cases of severe poisoning, diazepam, an anticonvulsant, should also be administered. Antidotes should be administered as prevention even if the diagnosis is in doubt**. Speed in removing material from eyes and skin is of extreme importance. *Eyes:* Eye contact can cause dangerous amounts of these chemicals to be quickly absorbed through the mucous membrane into the bloodstream. Immediately and gently flush eyes with plenty of warm or cold water (NO hot water) for at least 15 minutes, occasionally lifting the upper and lower eyelids. Get medical aid immediately. *Skin:* Get medical aid. Dermal contact can cause dangerous amounts of these chemicals to be absorbed into the bloodstream. Wearing the appropriate PPE equipment and respirator for organophosphate/carbamate pesticides, immediately flush skin with plenty of soap and water for at least 15 minutes while removing contaminated clothing and shoes. Shampoo hair promptly if contaminated. The removed, contaminated clothing and shoes should be double-bagged and left in Hot Zone for later disposal by hazardous materials experts. Skin may also be decontaminated with diluted hypochlorite solution. *Inhalation:* Get medical aid. Do not contaminate yourself. Wearing the appropriate PPE equipment and respirator for organophosphate pesticides, immediately remove the victim from the contaminated area to fresh air. If the victim is not breathing, administer artificial respiration. Do not use mouth-to-mouth method if victim ingested or inhaled the substance; give artificial respiration with the aid of a pocket mask equipped with a one-way valve or other proper respiratory medical device. If breathing is difficult, administer oxygen through bag/mask apparatus until medical help arrives. Do not leave victim unattended. *Ingestion:* Call poison control. Loosen all clothing. Never give anything by mouth to an unconscious person. If victim is *unconscious or having convulsions,* do nothing except keep victim warm. Get medical aid. Transfer promptly to a medical facility. In cases of ingestion, **do not induce vomiting**. If the victim is alert and asymptomatic, administer a slurry of activated charcoal at a dose of 1 g/kg (infant, child, and adult dose). A soda can and straw may be of assistance when offering charcoal to a child. *In some cases you may be specifically instructed by poison control to induce vomiting by way of 2 tablespoons of syrup of ipecac (adult) washed down with a cup of water*. Do NOT give activated charcoal before or with ipecac syrup.

Note to physician or authorized medical personnel: Treat cases of respiratory compromise, coma, or excessive pulmonary secretions with respiratory support using protocols and techniques available and within the scope of training. Some cases may necessitate procedures such as endotracheal intubation or cricothyrotomy by properly trained and equipped personnel. When possible, atropine (see *Antidotes*, below) should be given under medical supervision. Patients who are comatose, hypotensive, or having seizures or cardiac arrhythmias should be treated according to advanced life support protocols. *Antidotes:* Two antidotes are administered to treat organophosphate poisoning. Atropine is a competitive antagonist of acetylcholine at muscarinic receptors and is used to control the excessive bronchial secretions which are often responsible for death. Pralidoxime relieves both the nicotinic and muscarine effects of organophosphate poisoning by regenerating acetylcholinesterase and can reduce both the bronchial secretions and the muscle weakness associated with poisoning. The initial intravenous dose of atropine in adults should be determined by the severity of symptoms: An initial adult dose of 1.0 to 2.0 mg or pediatric dose of 0.01 mg/kg (minimum 0.01 mg) should be administered intravenously. If intravenous access cannot be established, atropine may also be given intramuscularly, subcutaneously or via endotracheal tube. Doses should be repeated every 15 minutes until excessive secretions and sweating have been controlled. Once bronchial secretion has been controlled, atropine administration should be repeated whenever the secretions begin to recur. In seriously poisoned patients, very large doses may be required. Alterations of pulse rate and pupillary size should not be used as indicators of treatment adequacy. Pralidoxime should be administered as early in poisoning as possible as its efficacy may diminish when given more than 24 to 36 hours after exposure. Doses are as follows: adult 1.0 g; pediatric 25 to 50 mg/kg. The drug should be administered intravenously over 30 to 60 minutes, but in a life-threatening situation one-half of the total dose can be given per minute for a total administration time of 2 minutes. Treatment should begin to take effect within 40 minutes with a reduction in symptoms and the amount of atropine necessary to control bronchial secretion. The initial dose can be repeated in 1 hour and then every 8 to 12 hours until the patient is clinically well and no longer requires atropine. If intravenous access cannot be established, pralidoxime may also be given intramuscularly. Early administration of diazepam in addition to the combined atropine and pralidoxime treatment may help prevent the onset of seizures and potential brain and cardiac morphologic damage following high-level organophosphate poisoning.

Personal Protective Methods: Wear protective gloves and clothing to prevent any reasonable probability of dermal contact. Safety equipment suppliers/manufacturers can provide recommendations on the most protective glove/clothing material for your operation. One recommendation is the use of DuPont™ Tychem® suit fabrics[88]. All protective clothing (suits, gloves, footwear, headgear) should be clean, available each day, and put on before work. Contact lenses should not be worn when working with this chemical. Wear splash chemical goggles and face shield unless full facepiece respiratory protection is worn. Employees should wash immediately with soap when skin is wet or contaminated. Provide emergency showers and eyewash.

Respirator Selection: Engineering controls should be used wherever feasible to maintain airborne concentrations of this chemical below the prescribed exposure limit. Respirators and protective equipment are less effective than engineering controls, and should be used only in non-routine or emergency situations which may result in exposure concentrations in excess of the TWA environmental limit. *At any concentrations above the NIOSH REL, or where there is no REL, at any detectable concentration:* SCBAF: Pd,Pp (APF = 10,000) (any NIOSH/MSHA- or European Standard EN 149-approved self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode); or SaF: Pd,Pp: ASCBA (APF = 10,000) (any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary, self-contained breathing apparatus operated in a pressure-demand or other positive-pressure mode).

Storage: Color Code-Blue: Health Hazard/Poison. Store in a secure poison location. Prior to working with this chemical you should be trained on its proper handling and storage. Where possible, automatically transfer material from other storage containers to process containers.

Shipping: Organophosphorus pesticides, solid or liquid (nonflammable), require a "poisonous materials" label. This chemical falls in Hazard Class 6.1.

Spill Handling: First remove all sources of ignition. Evacuate persons not wearing protective equipment from area of spill or leak until clean up is complete. Remove all ignition sources. Stay upwind; keep out of low areas. Ventilate area of spill or leak. Remove and isolate contaminated clothing at the site. Do not touch spilled material; stop leak if you can do so without risk. Use water spray to reduce vapors. *Small spills:* absorb with sand or other noncombustible absorbent material and place into containers for later disposal. *Large spills:* dike far ahead of spill for later disposal. Collect powdered material in the most convenient and safe manner and deposit in sealed containers. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable. Seek professional environmental engineering assistance from the U.S. EPA Environmental Response Team at (908) 548-8730 (24-hour response line).

Fire Extinguishing: Poisonous and corrosive gases are produced in fire including hydrogen chloride and oxides of phosphorus, sulfur, and nitrogen. May be fatal if inhaled, ingested or absorbed through skin. Inhalation or contact with some of these materials will irritate or burn skin and eyes. Vapors may cause dizziness or suffocation. *Small fires:* dry chemical, carbon dioxide; water spray; or foam. *Large fires:* water spray, fog, or foam. Stay upwind; keep out of low areas. Ventilate closed spaces before entering them. Firefighting gear (including SCBA) may not provide adequate protection. If exposure occurs, remove and isolate gear immediately and thoroughly decontaminate personnel. Wear positive-pressure breathing apparatus and special protective clothing. Remove and isolate contaminated clothing at the site. Move container from fire area if you can do so without risk. Fight fire from maximum distance. Dike fire-control water for later disposal. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies. From a secure, explosion-proof location, use water spray to cool exposed containers. If cooling streams are ineffective (venting sound increases in volume and pitch, tank discolors, or shows any signs of deforming), withdraw immediately to a secure position. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode.

Disposal Method Suggested: Destruction by alkali hydrolysis or incineration. May also be mixed with flammable solvent and sprayed into an incinerator equipped with afterburner and scrubber. Containers must be disposed of properly by following package label directions or by contacting your local or federal environmental control agency, or by contacting your regional EPA office.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- U.S. Environmental Protection Agency, Office of Pesticide Programs, "Chlorethoxyfos Facts" (June 2000). http://www.epa.gov/REDs/factsheets/chlorethfact.pdf
- USEPA, Office of Pesticide Programs, Pesticide Residue Limits, "Chlorethoxyfos", 40 CFR 180.486. http://www.epa.gov/pesticides/food/viewtols.htm

Chlorfenapyr C:0648

Use Type: Acaracide, Insecticide, Miticide

CAS Number: 122453-73-0

Formula: $C_{15}H_{11}BrClF_3N_2O$

Synonyms: Chlorphenapyr; 1*H*-Pyrrole-3-carbonitrile, 4-bromo-2-(4-chlorophenyl)-1-(ethoxymethyl)-5-(trifluoromethyl)-; 4-Bromo-2-(4-chlorophenyl)-1-(ethoxymethyl)-5-(trifluoromethyl)pyrrole-3-carbonitrile (IUPAC)

Trade Names: AC 303630®; CL 303630®; PHANTOM®; PIRATE® 3 F; PYLON®; SUMILARV® chlorfenapyr

Chemical class: Pyrrole (Pyrazole); Organofluorine

EPA/OPP PC Code: 129093

California DPR Chemical Code: 3938

HSDB Number: 7464

UN/NA & ERG Number: UN2811/154

Uses: Severely Restricted for use in EU. Active in U.S. as a foliar spray in greenhouses for ornamental crops and target pests including mites, caterpillar pests, thrips, and fungus gnats. No food use in U.S. Used on ornamental crops in commercial greenhouses to control mites, caterpillar pests, thrips and fungus gnats. Not for food use. Not an approved substance in EU countries[115]. Registered for use in the U.S.

U.S. Maximum Allowable Residue Levels for chlorfenapyr: U.S. FINAL RULE, January 26, 2003: 1 ppm in or on raw agricultural commodities – vegetables, fruiting, group 8, which include: chili, postharvest; pepper, nonbell; tomato, paste; eggplant; pepper, nonbell; sweet tomato, puree; groundcherry; tomatillo; tomato, wet, pomace; pepino; tomato; vegetable, fruiting; pepper; tomato, concentrated products; vegetable, fruiting; group pepper, bell; tomato, dried pomace. U.S. FINAL RULE, January 26, 2005: A new tolerance of 0.01 ppm was established January 2005 for residues of in or on all food commodities as a result of application of chlorfenapyr to crack, crevice and spot applications in food/feed handling areas where food/feed products are prepared, held, processed, or served.

Regulatory Authority and Advisory Information:

Carcinogenicty: EPA, not sufficient to assess human carcinogenic potential

Health Advisory: Endocrine disruptor (S!), Testicular, Uterine

Acute Oral Category: 2, WARNING

European/International Regulations: Hazard Symbol: T, Xn, N; risk phrases: R22; R23; R50/53; safety phrases: S1/2; S13; S36/37; S45; S60; S61 (see Appendix 1)

Description: White (pure) or light tan to yellowish powdery solid. Characteristic halide or ketone odor. Molecular weight = 407.62; Specific gravity (H_2O:1) = 0.543; Freezing/Melting point = 91.5 °C; 101 °C; Vapor pressure = 7.4×10^{-8} mmHg @ 25 °C; Flash point = 221.5 °C. Hazard Identification (based on NFPA-704 M Rating System): Health 2, Flammability 0, Reactivity 0. Low solubility in water; solubility (pH = 7) 0.14 mg/L.

Incompatibilities: Keep away from strong oxidizers.

Permissible Concentration in Water: GLC; HPLC (residues)

Determination in Water: Log K_{ow} = >4.5. Values above 3.0 are likely to bioaccumulate in aquatic organisms.

Routes of Entry: Inhalation, ingestion, eye contact.

Harmful Effects and Symptoms

This pesticide contains both bromine and fluorine, a combination that has the potential to produce severe adverse effects – particularly to the brain [Fluoride Action Network].

Short Term Exposure: Contact with eyes may cause irritation or injury. Inhalation should be avoided; use NIOSH- or CEN (UK)-approved air-purifying respirators for pesticides. May be harmful if swallowed. LD_{50} (oral, rat) = 441 mg/kg[83]; LD_{50} (dermal, rat) = >2 g/kg [83].

Long Term Exposure: Fluorides may cause bone disease (pain and tenderness of the bones); mottled teeth in children. May cause liver, brain, skin effects.

Points of Attack: Bones, brain, central nervous system.

Medical Surveillance: There is suggestive but no confirmative evidence of cancer from this material. Exposed persons should contact a physician for advice regarding the possible long term health effects and advice for medical monitoring.

First Aid: If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least 15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately. If this chemical contacts the skin, remove contaminated clothing and wash immediately with soap and water. Seek medical attention immediately. If this chemical has been inhaled, remove from exposure, begin rescue breathing (using universal precautions) if breathing has stopped, and CPR if heart action has stopped. Transfer promptly to a medical facility. When this chemical has been swallowed, get medical attention. Give large quantities of water and induce vomiting. Do not make an unconscious person vomit.

Personal Protective Methods: For emergency situations, wear a positive-pressure, pressure-demand, full facepiece self-contained breathing apparatus (SCBA) or pressure-demand supplied-air respirator with escape SCBA and a fully encapsulating, chemical-resistant suit. Suggested materials include Nitrile gloves; DuPont™ Tychem® suit fabrics[88].

Respirator Selection: Wherever and whenever workplace conditions warrant respirator use, a respiratory protection program must be followed that meets one or more of the following requirements: OSHA's 29 CFR 1910.134, ANSI Z88.2, or European Standard EN 149. If risk assessment shows air-purifying respirators are appropriate use a full-face particle respirator type N99 (US) or type P2 (EN 143) respirator cartridges in addition to engineering controls. If the respirator is the primary or sole means of protection, use a full-face supplied air respirator. Use respirators and components tested and approved under appropriate government standards such as NIOSH (US) or CEN (EU).

Storage: Color Code-Blue: Health Hazard/Poison. Store in a tightly closed container in a dry, well-ventilated and secure poison location. Prior to working with this chemical you should be trained on its proper handling and storage. Where possible, automatically transfer material from other storage containers to process containers.

Shipping: Toxic, solids, organic, n.o.s. require a label of "poisonous materials." This material falls in Hazard Class 6.1 and Packing Group III.

Spill Handling: If a small spill occurs, clean it up promptly. Don't wash it away. Instead, sprinkle the spill with sawdust, vermiculite, or kitty litter. Sweep it into a plastic garbage bag, and dispose of it as directed on the pesticide product label. For solids, isolate spill or leak area in all directions for at least 25 meters/75 feet. Increase, in the downwind direction, as necessary. Do not touch damaged containers or spilled material unless wearing appropriate protective clothing. Stop leak if you can do it without risk. Prevent entry into waterways, sewers, basements or confined areas. Cover with plastic sheet to prevent spreading. Absorb or cover with dry earth, sand or other non-combustible material and transfer to containers. Do not allow water to get inside containers. Dampen the spilled material with water. Clean up with dampened absorbent paper and transfer material to a suitable trash container. Seal the absorbent paper and your clothing in a vapor-tight plastic bag for eventual disposal. Wash all contaminated surfaces with a soap and water solution. Do not re-enter the contaminated area until an expert verifies that the area has been properly cleaned.

Fire Extinguishing: Decomposition products include toxic oxides of carbon, oxides of nitrogen and carbon, hydrogen fluoride, hydrogen chloride, and hydrogen bromide gases. *Fire involving storage or vehicular tanks:* isolate for 800 meters/0.5 mile in all directions; also, consider initial evacuation for 800 meters/0.5 mile in all directions. *Small fire:* dry chemical, carbon dioxide or water spray. *Large fire:* dry chemical, carbon dioxide, alcohol-resistant foam or water spray. Move containers from fire area if you can do it without risk. Dike fire-control water for later disposal; do not scatter the material. *Fire involving tanks or car/trailer loads:* fight fire from maximum distance or use unmanned hose holders or monitor nozzles. Do not get water inside containers. Cool containers with flooding quantities of water until well after fire is out. Withdraw immediately in the case of rising sound from venting safety devices or discoloration of tank. Always stay away from tanks engulfed in fire.

Disposal Method Suggested: The best method of disposal of small amounts of excess pesticides is to use them according to the directions on the label. If all of the remaining pesticide cannot be properly used, check with your local solid waste management authority, environmental agency, or health department to find out whether your community has a household hazardous waste collection program or a similar program for getting rid of unwanted, leftover pesticides. These authorities can also inform you of any local requirements for pesticide waste disposal.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- U.S. Environmental Protection Agency, Office of Pesticide Programs, Pesticide Fact Sheet, "Chlorfenapry," Washington DC (January 2001). http://www.epa.gov/opprd001/factsheets/chlorfenapyr.pdf

Chlorimuron-ethyl C:0658

Use Type: Herbicide

CAS Number: 90982-32-4

Formula: $C_{13}H_{11}ClN_4O_6S$

Synonyms: Benzoic acid,2-[((((4-chloro-6-methoxy-2-pyrimidinyl)amino)carbonyl)amino)sulfonyl]-,ethyl ester; Caswell No. 193B; Chlorimuronethyl ester; Chlorimuronethyl [Ethyl-2-[(((4-chloro-6-methoxyprimidin-2-yl)-carbonyl)amino)sulfonyl]benzoate]; 2-[((((4-Chloro-6-methoxy-2-pyrimidinyl)amino) carbonyl)amino) sulfonyl]benzoic acid, ethyl ester; Ethyl-2-[(((4-chloro-6-methoxyprimidin-2-yl)-carbonyl)-amino) sulfonyl]benzoate; Ethyl 2-[((4-chloro-6-methoxypyrimidine-2-yl)aminocarbonyl)aminosulfonyl]benzoate; Ethyl 2-[((((4-chloro-6-methoxy-2-pyrimidinyl)amino)carbonyl) amino)sulfonyl]benzoate

Trade Names: AUTHORITY®; CANOPY® (chlorimuron-ethyl+Metribuzin); CLASSIC®; CONCERT® cancelled; DPX-F6025®; GEMINI®[C]; LOROX®[C]; PREVIEW®[C]; RELIANCE®; SKERMISH®, cancelled; SYNCHRONCY®; SYNCHRONY®[C]

Chemical class: Sulfonylurea; Pyrimidine derivative[88]

EPA/OPP PC Code: 128901

California DPR Chemical Code: 2458

HSDB Number: 6850

UN/NA & ERG Number: UN3077 (solid)/171

RTECS® Number: DG5095000

Uses: Used to control broadleaf weeds and annual morning glory in soybeans and peanuts. Not listed as registered for use in EU countries[115]. Registered for use in the U.S., except California. There are more than 25 global suppliers[97].

U.S. Maximum Allowable Residue Levels for Chlorimuron-ethyl (40 CFR 180.429): peanuts 0.02 ppm; soybeans 0.05.

Human toxicity (long-term): Very low–140.00 ppb, Health Advisory

Fish toxicity (threshold): Very low–1308.29960 ppb, MATC (Maximum Acceptable Toxicant Concentration)

Regulatory Authority and Advisory Information:

Acute Oral Category: 3, CAUTION

EPCRA Section 313 Form R *de minimis* concentration reporting level: 1.0%

Description: Colorless to off white or pale yellow crystals or powder. Some formulations are listed as "flammable" in the literature. Odorless. Molecular weight = 414.83; Specific gravity (H_2O:1) = 1.51 @25 °C; Freezing/Melting point = 181 °C; Vapor pressure = 4.0×10^{-12} mmHg @ 25 °C[83,USDA]. Henry's Law constant = 4.27×10^{-11} atm-m^3/mol @ 25 °C (est)[83]. Hazard Identification (based on NFPA-704 M Rating System): Health 1, Flammability 0, Reactivity 0. Low solubility in water. Physical and toxicological properties may be affected by the carrier solvents used in commercial formulations.

Incompatibilities: Keep away from strong oxidizers, nitrates.

Determination in Water: Method: USGS-NWQL O-2060-01; Procedure: graphitized carbon-based solid-phase extraction and high-performance liquid chromatography/mass spectrometry; Analyte: chlorimuron-ethyl; Matrix: water; Detection limit: 0.0048. Log K_{ow} = 2.50[83]–>3.0. Values above 3.0 are likely to bioaccumulate in aquatic organisms.

Routes of Entry: Inhalation, dermal contact, ingestion

Harmful Effects and Symptoms

Human health effects from the sulfonylurea herbicides at low environmental doses or at biomonitored levels from low environmental exposures are unknown. The sulfonylurea herbicides are generally of low toxicity in mammalian studies. Animal studies showed low acute toxicity and little chronic, reproductive, or developmental toxicity or teratogenic effects. Developmental or teratogenic effects tended only to occur at high or maternally toxic doses. At high sublethal, chronic oral doses, such nonspecific effects as weight loss and anemia were observed. Some chemical-specific effects were noted at high doses in animals[96].

Short Term Exposure: May cause skin and eye irritation. Dermal contact may cause allergic reaction. Moderately poisonous if ingested or inhaled. LD_{50} (oral, rat) = >4000 mg/kg[83]; LD_{50} (dermal, rabbit) = >2000 mg/kg.

Long Term Exposure: Repeated or prolonged contact may cause skin and lung sensitization, resulting in allergies. May be a liver toxin.

Points of Attack: Skin, liver.

Medical Surveillance: Preliminary medical exam to detect chronic diseases of central nervous system, liver, heart, kidneys, lung and skin, as well as endocrinological or immunological disturbances, should protect susceptible individuals. Periodical medical exams of internal organs, skin and eyes are important to avoid chronic occupational intoxications. They should include lab and patch tests when necessary[83]. Urinary levels of the sulfonylurea herbicides reflect recent exposure. There is very limited information on the biomonitoring of sulfonylurea herbicides or their metabolites. Detection of the metabolites may reflect exposure to more than one particular sulfonylurea herbicide or exposure to environmental degradation products. The urinary metabolites dimethoxypyrimidine and dimethylpyrimidine can be used as nonspecific markers of exposure to the pyrimidinylsulfonylureas, a group that includes bensulfuron-methyl, halosulfuron, primisulfuron-methyl, and sulfosulfon. The urinary metabolite methoxymethyl triazine can be used as a nonspecific marker of exposure to the triazinylsulfonylureas, a group that includes chlorosulfuron, prosulfuron, and triasulfuron[96]. Evaluation by a qualified allergist, including exposure history and testing, may help diagnose lung allergy.

First Aid: If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least 15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately. If this chemical contacts the skin, remove contaminated clothing and wash immediately with soap and water. Seek medical attention immediately. If this chemical has been inhaled, remove from exposure, begin rescue breathing (using universal precautions) if breathing has stopped, and CPR if heart action has stopped. Transfer promptly to a medical facility. When this chemical has been swallowed, get medical attention. Give large quantities of water and induce vomiting. Do not make an unconscious person vomit.

Personal Protective Methods: Applicators and other handlers must wear: Coveralls worn over long-sleeved shirt and long pants; Chemical-resistant gloves such as DuPont™ Tychem® suit fabrics, barrier laminate, or Viton®; Chemical-resistant footwear plus socks; Protective eye wear; Chemical-resistant headgear for overhead exposure; Chemical-resistant apron when cleaning equipment, mixing, or loading[83]. Agricultural Use/Engineering Controls: When handlers use closed systems, enclosed cabs, or aircraft in a manner that meets the requirements listed in the Worker Protection Standard (WPS) for agricultural pesticides, ***40 CFR 170.240(d)(4-6)***, the handler PPE requirements may be reduced or modified as specified in the Worker Protection Standard. Firefighters should wear NIOSH approved self-contained breathing apparatus and full protective clothing.

Respirator Selection: Wherever and whenever workplace conditions warrant respirator use, a respiratory protection program must be followed that meets one or more of the following requirements: OSHA's 29 CFR 1910.134, ANSI Z88.2, or European Standard EN 149.

Storage: Color Code-Blue: Health Hazard/Poison: Store in a tightly closed container in a dry, well-ventilated and secure poison location. Prior to working with this chemical you should be trained on its proper handling and storage. Where possible, automatically transfer material from other storage containers to process containers. *Flammable formula*: Color Code-Red Stripe: Flammability Hazard: Store separately from all other flammable materials. Prior to working with this chemical you should be trained on its proper handling and storage. Before entering confined space where this chemical may be present, check to make sure that an explosive concentration does not exist. Store in tightly closed containers in a cool, well-ventilated area away from chlorine compounds, oxidizing agents, and combustible materials. Sources of ignition, such as smoking and open flames, are prohibited where the chemical is handled, used, or stored. Use only non-sparking tools and equipment, especially when opening and closing containers. Wherever this chemical is used, handled, manufactured, or stored, use explosion-proof electrical equipment and fittings. Piping should be electrically bonded and grounded.

Shipping: Environmentally hazardous substances, solid or liquid, usually fall in Hazard Class 9.

Spill Handling: Evacuate and restrict persons not wearing protective equipment from area of spill or leak until clean up is complete. Remove all ignition sources. Dampen spilled material with alcohol to avoid dust. Collect powdered material in the most convenient and safe manner and deposit in sealed containers. Ventilate area of spill or leak after clean up is complete. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable.

Fire Extinguishing: Hazardous decomposition includes oxides of nitrogen, sulfur, carbon, and hydrogen chloride gas. Use dry chemical, carbon dioxide; water spray; or alcohol-resistant foam extinguishers. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies. From a secure, explosion-proof location, use water spray to cool exposed containers. If cooling streams are ineffective (venting sound increases in volume and pitch, tank discolors, or shows any signs of deforming), withdraw immediately to a secure position. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode.

Disposal Method Suggested: Do not discharge into drains or sewers. Dispose of waste material as hazardous waste using a licensed disposal contractor to an approved landfill. Consult with environmental regulatory agencies for guidance on acceptable disposal practices. Incineration with effluent gas scrubbing is recommended. Containers must be disposed of properly by following package label directions or by contacting your local or federal environmental control agency, or by contacting your regional EPA office.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- Pesticide Management Education Program, "Chlorimuron ethyl Herbicide Profile 4/86," Cornell University, Ithaca, NY (April 4, 1986). http://pmep.cce.cornell.edu/profiles/herb-growthreg/cacodylic-cymoxanil/chlorimuron-ethyl/herb-prof-chlorim-ethyl.html
- USEPA, Office of Pesticide Programs, Pesticide Residue Limits, "Chlorimuron ethyl," 40 CFR 180.429. http://www.setonresourcecenter.com/40CFR/Docs/wcd0004d/wcd04d68.asp

Chlormequat chloride C:0710

Use Type: Plant growth regulator

CAS Number: 999-81-5

Formula: $C_5H_{13}Cl_2N$; $ClCH_2CH_2N(CH_3)_3Cl$

Synonyms: Ammonium, (2-chloroethyl)trimethyl; Chloride 2-chloro-*N,N,N*-trimethylethanaminium chloride; Choline dichloride; 2-Chloroethyl trimethylammonium chloride; Chlorcholinchlorid; Chlorcholine chloride; Chlormequat; Chlorocholine chloride; (*β*-Chloroethyl)trimethylammonium chloride; 2-Chloro-*N,N,N*-trimethylammonium chloride; (2-Chloroethyl)trimethylammonium chloride; 2-Chloro-*N,N,N*-ethyl)trimethylethanaminium chloride; Ethanaminium, 2-chloro-*N,N,N*-trimethyl-, chloride; NCI-C02960; Trimethyl-*β*-chlorethylammoniumchlorid; Trimethyl-*β*-chloroethyl ammonium chloride

Trade Names: AC 38555®; ADJUST®, ATLAS CHLORMEQUAT®; CCC PLANT GROWTH REGULANT®; 60-CS-16®; CYCLOCEL®; CYCOCEL®; CYCOCEL-EXTRA®; CYCOGAN®; CYCOGAN EXTRA®; CYOCEL®; EI 38,555®; HICO CCC®; HORMOCEL-2CCC®; INCRECEL®; LIHOCIN®; RETACEL®; RETACIL®; STABILAN®; TUR®; WR 62®

Chemical class: Quarternary ammonium salt

EPA/OPP PC Code: 018101

California DPR Chemical Code: 1512

HSDB Number: 1541

UN/NA & ERG Number: UN2811/154

RTECS® Number: BP5250000

EC Number: 007-003-00-6

Uses: Said to be effective for cereal grains, tomatoes, and peppers; cotton, grapes, mango, tobacco, vegetables. In California, major uses are in greenhouse plants and flowers and in nurseries, including geraniums, azaleas, hibiscus.

Regulatory Authority and Advisory Information: Acute Oral Category: 2, WARNING

Health Advisory: Nerve Toxin (S!), Mutagen, Skin irritant/sensitizer

Superfund/EPCRA 302 Extremely Hazardous Substances: TPQ = 100/10,000 lb (45.4/4540 kg)

Reportable Quantity (RQ): 100 lb (45.4 kg)

European/International Regulations: Hazard Symbol: Xn; risk phrases: R21/22; safety phrases: S2; S36/37 (see Appendix 1)

WGK (German Aquatic Hazard Class): 2-Hazard to waters

Description: Chlormequat chloride is a white to yellowish crystalline solid with a fish-like odor. Molecular weight = 158.09; Freezing/Melting point = 245 °C (decomposes); Vapor pressure = 79×10^{-9} mmHg @ 20C°. Hazard Identification (based on NFPA-704 M Rating System): Health 3, Flammability 0, Reactivity 0. Highly soluble in water. Carrier solvents used in commercial products may alter physical and toxicological properties

Incompatibilities: Chlormequat chloride decomposes on heating or in fire, forming nitrogen oxides, carbon monoxide, and hydrogen chloride fumes. This chemical decomposes on heating with strong aqueous alkali solutions, forming trimethylamine and other gaseous products. Contact with strong oxidizers may cause fire and explosions. Attacks many metals in presence of water

Permissible Exposure Limits in Air: Protective Action Criteria (PAC) Ver. 27[89]

PAC-1: 0.64 mg/m^3
PAC-2: 7 mg/m^3
PAC-3: 11 mg/m^3

Permissible Concentration in Water:

Determination in Water: Log K_{ow} = <– 0.5. Unlikely to bioaccumulate in marine organisms.

Routes of Entry: Inhalation, absorbed through the skin

Harmful Effects and Symptoms

There have been nearly 2700 incidents reported to the Opp incident data system (ids) and the California Department of Pesticide Regulation from 1982 to 2004 associated with exposure to end-use products containing quaternary ammonium compounds: most of the incidents are related to dermal, ocular and inhalation irritation. Allergic type reaction has also been reported in some incidents[83].

Short Term Exposure: Chlormequat chloride is an irritant and can be absorbed through the skin. Irritates the eyes and the respiratory tract. Higher exposures can cause pulmonary edema, a medical emergency that can be delayed for several hours. This can cause death. Exposure can cause nausea and vomiting. Higher levels can cause slow or irregular heartbeat, tremors, seizures, and coma. This can be fatal. Chlormequat chloride may affect the nervous system. Quaternary ammonium compounds: Inhalation incident symptoms: respiratory irritation/burning, irritation to mouth, throat, nose; vomiting, nausea. Symptoms of exposure (from above data system): nausea, headache, and sore throat are the primary systemic effects that have been reported. The primary dermal effects that have been reported are rash, burning sensation, numbness, and itching. Allergic symptoms: hives and allergic contact dermatitis. Oral incident symptoms: abdominal pain, dizziness, and headache. Ocular incident symptoms: irritation, burning, eye pain, conjunctivitis, swelling eye and swelling of eyelid. LD_{50} (oral, rat) = 600 mg/kg; LD_{50} (dermal, rat) = >4000 mg/kg.

Long Term Exposure: May cause liver damage. May cause tumors. May cause reproductive and fetal effects.

Points of Attack: Lungs, liver, nervous system. Reproductive cells.

Medical Surveillance: Liver function tests. Consider chest x-ray following acute overexposure. EKG examination of the nervous system. In addition to comprehensive initial medical and work histories emphasizing reproductive experience and menstrual history, patient should have physical examination and testing of genito-urinary tract, sperm count, motility and morphology. If required, other tests, such as serum testosterone, serum follicle stimulating hormone (FSH), and serum lutenizing hormone (LH), may be indicated.

First Aid: If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least 15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately. If this chemical contacts the skin, remove contaminated clothing and wash immediately with soap and water. Seek medical attention immediately. If this chemical has been inhaled, remove from exposure, begin rescue breathing (using universal precautions) if breathing has stopped, and CPR if heart action has stopped. Transfer promptly to a medical facility. When this chemical has been swallowed, get medical attention. Give large quantities of water and induce vomiting. Do not make an unconscious person vomit. Medical observation is recommended for 24 to 48 hours after breathing overexposure, as pulmonary edema may be delayed. As first aid for pulmonary edema, a doctor or authorized paramedic may consider administering a corticosteroid spray.

Respirator Selection: SCBA > 0.64 mg/m^3. Wherever and whenever workplace conditions warrant respirator use, a respiratory protection program must be followed that meets one or more of the following requirements: OSHA's 29 CFR 1910.134, ANSI Z88.2, or European Standard EN 149.

Storage: Store in a cool, dry area away from moisture, foodstuffs, acids, or oxidizers. Important to avoid high temperatures.

Shipping: Toxic, solids, organic, n.o.s. require a label of "poisonous materials." This material falls in Hazard Class 6.1 and Packing Group III.

Spill Handling: Wear safety goggles, full work clothing and impervious gloves and boots. If vapors are present, wear a NIOSH- or CEN (UK)-approved respiratory protection. Floor area may be slippery. Contain spills with inert material such as dry earth or dry sand. Scoop into containers and seal up for proper disposal in accordance with all local, state, and federal laws.

Fire Extinguishing: Hazardous decomposition includes oxides of nitrogen and carbon and hydrogen chloride gas. *Fire involving storage or vehicular tanks:* isolate for 800 meters/0.5 mile in all directions; also, consider initial evacuation for 800 meters/0.5 mile in all directions. *Small fire:* dry chemical, carbon dioxide or water spray. *Large fire:* dry chemical, carbon dioxide, alcohol-resistant foam or water spray. Move containers from fire area if you can do it without risk. Dike fire-control water for later disposal; do not scatter the material. *Fire involving tanks or car/trailer loads:* fight fire from maximum distance or use unmanned hose holders or monitor nozzles. Do not get water inside containers. Cool containers with flooding quantities of water until well after fire is out. Withdraw immediately in the case of rising sound from venting safety devices or discoloration of tank. Always stay away from tanks engulfed in fire.

Disposal Method Suggested: High-temperature incineration. In accordance with 40CFR165, follow recommendations for the disposal of pesticides and pesticide containers. Containers must be disposed of properly by following package label directions or by contacting your local or federal environmental control agency, or by contacting your regional EPA office.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- New Jersey Department of Health and Senior Services, Hazardous Substance Fact Sheet, “Chlormequat Chloride,” Trenton NJ (April 1999). http://www.state.nj.us/health/eoh/rtkweb/2236.pdf
- USEPA, “Chemical Profile: Chlormequat Chloride,” Washington DC, Chemical Emergency Preparedness Program (October 31, 1985)

Chloroneb C:0915

Use Type: Fungicide

CAS Number: 2675-77-6

Formula: $C_8H_8Cl_2O_2$

Synonyms: Benzene, 1,4-dichloro-2,5-dimethoxy-; 1,4-Dichloro-2,5-dimethoxybenzene

Trade Names: CHLORAXYL® SEED TREATER; DELTA-COAT® II; DEMOSAN®; SOIL FUNGICIDE®-1823; TERSAN® SP; TERRANEB® SP; SOIL FUNGICIDE 1823®

Chemical class: Substituted benzene

EPA/OPP PC Code: 027301

California DPR Chemical Code: 135[97].

HSDB Number: 1542

UN/NA & ERG Number: UN2761/151 (organochlorine pesticide, solid, toxic); UN2996

RTECS® Number: CZ4750000

EC Number: 220-222-3

Uses: A systemic fungicide used to control snow mold on turf grass; used on cotton, sugar beets and bean seeds to control seedling disease. Not approved for use in EU countries[115]. Registered for use in the U.S. except California.

U.S. Maximum Allowable Residue Levels for Chloroneb and its metabolite 2,5-dichloro-4-methoxyphenol (calculated as chloroneb) (40 CFR 180.257): in or on the following food commodities: bean 0.1 ppm (N); bean, forage 2 ppm; beet, sugar, roots 0.1 ppm (N); beet, sugar, tops 0.1 ppm (N); cattle, fat 0.2 ppm; cattle, meat 0.2 ppm; cattle, meat byproducts 0.2 ppm; cotton, forage 2 ppm; cotton, undelinted seed 0.1 ppm (N); goat, fat 0.2 ppm; goat, meat 0.2 ppm; goat, meat byproducts 0.2 ppm; hog, fat 0.2 ppm; hog, meat 0.2 ppm; hog, meat byproducts 0.2 ppm; horse, fat 0.2 ppm; horse, meat 0.2 ppm; horse, meat byproducts 0.2 ppm; milk 0.05 ppm (N); sheep, fat 0.2 ppm; sheep, meat 0.2 ppm; sheep, meat byproducts 0.2 ppm; soybean 0.1 ppm (N); and soybean, forage 2 ppm. (2004). (N) = Negligible

Human toxicity (long-term)[101]: Low–91.00 ppb, Health Advisory

Fish toxicity (threshold)[101]: Very low–530.91122 ppb, MATC (Maximum Acceptable Toxicant Concentration)

Regulatory Authority and Advisory Information:

Health Advisory: Mutagen

Description: Colorless crystalline solid. Musty odor. Molecular weight = 207.06; Specific gravity (H_2O:1) = 1.66; Boiling point = 268 °C; Freezing/Melting point = 133–135 °C; Vapor pressure = 3×10^{-3} mmHg. @ 20 °C. Low solubility in water.

Incompatibilities: May react with strong oxidizers such as chlorates, peroxides, nitrates, etc.

Permissible Exposure Limits in Air: No standards established.

Determination in Air: Filter; none; Gravimetric; NIOSH IV [Particulates NOR; #0500 (total), #0600 (respirable)][18].

Permissible Concentration in Water: State Drinking Water Guidelines: Florida 91 μg/L. Runoff from spills or fire control may cause water pollution.

Determination in Water: Log K_{ow} = >3.4. Values above 3.0 are likely to bioaccumulate in aquatic organisms.

Harmful Effects and Symptoms

Short Term Exposure: Overexposure symptoms include apprehension, anxiety, confusion, nervous excitation; dizziness; headache; numbness and weakness in limbs; muscle twitching, tremors; nausea and vomiting; slow, shallow respiration, bluish face; convulsions; loss of consciousness; breathing stops; death. LD_{50} (oral, rat) = >11 g/kg; LD_{50} (dermal, rat) = >5 g/kg.

Long Term Exposure: May cause reproductive and fetal effects.

Points of Attack: Reproductive cells.

Medical Surveillance: In addition to comprehensive initial medical and work histories emphasizing reproductive experience and menstrual history, patient should have physical examination and testing of genito-urinary tract, sperm count, motility and morphology. If required, other tests, such as serum testosterone, serum follicle stimulating hormone (FSH), and serum lutenizing hormone (LH), may be indicated. Medical observation is recommended for 24 to 48 hours after breathing overexposure, as pulmonary edema may be delayed. As first aid for pulmonary edema, consider administering a corticosteroid spray. Cigarette smoking may exacerbate pulmonary injury and should be discouraged for at least 72 hours following exposure

First Aid: Speed in removing material from eyes and skin is of extreme importance. *Eyes:* Eye contact can cause dangerous amounts of these chemicals to be quickly absorbed through the mucous membrane into the bloodstream. Directly, irrigate with large amounts of plain, tepid water or saline for 20 minutes, occasionally lifting the lower and upper lids. During this time, remove contact lenses, if easily removable without additional trauma to the eye. Get medical aid immediately. Have physician check for possible delayed damage. *Skin:* Get medical aid. Dermal contact can cause dangerous amounts of these chemicals to be absorbed into the bloodstream. Wearing the appropriate PPE equipment and respirator for organochlorine pesticides, immediately flush exposed skin, hair, and under nails with plain, running, tepid water for 20 minutes, then wash twice with mild soap. Shampoo hair promptly if contaminated; protect eyes. **Do not scrub skin or hair**, since this can increase absorption through the skin. Rinse thoroughly with water. Victims who are able and cooperative may assist with their own decontamination. Remove and double-bag contaminated clothing and personal belongings. Leather absorbs many organochlorines; therefore, items such as leather shoes, gloves, and belts should be discarded. If the skin is swollen or inflamed, cool affected areas with cold compresses. *Ingestion:* Call poison control. Loosen all clothing. Never give anything by mouth to an unconscious person. Get medical aid. *Do not induce vomiting*. * In cases of ingestion, the patient is at risk of central nervous system depression or seizures, which may lead to pulmonary aspiration during vomiting. If the victim is conscious and able to swallow, *administer an aqueous slurry of activated charcoal at 1 g/kg (usual adult dose 60–90 g, child dose 25–50 g). A soda can and straw may be of assistance when offering charcoal to a child. The efficacy of activated charcoal for some organochlorine poisoning (such as chlordane) is uncertain. If victim is *unconscious or having convulsions,* do nothing except keep victim warm. **In some cases you may be specifically instructed by poison control to induce vomiting by way of 2 tablespoons of syrup of ipecac (adult) washed down with a cup of water. Do not give activated charcoal* <u>*before or with*</u> *ipecac syrup.* *Inhalation:* Get medical aid. Do not contaminate yourself. Wearing the appropriate PPE equipment and respirator for organochlorine pesticides, immediately remove the victim from the contaminated area to fresh air. For inhalation exposures, monitor for respiratory distress. If the victim is not breathing, administer artificial respiration. Do not use mouth-to-mouth method if victim ingested or inhaled the substance; give artificial respiration with the aid of a pocket mask equipped with a one-way valve or other proper respiratory medical device. If cough or breathing difficulty develops, evaluate for respiratory tract irritation, bronchitis, or pneumonitis. If breathing is difficult, administer 100% humidified supplemental oxygen through bag/mask apparatus until medical help arrives. Do not leave victim unattended

Personal Protective Methods: Wear protective gloves and clothing to prevent any reasonable probability of dermal contact. Safety equipment suppliers/manufacturers can provide recommendations on the most protective glove/clothing material for your operation. At minimum, use Tyvek®-type disposable material. All protective clothing (suits, gloves, footwear, headgear) should be clean, available each day, and put on before work. Contact lenses should not be worn when working with this chemical. Wear dust-proof chemical goggles and face shield unless full facepiece respiratory protection is worn. Employees should wash immediately with soap when skin is wet or contaminated. Provide emergency showers and eyewash.

Respirator Selection: Wherever and whenever workplace conditions warrant respirator use, a respiratory protection program must be followed that meets one or more of the following requirements: OSHA's 29 CFR 1910.134, ANSI Z88.2, or European Standard EN 149. Where the neat (undiluted) test chemical is weighed and diluted, wear a NIOSH-approved half face respirator equipped with a combination filter cartridge, i. e. organic vapor/acid gas/HEPA (specific for organic vapors, HCl, acid gas, SO_2 and a high-efficiency particulate filter)[88].

Storage: Color Code-Blue: Health Hazard/Poison. Store under ambient temperatures in a tightly closed container in a dry, well-ventilated and secure poison location. Prior to working with this chemical you should be trained on its proper handling and storage. Where possible, automatically transfer material from other storage containers to process containers. Keep away from all mineral acids and bases.

Shipping: "Pesticides, liquid, toxic, n. o. s.," or "Organochlorine pesticide, liquid, toxic," require a "poisonous materials" label. This chemical falls in Hazard Class 6.1.

Spill Handling: For solids, isolate spill or leak area in all directions for at least 25 meters/75 feet. Increase, in the downwind direction, as necessary. Do not touch damaged containers or spilled material unless wearing appropriate protective clothing. Stop leak if you can do it without risk. Prevent entry into waterways, sewers, basements or confined areas. This chemical is probably combustible. Should a spill occur while you are handling this chemical, *first remove all sources of ignition*, then you should dampen the solid spill material with 60–70% ethanol and transfer the dampened material to a suitable container. Use absorbent paper dampened with 60–70% ethanol to pick up any remaining material. Seal the absorbent paper, and any of your clothes, which may be contaminated, in a vapor-tight plastic bag for eventual disposal. Solvent wash all contaminated surfaces with 60–70% ethanol followed by washing with a soap and water solution. Do not re-enter the contaminated area until the Safety Officer (or other responsible person) has verified that the area has been properly cleaned.

Fire Extinguishing: Decomposition products include toxic hydrogen chloride gas. Fires involving this material can be controlled with a dry chemical, carbon dioxide or alcohol-resistant foam extinguisher. Move containers from fire area if you can do it without risk. Dike fire-control water for later disposal. Use water spray or fog; do not scatter material using straight water jet streams. *Fire involving storage or vehicular tanks:* isolate for 800 meters/0.5 mile in all directions; also, consider initial evacuation for 800 meters/0.5 mile in all directions. Fight fire from maximum distance or use unmanned hose holders or monitor nozzles. Do not allow water to get inside containers. Cool containers with flooding quantities of water until well after fire is out. Withdraw immediately in the case of rising sound from venting safety devices or discoloration of tank. *Always* stay away from tanks engulfed in fire. For massive fire, use unmanned hose holders or monitor nozzles; if this is impossible, withdraw from area and let fire burn.

Disposal Method Suggested: Do not discharge into drains or sewers. Dispose of waste material as hazardous waste using a licensed disposal contractor to an approved landfill. Consult with environmental regulatory agencies for guidance on acceptable disposal practices. Incineration with effluent gas scrubbing is recommended. Containers must be disposed of properly by following package label directions or by contacting your local or federal environmental control agency, or by contacting your regional EPA office.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- Pesticide Management Education Program, "Chloroneb (Demosan, Tersan-SP) Chemical Profile 1/85," Cornell University, Ithaca, NY (January 1985). http://pmep.cce.cornell.edu/profiles/fung-nemat/aceticacid-etridiazole/chloroneb/fung-prof-chloroneb.html
- USEPA, Office of Pesticide Programs, Pesticide Residue Limits, "Chloroneb", 40 CFR 180.257, http://www.epa.gov/pesticides/food/viewtols.htm

Chlorophacinone C:0940

Use Type: Rodenticide

CAS Number: 3691-35-8

Formula: $C_{23}H_{15}ClO_3$

Synonyms: 2-(*α*-*p*-Chlorophenylacetyl)indane-1,3-dione; 2-[(*p*-Chlorophenyl)phenylacetyl]-1,3-indandione; 1*H*-Indene-1,3(2*H*)-dione, 2-[(4-chlorophenyl)phenylacetyl]-; 1,3-Indandione, 2-[(*p*-chlorophenyl)phenylacetyl]-; 2-[2-Phenyl-2-(4-chlorophenyl)acetyl]-1,3-indandione

Trade Names: AFNOR®; CAID®; DELTA®; DRAT RAT BAIT®; ENDORATS®; LIPHADIONE®; LM 91®; MICROZUL®; MURIOL®; PARTOX®[C]; QUICK®; RAMUCIDE®; RANAC®; RATOMET®; RAVIAC®; ROZOL®[C]; TOPITOX®

Chemical Class: 1,3-Indandione

EPA/OPP PC Code: 067707

California DPR Chemical Code: 1625

HSDB Number: 6432

UN/NA & ERG Number: UN2811/154

RTECS® Number: NK5335000

EC Number: 223-003-0 [*Annex I Index No.:* 606-014-00-9]

Uses: This material is an anticoagulant rodenticide used around livestock and also on crops such as artichokes. Some brands are labeled for use indoors and outdoors for the control of mice, rats, moles, muskrats, voles and vampire bats. Not approved for use in EU countries[115]. Registered for use in the U.S. There are 24 global suppliers[97].

Human toxicity (long-term)[101]: Extra high–0.03500 ppb, Health Advisory

Fish toxicity (threshold)[101]: Intermediate–27.64016 ppb, MATC (Maximum Acceptable Toxicant Concentration)

Regulatory Authority and Advisory Information:

Acute Oral Category: 1, DANGER–POISON

Superfund/EPCRA 302 Extremely Hazardous Substances: TPQ = 100/10,000 lb (45.4/4540 kg)

Reportable Quantity (RQ): 100 lb (45.4 kg)

European/International Regulations: Hazard Symbol: T+, N; risk phrases: R23; R27/28; R48/24/25; R50/53; safety phrases: S1/2; S36/37; S45; S60; S61 (see Appendix 1)

Description: Chlorophacinone is a white to pale yellow crystalline solid. Molecular weight = 374.82; Freezing/Melting point = 138 °C. Hazard Identification (based on NFPA-704 M Rating System): Health 2, Flammability 0, Reactivity 0. Low solubility in water; solubility = 100 mg/L.

Permissible Exposure Limits in Air

Protective Action Criteria (PAC) Ver. 27[89]

PAC-1: 0.091 mg/m^3
PAC-2: 1 mg/m^3
PAC-3: 1 mg/m^3

Determination in Water: Log K_{ow} = 2.0. Unlikely to bioaccumulate in marine organisms.

Routes of Entry: Ingestion, inhalation, and dermal contact. Persons with who are taking anticoagulants or are suffering from bleeding disorders must be protected from exposure.

Harmful Effects and Symptoms

Chlorophacinone is an anticoagulant. Hemorrhage is the most common sign and may be manifested by nose and gum bleeding, bloody stools and urine, ecchymoses (extravasations of blood into skin), and hemoptysis (coughing up of blood). Bruising is heightened. Abdominal and flank pain may also occur. Chlorophacinone could be hazardous to other small mammals and birds if used indiscriminately. Persons with bleeding problems and children should not come in contact.

Short Term Exposure: Contact with eyes or skin may cause irritation or injury. Contact may cause burns to skin and eyes. Symptoms of exposure are similar to those of warfarin. Inhalation should be avoided; use NIOSH- or CEN (UK)-approved air-purifying respirators for pesticides. May be harmful if swallowed. Symptoms develop after a few days or a few weeks or repeated ingestion and include nosebleed and bleeding gums; pallor and sometimes a rash; massive bruises, especially of the elbow, knees, and buttocks; blood in urine and feces; occasionally paralysis from cerebral hemorrhage; and hemorrhagic shock and death. Chlorophacinone is highly toxic orally and by skin adsorption. The probable oral lethal dose for humans is less than 5 mg/kg to 50 mg/kg, or between a taste (less than 7 drops) and 1 teaspoonful for a 150 lb (70 kg) person. LD_{50} (oral, rat) = 3.15 mg/kg.

Long Term Exposure: See above

Points of Attack: Blood, cardiovascular system

First Aid: *Emergency Life-Support Procedures:* Acute exposure to this chemical may require decontamination and life support for the victims. Emergency personnel should wear protective clothing appropriate to the type and degree of contamination. Air-purifying or supplied-air respiratory equipment should also be worn, as necessary. Rescue vehicles should carry supplies such as plastic sheeting and disposable plastic bags to assist in preventing spread of contamination. *Inhalation Exposure:* Move victims to fresh air. Emergency personnel should avoid self-exposure to chlorophacinone. Evaluate vital signs including pulse and respiratory rate, and note any trauma. If no pulse is detected, provide CPR. If not breathing, provide artificial respiration. If breathing is labored, administer oxygen or other respiratory support. Obtain authorization and/or further instructions from the local hospital for administration of an antidote or performance of other invasive procedures. RUSH to a health care facility. *Dermal/Eye Exposure:* Remove victims from exposure. Emergency personnel should avoid self-exposure to chlorophacinone. Evaluate vital signs including pulse and respiratory rate, and note any trauma. If no pulse is detected, provide CPR. If not breathing, provide artificial respiration. If breathing is labored, administer oxygen or other respiratory support. Remove contaminated clothing as soon as possible. If eye exposure has occurred, eyes must be flushed with lukewarm water for at least 15 minutes. Wash exposed skin areas twice with soap and water. Obtain authorization and/or further instructions from the local hospital for administration of an antidote or performance of other invasive procedures. RUSH to a health care facility. *Ingestion Exposure:* Evaluate vital signs including pulse and respiratory rate, and note any trauma. If no pulse is detected, provide CPR. If not breathing, provide artificial respiration. If breathing is labored, administer oxygen or other respiratory support. Obtain authorization and/or further instructions from the local hospital for administration of an antidote or performance of other invasive procedures. Vomiting may be induced with syrup of ipecac. If elapsed time since ingestion of chlorophacinone is unknown or suspected to be greater than 30 minutes, do not induce vomiting and RUSH to health care facility. Ipecac should not be administered to children under 6 months of age. ***Warning:*** Syrup of ipecac should be administered only if victims are alert, have an active gag-reflex, and show no signs of impending seizure or coma. If ANY uncertainty exists, RUSH to health care facility. The following dosages of ipecac are recommended: children up to 1 year old, 10 mL (1/3 oz); children 1 to 12 years old, 15 mL (1/2 oz); adults, 30 mL (1 oz). Walk the victims and give large quantities of water. If vomiting has not occurred after 15 minutes, ipecac may be re-administered. Continue to ambulate and give water to the victims. If vomiting has not occurred within 15 minutes after second administration of ipecac, administer activated charcoal. 4. Activated charcoal may be administered if victims are conscious and alert. Use 15 to 30 g (1/2 to 1 oz) for children, 50 to 100 g (1-3/4 to 3-1/2 oz) for adults, with 125 to 250 mL (1/2 to 1 cup) of water. 5. Promote excretion by administering a saline cathartic or sorbitol to conscious and alert victims. Children require 15 to 30 g (1/2 to 1 oz) of cathartic; 50 to 100 g (1-3/4 to 3-1/2 oz) is recommended for adults. 6. RUSH to a health care facility[83].

Personal Protective Methods: Wear protective gloves and clothing to prevent any reasonable probability of dermal contact. Safety equipment suppliers/manufacturers can provide recommendations on the most protective glove/clothing material for your operation. All protective clothing (suits, gloves, footwear, headgear) should be clean, available each day, and put on before work. Contact lenses should not be worn when working with this chemical. Wear dust-proof chemical goggles and face shield unless full facepiece respiratory protection is worn. Employees should wash immediately with soap when skin is wet or contaminated. Provide emergency showers and eyewash.

Respirator Selection: SCBA > 0.091 mg/m^3. NIOSH: SCBAF: Pd,Pp (APF = 10,000) (any NIOSH/MSHA- or European Standard EN 149-approved self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode); or SaF: Pd,Pp: ASCBA (APF = 10,000) (any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary, self-contained breathing apparatus operated in a pressure-demand or other positive-pressure mode).

Storage: Color Code-Green: General storage may be used. Prior to working with this chemical you should be trained on its proper handling and storage. Store in tightly closed containers in a cool, well-ventilated area.

Shipping: Indandione pesticides, solid, toxic, n. o. s., require a "poisonous materials" label. It usually falls in Hazard Class 6.1.

Spill Handling: As an immediate precautionary measure, isolate spill or leak area in all directions for at least 50 meters/150 feet for liquids and at least 25 meters/75 feet for solids. Increase, in the downwind direction, as necessary, the isolation distance shown above. Eliminate all ignition sources (no smoking, flares, sparks or flames in immediate area). Do not touch damaged containers or spilled material unless wearing appropriate protective clothing. Stop leak if you can do it without risk. Prevent entry into waterways, sewers, basements or confined areas. Absorb or cover with dry earth, sand or other non-combustible material and transfer to containers. Do not get water inside containers.

Fire Extinguishing: Hazardous decomposition includes oxides of carbon and hydrogen chloride gas. *Fire involving storage or vehicular tanks:* isolate for 800 meters/0.5 mile in all directions; also, consider initial evacuation for 800 meters/0.5 mile in all directions. *Small fire:* dry chemical, carbon dioxide or water spray. *Large fire:* dry chemical, carbon dioxide, alcohol-resistant foam or water spray. Move containers from fire area if you can do it without risk. Dike fire-control water for later disposal; do not scatter the material. *Fire involving tanks or car/trailer loads:* fight fire from maximum distance or use unmanned hose holders or monitor nozzles. Do not get water inside containers. Cool containers with flooding quantities of water until well after fire is out. Withdraw immediately in the case of rising sound from venting safety devices or discoloration of tank. Always stay away from tanks engulfed in fire. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode.

Disposal Method Suggested: Incineration at high temperature with effluent gas scrubbing.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- New Jersey Department of Health and Senior Services, "Hazardous Substance Fact Sheet, Chlorophacinone," Trenton, NJ (July 2000). http://www.state.nj.us/health/eoh/rtkweb/0400.pdf
- Pesticide Management Education Program, "Chemical Profile 1/85 on Chlorophacionone (Rozol)," Cornell University, Ithaca, NY (Modified March 1, 2002). http://pmep.cce.cornell.edu/profiles/rodent/chlorophacinone/rod-prof-chlorophacinone.html
- USEPA, "Chemical Profile: Chlorophacinone," Washington DC, Chemical Emergency Preparedness Program (October 31, 1985)

Chloropicrin C:0980

Use Type: Soil fumigant, Nematicide

CAS Number: 76-06-2

Formula: CCl_3NO_2

Synonyms: AI3-00027; Caswell No. 214; Chloroform, nitro-; Methane, trichloronitro-; Mycrolysin; NCI-C00533; Nitrotrichloromethane; Nitrochloroform; Trichloronitromethane; Trichlor

Trade Names: BROM-O-GAS®[C]; BROZONE®[C]; CHLOR-O-PIC®; DOWFUME®; FUM-A-CIDE® 15[C]; KLOP®; LARVACIDE®[C]; LARVACIDE 100®; METAPICRIN®; NAMFUME®[C]; NEMAX®; OG-25®; PESTMASTER® FUMIGANT 1[C]; PICFUME®; PIC-CHLOR® 16; PICRIDE®; PROFUME A®; PS®; TELONE®; TELONE® C[C]; TERR-O-CIDE® 15[C]; TERR-O-GAS®; TIMBERFUME II®; TRI-CLOR®[C]; TRI-CON®; TRI-FORM®; TRIFUME®[C];

Chemical class: Halo-organics

EPA/OPP PC Code: 081501

California DPR Chemical Code: 136

HSDB Number: 977

UN/NA & ERG Number: UN1580/154; UN1583 (Chloropicrin mixtures, n. o. s.)/154

RTECS® Number: PB6300000

EC Number: 200-930-9 [*Annex I Index No.:* 610-001-00-3]

Uses: Not approved for use in EU countries[115]. A U.S. EPA restricted Use Pesticide (RUP) as telone. Chloropicrin is used in the manufacture of the dye-stuff methyl violet and in other organic syntheses. It has been used as a chemical warfare gas. It is used as a preplant soil fumigant in seed beds and transplant nurseries for control of verticillium wilt, nematodes, weed seeds and insects. In grain elevators, it is used to control insects and rodents. The top four uses in California are on strawberries, tomatoes, bell peppers, and outdoor nursery plants.

U.S. Maximum Allowable Residue Levels for Chloropicrin (40 CFR 180.1008): Exempted from the requirement for residues when used as a fumigant for the following grains: barley, grain, post-harvest; buckwheat, grain, post-harvest; corn, field, grain, post-harvest; corn, pop, grain, post-harvest; oat, grain, post-harvest; rice, grain, post-harvest; rye, grain, post-harvest; sorghum, grain, post-harvest; wheat, grain, post-harvest

Human toxicity (long-term)[101]: Low–56.0 ppb, Health Advisory

Fish toxicity (threshold)[101]: High–1.37795 ppb, MATC (Maximum Acceptable Toxicant Concentration)

Regulatory Authority and Advisory Information:

Carcinogenicity: ACGIH, A4, Not classified as a human carcinogen.

Acute Oral Category: 1, DANGER–POISON

Health Advisory: Nerve Toxin (S!), Mutagen

DOT Inhalation Hazard Chemicals

Potential Ground Water Pollutant [California FAC Section 13145(d)/12811, active]

OSHA 29CFR1910.119, Appendix A. Process Safety List of Highly Hazardous Chemicals, TQ = 500 lb (227 kg)

Safe Drinking Water Act: Priority List (55 FR 1470)

EPCRA Section 313 Form R *de minimus* concentration reporting level: 1.0%

European/International Regulations: Hazard Symbol: T+, Xn, Xi; risk phrases: R22; R26; R36/37/38; safety phrases: S1/2; S36/37; S38; S45 (see Appendix 1).

Description: Chloropicrin is a highly toxic and reactive, colorless to faint yellow, oily liquid. Sharp, penetrating (pepper-like) odor that causes tearing. Odor threshold = 1.1 ppm. Molecular weight = 164.38; Specific gravity (H_2O:1) = 1.66; Boiling point = 121 °C; Freezing/Melting point = – 64 °C; Vapor pressure = 16.9 mmHg @ 20 °C. Hazard Identification (based on NFPA-704 M Rating System): Health 4, Flammability 0, Reactivity 3. Slightly soluble in water; solubility = 0.2272 g/100 ml @ 0 °C; 0.1621 g/100 ml at 25 °C.

Incompatibilities: Can be self-reactive. Chloropicrin may explode when heated under confinement. Quickly elevated temperatures, shock, contact with alkali metals or alkaline earth may cause explosions. A strong oxidizer; violent reaction with reducing agents, aniline (especially in presence of heat), alcoholic sodium hydroxide, combustible substances, sodium methoxide, propargyl bromide, metallic powders. Liquid attacks some light metals, and some plastics, rubber and coatings.

Permissible Exposure Limits in Air:

NIOSH IDLH: 2 ppm; 300 ppm for 10 minutes can be lethal to humans[83,EPA]

Conversion factor: 1 ppm = 6.72 mg/m^3 @ 25 °C & 1 atm

OSHA PEL: 0.1 ppm/0.7 mg/m^3 TWA
NIOSH REL: 0.1 ppm/0.7 mg/m^3 TWA
ACGIH TLV®[1]: 0.1 ppm/0.67 mg/m^3 TWA; not classifiable as a human carcinogen
Protective Action Criteria (PAC) Ver. 27[89]
PAC-1: **0.5**$_{\mathbf{A}}$ ppm
PAC-2: **0.15**$_{\mathbf{A}}$ ppm
PAC-3: **1.4**$_{\mathbf{A}}$ ppm
Subscript "**A**" signifies 60-minute AEGL (Acute Emergency Guideline Level) values.
DFG MAK: 0.1 ppm/0.68 mg/m^3 TWA; Peak Limitation Category I(1)

Permissible Exposure Limits in Air: No standards established.

Permissible Concentration in Water: State Drinking Water Guidelines: Florida 7.3 μg/L; California: 56 μg/L.

Determination in Water: Log K_{ow} = <2.5. Unlikely to bioaccumulate in marine organisms. When liquid chloropicrin enters water, it mixes very slowly, falling to the bottom, where it breaks down in less than a day. Nevertheless, warn pollution control authorities and advise shutting water intakes. Chloropicrin is very poisonous to fish.

Routes of Entry: Inhalation, ingestion, eye and dermal contact

Harmful Effects and Symptoms:

Short Term Exposure: Chlorpicrin was used as poison gas in WW I. Exposure causes intense tearing of the eyes, headache, nausea and vomiting, diarrhea, and cough. Contact can severely irritate the skin, causing rash or burning sensation. Higher exposures can irritate and burn the lungs, causing a build-up of fluid (pulmonary edema), a medical emergency that can be delayed for several hours. This can cause death. The LD_{50} (oral, rat) = 37.5 mg/kg[14].

Long Term Exposure: Repeated exposure can damage the lungs, causing bronchitis. It may also damage the liver and kidneys. May cause tumors.

Points of Attack: Eyes, skin, respiratory system, liver, kidneys.

Medical Surveillance: Before beginning employment and at regular times after that, the following is recommended: Lung function test. If symptoms develop or overexposure has occurred, the following may be useful: Liver and kidney function tests. Consider chest x-ray following acute overexposure

First Aid: If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least 15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately. If this chemical contacts the skin, remove contaminated clothing and wash immediately with soap and water. Seek medical attention immediately. If this chemical has been inhaled, remove from exposure, begin rescue breathing (using universal precautions) if breathing has stopped, and CPR if heart action has stopped. Transfer promptly to a medical facility. When this chemical has been swallowed, get medical attention. Give large quantities of water and induce vomiting. Do not make an unconscious person vomit. Medical observation is recommended for 24 to 48 hours after breathing overexposure, as pulmonary edema may be delayed. As first aid for pulmonary edema, a doctor or authorized paramedic may consider administering a corticosteroid spray.

Personal Protective Methods: Wear protective gloves and clothing to prevent any reasonable probability of dermal contact. Safety equipment suppliers/manufacturers can provide recommendations on the most protective glove/clothing material for your operation. The International Technical Information Institute recommends wearing Neoprene™ gloves. All protective clothing (suits, gloves, footwear, headgear) should be clean, available each day, and put on before work. Contact lenses should not be worn when working with this chemical. Wear splash proof chemical goggles and face shield unless full facepiece respiratory protection is worn. Employees should wash immediately with soap when skin is wet or contaminated. Provide emergency showers and eyewash.

Respirator Selection: SCBA > **0.5**$_{\mathbf{A}}$ ppm. Subscript "**A**" signifies 60-minute AEGL (Acute Emergency Guideline Level) values. NIOSH: *2 ppm:* Sa:Cf (APF = 25) (any supplied-air respirator operated in a continuous-flow mode); or PaprOv (APF = 25) [any powered, air-purifying respirator with organic vapor cartridge(s)]; or CcrFOv (APF = 50) [any chemical cartridge respirator with a full facepiece and organic vapor cartridge(s)]; or GmFOv (APF = 50) [any air-purifying, full facepiece respirator (gas mask) with a chin-style, front- or back-mounted acid gas canister); or SCBAF (APF = 50) (any self-contained breathing apparatus with a full facepiece); or SaF (APF = 50) (any supplied-air respirator with a full facepiece). *Emergency or planned entry into unknown concentrations or IDLH conditions:* SCBAF: Pd,Pp (APF = 10,000) (any self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode); or SaF: Pd,Pp: ASCBA (APF = 10,000) (any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary self-contained breathing apparatus operated in a pressure-demand or other positive-pressure mode). *Escape:* GmFOv (APF = 50) [any air-purifying, full facepiece respirator (gas mask) with a chin-style, front- or back-, mounted organic vapor canister] or SCBAE (any appropriate escape-type, self-contained breathing apparatus).

Note: Substance causes eye irritation or damage; eye protection needed.

Storage: Color Code-Blue: Health Hazard/Poison. Store in a secure poison location. Color Code-White: Corrosive or Contact Hazard; Store separately in a corrosion-resistant location. Prior to working with chloropicrin you should be trained on its proper handling and storage. Before entering confined space where chloropicrin may be present, check to make sure that an explosive concentration does not exist. Chloropicrin must be stored to avoid contact with strong oxidizers, such as chlorine or chlorine dioxide, since violent reactions occur. Store in tightly closed containers in a cool, well-ventilated area away from heat. High temperatures or severe shock may cause an explosion, particularly with containers having capacities of greater than 30 gallons. Where possible, automatically pump liquid from drums or other storage containers to process containers. Sources of ignition, such as smoking and open flames, are prohibited where this chemical is used, handled, or stored in a manner that could create a potential fire or explosion hazard.

Shipping: Chloropicrin must be labeled "poisonous materials." Hazard Class is 6.1. Technical name required.

Spill Handling: Evacuate and restrict persons not wearing protective equipment from area of spill or leak until clean-up is complete. Remove all ignition sources. Ventilate area of spill or leak. Absorb liquids in vermiculite, dry sand, earth, peat, carbon, or a similar material and deposit in sealed containers. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable.

Initial isolation and protective action distances

Distances shown are likely to be affected during the first 30 minutes after materials are spilled and could increase with time. If more than one tank car, cargo tank, portable tank, or large cylinder involved in the incident is leaking, the protective action distance may need to be increased. You may need to seek emergency information from CHEMTREC at (800) 424-9300 or seek professional environmental engineering assistance from the U.S. EPA Environmental Response Team at (908) 548-8730 (24-hour response line).

Small spills (from a small package or a small leak from a large package)

Note: there is no specific information for "PS" Chloropicrin, used as a weapon in the current DOT tables.

First: isolate in all directions (feet/meters) 100/30
Then: Protect persons downwind (miles/kilometers)
  Day 0.3/0.5
  Night 0.6/1.4

Large spills (from a large package or from many small packages)

First: isolate in all directions (feet/meters) 500/150
Then: Protect persons downwind (miles/kilometers)
  Day 1.2/1.9
  Night 2.1/3.3

Restrict persons not wearing protective equipment from area of spill or leak until clean up is complete. Ventilate the area of spill or leak.

Fire Extinguishing: Chloropicrin is a noncombustible liquid. However, in the case where a chloropicrin tank is adjacent to a fire, the tank will heat, causing extremely high pressurization and explosion. Evacuate area. Even if the tank doesn't fail, the safety valve may open, releasing chloropicrin, so evacuate. If necessary, fight fire from an explosion-resistant location. When heated, chloropicrin breaks down to poison gases such as phosgene (another good reason to evacuate), and at high temperature it can violently break down into several poisonous gases, including hydrogen chloride and nitrous vapors. The danger from a heated chloropicrin tank is too great to risk a manned fire fighting effort; if possible, an unattended fire monitor aimed at the upper part of the chloropicrin tank will cool the tank and may prevent tank failure. In general, it's best to use a spray or fog pattern rather than a solid stream, to avoid spreading the burning fuel around. If there is a reason that you have to extinguish a fire near a chloropicrin tank, use a fire fighting agent (water, ordinary foam, alcohol-resistant foam, or dry chemical) appropriate for that fuel. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies. From a secure, explosion-proof location, use water spray to cool exposed containers. If cooling streams are ineffective (venting sound increases in volume and pitch, tank discolors, or shows any signs of deforming), withdraw immediately to a secure position. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode.

Disposal Method Suggested: Incineration (816 °C, 0.5 second minimum for primary combustion; 1204 °C, 1.0 second for secondary combustion) after mixing with other fuel. The formation of elemental chlorine may be prevented by injection of steam or using methane as a fuel in the process. Chloropicrin reacts readily with alcoholic sodium sulfite solutions to produce methanetrisulfonic acid (which is relatively nonvolatile and less harmful). This reaction has been recommended for treating spills and cleaning equipment. Although not specifically suggested as a decontamination procedure, the rapid reaction of chloropicrin with ammonia to produce guanidine (LD_{50} = 500 mg/kg) could be used for detoxification. The Chemical Manufacturers' Association has suggested two procedures for disposal of chloropicrin: (a) Pour or sift over soda ash. Mix and wash slowly into large tank. Neutralize and pass to sewer with excess water. (b) Absorb on vermiculite. Mix and shovel into paper boxes. Drop into incinerator with afterburner and scrubber. Containers must be disposed of properly by following package label directions or by contacting your local or federal environmental control agency, or by contacting your regional EPA office.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- EXTOXNET, Extension Toxicology Network, "Pesticide Information Profile, Chloropicrin," Oregon State University, Corvallis, OR. http://ace.ace.orst.edu/info/extoxnet/pips/chloropi.htm

- USEPA, Office of Pesticide Programs, Pesticide Residue Limits, “Chloropicrin”, 40 CFR 180.1008. http://www.epa.gov/pesticides/food/viewtols.htm
- Sax, N. I., Ed., “Dangerous Properties of Industrial Materials Report,” 2, No. 2, 17-19, New York, Van Nostrand Reinhold Co. (1982)
- New Jersey Department of Health and Senior Services and Senior Services, “Hazardous Substance Fact Sheet: Chloropicrin,” Trenton, NJ (April 1998). http://www.state.nj.us/health/eoh/rtkweb/0405.pdf
- USEPA; *Acute Exposure Guideline Levels (AEGLs)*: Chloropicrin (CAS Reg. No. 76-06-2). Technical Support Document for Interim AEGL p.7, Washington DC, June 2008. http://www.epa.gov/oppt/aegl/pubs/chloropicrin_interim.pdf

Chlorothalonil C:1040

Use Type: Fungicide

CAS Number: 1897-45-6; 28343-61-5 (metabolite 4-hydroxy-2,5,6-trichloroisophthalonitrile)

Formula: $C_8Cl_4N_2$; $C_6Cl_4(CN)_2$

Synonyms: 1,3-Benzenedicarbonitrile,2,4,6,6-tetrachloro-; 1,3-Dicyanotetrachlorobenzene; Isophthalonitrile, tetrachloro; Metatetrachloro phthalodinitrile; NCI-C00102; 2,4,5,6-Tetrachloro-1,3-benzenedicarbonitrile; 2,4,5,6-Tetrachloro-1,3-dicyanobenzene; Tetrachloroisophthalonitrile; *meta*-Tetrachlorophthalodinitrile; Tetrachlorophthalodinitrile, *meta*-; Thalonil

Trade Names: ATLAS CROPGARD®; BANOL C®; BB CHLOROTHALONIL®; BOMmHgDIER®; BRAVO®; BRAVO® 6 F; BRAVO® 500; BRAVO® 6 F; BRAVO ULTREX®; BRAVO-W-75®; CHILTERN OLE®; CONTACT® 75; DAC® 2787; DACONIL®; DACONIL® 2787 FUNGICIDE; DACONIL® 2787 W; DACONIL® F; DACONIL® M; DACONIL® TURF; DACOSOIL®; DIVA FUNGICIDE®[C]; ECHO®; EXOTHERM®; EXOTHERM TERMIL®; FORTURF®; FUNGINIL®; IMPACT EXCEL®; JUPITAL®; NUOCIDE®; OLE®; PILLARICH®; POWER CHLOROTHALONIL® 50; REPULSE®; RIDOMIL GOLD/BRAVO®; SICLOR®; SIPCAM® UK ROVER 5000; SWEEP®; TER-MIL®; TPN®; TPN (PESTICIDE)®; TRIPART FABER®; TRIPART ULTRAFABER®; TUFFCIDE®

Chemical class: Substituted benzene; Chloronitrile

EPA/OPP PC Code: 081901

California DPR Chemical Code: 677

HSDB Number: 1546

UN/NA & ERG Number: UN3276/151

RTECS® Number: NT2600000

EC Number: 217-588-1 [*Annex I Index No.:* 608-014-00-4]

Uses: Chlorothalonil is a broad-spectrum fungicide. It is used on vegetables, peanuts, potatoes, small fruits, trees, turf, roses, ornamentals, and other crops. In California, the top crops are tomatoes, onions, celery, and landscaping. It targets fungal blights, needlecasts, and cankers on conifer trees. This is the second most used fungicide in the U.S. It can be found in formulations with many other pesticides

U.S. Maximum Allowable Residue Levels for Chlorothalonil and its metabolite 4-hydroxy-2,5,6-trichloroisophthalonitrile (CAS: 28343-61-5) (***40 CFR 180.275***): in or on the following food commodities: almond 0.05 ppm; almond, hulls 1.0 ppm; apricot 0.5 ppm; asparagus 0.1 ppm; banana (NMT 0.05 ppm in edible pulp) 0.5 ppm; bean (dry) 0.1 ppm; bean, snap, succulent 5 ppm; blueberry 1.0 ppm; broccoli 5 ppm; Brussels sprouts 5 ppm; cabbage 5 ppm; carrot, roots 1 ppm; cauliflower 5 ppm; celery 15 ppm; cherry, sweet 0.5 ppm; cherry, tart 0.5 ppm; cocoa bean, dried bean 0.05 ppm; coffee bean 0.20 ppm; corn, sweet, kernel plus cob with husks removed 1 ppm; cranberry 5.0 ppm; cucumber 5 ppm; mango 1.0 ppm; melon 5 ppm; mushroom 1.0 ppm; nectarine 0.5 ppm; onion, dry bulb 0.5 ppm; onion, green 5 ppm; papaya 15 ppm; parsnip, root 1 ppm; passionfruit 3 ppm; peach 0.5 ppm; peanut 0.3 ppm; pepper, nonbell (there are no registrations as of January, 2001) 5 ppm; pistachio 0.2 ppm; plum 0.2 ppm; plum, prune 0.2 ppm; potato 0.1 ppm; pumpkin 5 ppm; soybean 0.2 ppm; squash, summer 5 ppm; squash, winter 5 ppm; and tomato 5 ppm.

Human toxicity (long-term)[101]***:*** Intermediate–45.69190 ppb, CHCL (Chronic Human Carcinogen Level)

Fish toxicity (threshold)[101]***:*** High–4.41591 ppb, MATC (Maximum Acceptable Toxicant Concentration)

Regulatory Authority and Advisory Information:

Carcinogenicity: EPA Group B2 Probable Human Carcinogen; EU GHS Category 2: Suspected human carcinogen

California Proposition 65 Chemical: Cancer (1/1/1989)

Health Advisory: Mutagen

Acute Oral Category: 2, WARNING

Potential Ground Water Pollutant [California FAC Section 13145(d)/12811, active]

EPCRA Section 313 Form R *de minimis* concentration reporting level: 1.0%

Potential Inhalation Hazard

European/International Regulations: Hazard Symbol: T+, Xi, N; risk phrases: R26; R37; R40; R41; R43; R50/53; safety phrases: S1/2; S28; S36/37/39; S45; S60; S61

WGK (German Aquatic Hazard Class): 3-Severe hazard to waters.

As a cyanide compound:

California Proposition 65 Chemical: Cancer (1/1/1989)

Clean Air Act: Hazardous Air Pollutants (Title I, Part A, Section 112)

Clean Water Act: 40CFR423, appendix A, Priority Pollutants as cyanide, total

US DOT Regulated Marine Pollutant (49CFR172.101, appendix B) *as cyanide mixtures*

European/International Regulations: Hazard Symbol: T+, N; risk phrases: R26; R37; R40; R41; R43; R50/53; safety phrases: S1/2; S28; S36/37/39; S45; S60; S61 (see Appendix 1)

Description: Chlorothalonil is a combustible, white, odorless, crystalline solid. Commercial products may be formulated as water-dispersible granules, wettable powder, and/or dust. Molecular weight = 265.9; Specific gravity (H_2O:1) = 2.8; Boiling point = 350 °C; Freezing/Melting point = 260 °C; Vapor pressure = 5.7×10^{-7} mmHg @ 20 °C. Hazard Identification (Based on the NFPA-704 M Rating System): Health 3, Flammability 1, Reactivity 0. Low solubility in water. Physical and toxicological properties may be affected by the carrier solvents used in commercial formulations.

Incompatibilities: Contact with strong oxidizers may cause a fire and explosion hazard. Slow hydrolysis at pH > 9.0. Thermal decomposition may include fumes of hydrogen cyanide.

Permissible Exposure Limits in Air:

IDLH level = 25 mg[CN]/m^3

NIOSH REL: Danger of sensitization of the skin; Carcinogen level 3B; *Nitriles*: 2 ppm, Ceiling Concentration, not to be exceeded in any 15-minute work period.

Protective Action Criteria (PAC) Ver. 27[89]

PAC-1: 0.56 mg/m^3
PAC-2: 6.1 mg/m^3
PAC-3: 8.6 mg/m^3

DFG MAK: Danger of sensitization of the skin; Carcinogen level 3B

Determination in Air: NIOSH REL: (Nitriles) TWA 22 mg/m^3; NIOSH REL: (Nitriles) CL 4 mg/m^3/15minute. See also NIOSH Criteria Document 78-212 NITRILES[18].

Permissible Concentration in Water: Federal Drinking Water Guidelines: 100 ppb[93]. Federal and State drinking water guidelines for cyanide/cyanide ion: Federal Drinking Water Guidelines: EPA 200 μg/L/cyanide ion; State Drinking Water Standards: California 150 μg/L; State Drinking Water Guidelines: Arizona 220 μg/L

Determination in Water: Analysis of chlorothalonil is by a gas chromatographic (GC) method applicable to the determination of certain chlorinated pesticides in water samples. In this method, approximately 1 liter of sample is extracted with methylene chloride. The extract is concentrated and the compounds are separated using capillary column GC. Measurement is made using an electron capture detector. The method detection limit has not been determined for chlorothalonil, but it is estimated that the detection limits for analytes included in this method are in the range of 0.01 to 0.1 μg/L

Routes of Entry: Inhalation, dermal contact

Harmful Effects and Symptoms

Johnson et al. (1983) reported that chlorothalonil exposure resulted in contact dermatitis in 14 of 20 workers involved in woodenware preservation. The wood preservative used by the workers consisted mainly of "white spirit," with 0.5% chlorothalonil as a fungicide. Workers exhibited erythema and edema of the eyelids, especially the upper eyelids, and eruptions on the wrist and forearms. Results of patch test conducted with 0.1% chlorothalonil in acetone were positive in 7 of 14 subjects. Reactions ranged from a few erythematous papules to marked papular erythema with a brownish hue without infiltration. *Wilson et al. (1985)* gave chlorothalonil (98.1% pure with less than 0.03% hexachlorobenzene) to Fischer 344 rats (60/sex/dose) in their diet at dose levels of 0, 40, 80 or 175 mg/kg/day. Males were treated for 116 weeks, while females received the chemical for 129 weeks. Survival among the various groups was comparable. In both sexes, at the high dose level, there were significant decreases in body weights. In addition, there were also significant increases in blood urea nitrogen and creatinine, while there were decreases in serum glucose and albumin levels. In both sexes, there were dose-dependent increases in kidney carcinomas and adenomas at doses above 40 mg/kg/day. In the high-dose females, there was also a significant increase in stomach papillomas. The data show that, in the Fischer 344 rat, chlorothalonil is a carcinogen. The (oral, rat) = 10 g/kg (insignificantly toxic)

Short Term Exposure: Irritates the eyes, skin, respiratory tract. Inhalation can cause coughing, phlegm, and/or tightness in the chest. LD_{50} (oral, rat, male) = 422 mg/kg; LD_{50} (dermal, rat) = >10 g/kg[14].

Long Term Exposure: May cause cancer. Repeated or prolonged contact with skin may cause nose bleeding, skin sensitization and dermatitis with skin rash. May affect the kidneys and gastrointestinal tract. This chemical causes cancer of the kidneys in animals. May cause tumors; reproductive and fetal effects; neurotoxic.

Points of Attack: Skin, lungs and kidneys. Reproductive cells. Central nervous system.

Medical Surveillance: This chemical is a suspected or known human carcinogen. Exposed persons should contact a physician for advice regarding the possible long term health effects and advice for medical monitoring. In addition to comprehensive initial medical and work histories emphasizing reproductive experience and menstrual history, patient should have physical examination and testing of genito-urinary tract, sperm count, motility and morphology. If required, other tests, such as serum testosterone, serum follicle stimulating hormone (FSH), and serum lutenizing hormone (LH), may be indicated. Complete blood count. Lung function tests. Kidney function tests. Evaluation by a qualified allergist, including exposure history and testing, may help diagnose allergy.

First Aid: If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least 15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately. Give artificial respiration if victim is not breathing. *Do not* use mouth-to-mouth method if victim ingested or inhaled the substance; give artificial respiration with the aid of a pocket mask equipped with a one-way valve or other proper respiratory medical device. Administer oxygen if breathing is difficult. Remove and isolate contaminated clothing and shoes. In cases of contact with substance, immediately flush skin or eyes with running water for at least 20 minutes. For minor skin contact, avoid spreading material on unaffected skin. Keep victim warm and quiet. Effects of exposure (inhalation, ingestion or skin contact) to substance may be delayed. Ensure that medical personnel are aware of the material(s) involved and take precautions to protect themselves.

Personal Protective Methods: Applicators and other handlers must wear: Coveralls worn over long-sleeved shirt and

long pants; Chemical-resistant gloves such as DuPont™ Tychem® suit fabrics, barrier laminate, or Viton®; Chemical-resistant footwear plus socks; Protective eye wear; Chemical-resistant headgear for overhead exposure; Chemical-resistant apron when cleaning equipment, mixing, or loading[83]. Agricultural Use/Engineering Controls: When handlers use closed systems, enclosed cabs, or aircraft in a manner that meets the requirements listed in the Worker Protection Standard (WPS) for agricultural pesticides, 40 CFR 170.240(d)(4-6), the handler PPE requirements may be reduced or modified as specified in the Worker Protection Standard. Firefighters should wear NIOSH approved self-contained breathing apparatus and full protective clothing.

Respirator Selection: SCBA > $0.56\,mg/m^3$. *Nitriles*: NIOSH, *10 ppm:* Sa (APF = 10) (any supplied-air respirator); *25 ppm:* Sa:Cf (APF = 25) (any supplied-air respirator operated in a continuous-flow mode); *50 ppm:* SCBAF (APF = 50) (any self-contained breathing apparatus with a full facepiece); or SaF (APF = 50) (any supplied-air respirator with a full facepiece); *250 ppm:* SaF:Pd,Pp (APF = 2000) (any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode). *Emergency or planned entry into unknown concentrations or IDLH conditions:* SCBAF:Pd,Pp (APF = 10,000) (any self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode); or SaF:Pd,Pp:ASCBA (APF = 10,000) (any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary self-contained breathing apparatus operated in a pressure-demand or other positive-pressure mode. *Escape*: GmFOv (APF = 50) [any air-purifying, full facepiece respirator (gas mask) with a chin-style, front- or back-mounted organic vapor canister] or SCBAE (any appropriate escape-type, self-contained breathing apparatus).

Storage: Color Code-Blue: Health Hazard/Poison. Store in a secure poison location. Prior to working with chlorothalonil you should be trained on its proper handling and storage. Store in tightly closed containers in a cool, well-ventilated area. Metal containers involving the transfer of this chemical should be grounded and bonded. Drums must be equipped with self-closing valves, pressure vacuum bungs; and flame arresters. Use only non-sparking tools and equipment, especially when opening and closing containers of this chemical. Sources of ignition, such as smoking and open flames, are prohibited where this chemical is used, handled, or stored in a manner that could create a potential fire or explosion hazard. A regulated, marked area should be established where this chemical is handled, used, or stored in compliance with OSHA Standard 1910.1045.

Shipping: Nitriles, liquid, toxic, and Pesticides, solid, toxic, n. o. s. require a shipping label of "poisonous materials." They usually fall in Hazard Class 6.1. Technical name required.

Spill Handling: Issue a poison warning.

First: isolate in all directions (feet/meters) 100/30
Then: Protect persons downwind (miles/kilometers)
Day 0.1/0.2
Night 0.1/0.2

Large spills (from a large package or from many small packages)

First: isolate in all directions (feet/meters) 200/60
Then: Protect persons downwind (miles/kilometers)
Day 0.3/0.5
Night 0.5/0.8

Remove all sources of ignition. Evacuate persons not wearing protective equipment from area of spill or leak until clean up is complete. Remove all ignition sources. Dampen spilled material with acetone to avoid dust. Collect powdered material in the most convenient and safe manner and deposit in sealed containers. Ventilate area after clean up is complete. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable. Soil Adsorption Index (K_{oc}) = 1380[83].

Fire Extinguishing: Potential Inhalation Hazard: Hazardous decomposition includes hydrogen cyanide, hydrogen chloride and oxides of nitrogen and carbon. *On a small fire:* use dry chemical, CO_2 or water spray. *On a large fire:* use water spray, fog or regular foam. Move containers from fire area if you can do it without risk. Dike fire-control water for later disposal; do not scatter the material. Use water spray or fog; do not use straight streams. *Fire involving storage or vehicular tanks:* isolate for 800 meters/0.5 mile in all directions; also, consider initial evacuation for 800 meters/0.5 mile in all directions. Fight fire from maximum distance or use unmanned hose holders or monitor nozzles. Do not get water inside containers. Cool containers with flooding quantities of water until well after fire is out. Withdraw immediately in the case of rising sound from venting safety devices or discoloration of tank. ALWAYS stay away from tanks engulfed in fire. For massive fire, use unmanned hose holders or monitor nozzles; if this is impossible, withdraw from area and let fire burn. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies.

Disposal Method Suggested: Incineration in a unit operating @ 850 °C equipped with off-gas scrubbing equipment. An empty pesticide container can be as hazardous as a full one because of residues left inside.

Never reuse such a container. When empty, a pesticide container should be rinsed carefully three times and the rinsewater thoroughly drained back onto the sprayer or the container previously used to mix the pesticide. Use the rinsewater as a pesticide, following label directions. Replace the cap or closure securely. Dispose of the container according to label instructions. Do not puncture or burn a pressurized container like an aerosol – it could explode. Do cut or puncture other empty pesticide containers made of metal or plastic to prevent someone from reusing them. Wrap the empty container and put it in the trash after you have rinsed it[83].

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- USEPA, Office of Pesticide Programs, Pesticide Residue Limits, "Chlorothalonil," 40 CFR 180.275. http://www.epa.gov/pesticides/food/viewtols.htm
- EXTOXNET, Extension Toxicology Network, "Pesticide Information Profile, Chlorothalonil," Oregon State University, Corvallis, OR (June 1996). http://ace.ace.orst.edu/info/extoxnet/pips/chloroth.htm
- New Jersey Department of Health and Senior Services, Hazardous Substance Fact Sheet, Chlorothalonil, Trenton, NJ (April 1998). http://www.state.nj.us/health/eoh/rtkweb/0415.pdf
- USEPA, "Chemical Profile: Chlorothalonil," Washington DC, Office of Drinking Water (August 1987)
- National Institute for Occupational Safety and Health, Criteria for a Recommended Standard: Occupational Exposure to Nitriles, Washington DC
- "Handbook of Chemical Property Estimation Methods." Amer Chemical Society, Washington DC, 1990

Chloroxylenol C:1064

Use Type: Microbiocide

CAS Number: 88-04-0

Formula: C_8H_9ClO

Synonyms: Benzytol; 4-Chloro-3,5-dimethylphenol; 4-Chloro-3,5-xylenol; Chloro-*m*-xylenol; 3,5-Dimethyl-4-chlorophenol; Parachlorometaxylenol; *p*-Chloro-*m*-xylenol

Trade Names: BAR-FUNGAL PLUS®[C]; BIO SLIME®[C]; DESSON®; DETTOL®; ECOTRU®; ESPADOL®; HUSEPT®; HUSEPT EXTRA®; NIPACIDE®; OTTASEPT®[C]; OTTASEPT® EXTRA[C]; PCMX; RBA 777®

Chemical class: Chlorinated phenol

EPA/OPP PC Code: 086801

California DPR Chemical Code: 925

HSDB Number: 7427

UN/NA & ERG Number: UN2020 (chlorophenols, solid)/153; UN2021 (chlorophenols, liquid)/153

RTECS® Number: ZE685000

EC Number: 201-793-8 [*Annex I Index No.:* 604-038-00-4]

Uses: Chloroxylenol was first registered in the U.S. for use as a fungicide and is now applied as an antimicrobial for control of bacteria, algae and fungi in adhesives, emulsions, paints and wash tanks. It is registered for use in household and domestic dwellings, laundry equipment, bathrooms, diaper pails and in industrial water and aqueous systems. Not listed for use in EU countries[115]. Registered for use in the U.S. There are 64 global suppliers[97].

Regulatory Authority and Advisory Information:

List of priority pollutants (EPA) as chlorophenols

AB 2588-Air Toxics "Hot Spots" Chemicals (CAL) as chlorophenols

The "Director's List" (CAL/OSHA) as chlorophenols

Clean Water Act: Toxic Pollutant (Section 401.15) other than those listed elsewhere; includes trichlorophenols

RCRA Section 261 Hazardous Constituents, waste number not listed as chlorophenols

US DOT Regulated Marine Pollutant (49CFR172.101, appendix B) as chlorophenols

EPCRA Section 313 (as chlorophenols) Form R *de minimis* concentration reporting level: 1.0%

European/International Regulations: Hazard Symbol: N; risk phrases: R51/53; safety phrases: S61 (see Appendix 1)

Description: A white to beige crystalline powder. Phenolic odor. Molecular weight = 156.61; Specific gravity (H_2O:1) = 0.89 @ 20 °C; Boiling point = 246 °C; Freezing/Melting point = 116 °C. Hazard Identification (based on NFPA-704 M Rating System): Health 2, Flammability 0, Reactivity 0. Slightly soluble in water.

Incompatibilities: Reacts with boranes, alkalies, aliphatic amines, amides, nitric acid, sulfuric acid. Keep away from oxidizers (chlorates, nitrates, peroxides, permanganates, perchlorates, chlorine, bromine, fluorine, etc). Flammable hydrogen gas may be generated, and the heat from reaction may ignite the gas. May generate heat on contact with bases, acid chlorides or acid anhydrides. Heating may initiate dangerous polymerization.

Permissible Concentration in Water: No criteria set for this chemical; however, EPA recommends that drinking water contain not > 0.04 mg/L of 2-chlorophenol for a lifetime exposure for an adult, and 0.05 mg/L for a 1-day, 10-day, or longer exposure for a child.

Determination in Water: Log K_{ow} = 2.8–3.3. Values above 3.0 are likely to bioaccumulate in aquatic organisms.

Routes of Entry: Inhalation, absorbed by skin, ingestion.

Harmful Effects and Symptoms

Short Term Exposure: Inhalation can cause severe irritation, burns to the nose and throat, headache, dizziness, vomiting, lung damage, muscle twitching, spasms, tremors, weakness, staggering and collapse. Dermal contact can cause severe irritation and burns. May be absorbed through the skin to cause or increase the severity of symptoms listed above. Eye contact may cause severe irritation. May cause burns. Ingestion may cause irritation, burns to the mouth and throat, low blood pressure, profuse sweating, intense thirst, nausea, abdominal pain, stupor, vomiting, red blood cell damage and accumulation of fluid in the lungs followed by pneumonia. May also cause restlessness and increased breathing rate followed by rapidly developing muscle weakness. Tremors, convulsions and coma can promptly set in and will continue until death. LD_{50} (oral, rat) = >3500 mg/kg. Low toxicity.

Long Term Exposure: Skin sensitivity may develop. May have effects on the blood, heart, liver, lung, kidney. The state of New Jersey lists at least one chlorophenol as a probable carcinogen in humans; may cause leukemia and soft tissue cancers in humans. The substance may cause effects on the central nervous system and bladder. Chlorophenols leave the body quickly, so they are not likely to accumulate in the mother's tissues or breast milk. There are no human studies on the effects of chlorophenols on developing fetuses. Studies in rats showed that chlorophenols can pass through the placenta and produce toxic effects on the developing fetuses. The most common problems in children are delayed hardening of the bones of the breastbone, spine, and skull.

Points of Attack: Eyes, skin (sensitizer), respiratory system.

Medical Surveillance: If symptoms develop or overexposure is suspected, the following may be useful: Liver function tests. Kidney function tests. Examination by a qualified allergist. EKG.

First Aid: If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least 15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately. If this chemical contacts the skin, remove contaminated clothing and wash immediately with soap and water. Seek medical attention immediately. If this chemical has been inhaled, remove from exposure, begin rescue breathing (using universal precautions) if breathing has stopped, and CPR if heart action has stopped. Transfer promptly to a medical facility. When this chemical has been swallowed, get medical attention. If victim is conscious and able to swallow, have victim drink 4 to 8 ounces of water. Do not induce vomiting. *Note to physician or authorized medical personnel*: Medical observation is recommended for 24 to 48 hours after breathing overexposure, as pulmonary edema may be delayed. As first aid for pulmonary edema, consider administering a corticosteroid spray. Cigarette smoking may exacerbate pulmonary injury and should be discouraged for at least 72 hours following exposure.

Respirator Selection: Wherever and whenever workplace conditions warrant respirator use, a respiratory protection program must be followed that meets one or more of the following requirements: OSHA's 29 CFR 1910.134, ANSI Z88.2, or European Standard EN 149.

Storage: Color Code-Blue: Health Hazard/Poison. Store in a tightly closed container in a dry, well-ventilated and secure poison location. Prior to working with this chemical you should be trained on its proper handling and storage. Where possible, automatically transfer material from other storage containers to process containers.

Shipping: Chlorophenols, liquid or solid, require a shipping label of "poisonous materials" and fall in Hazard Class 6.1.

Spill Handling: Dampen the spilled material with water. Clean up with dampened absorbent paper and transfer material to a suitable trash container. Seal the absorbent paper and your clothing in a vapor-tight plastic bag for eventual disposal. Wash all contaminated surfaces with a soap and water solution. Do not re-enter the contaminated area until an expert verifies that the area has been properly cleaned.

Fire Extinguishing: *On a small fire:* use dry chemical powder, carbon dioxide or water spray. *On a large fire:* use dry chemical, carbon dioxide, water spray, fog or alcohol - resistant foam. Move containers from fire area if you can do it without risk. Dike fire-control water for later disposal. Use water spray or fog; do not scatter material using straight water jet streams. *Fire involving storage or vehicular tanks:* isolate for 800 meters/0.5 mile in all directions; also, consider initial evacuation for 800 meters/0.5 mile in all directions. Fight fire from maximum distance or use unmanned hose holders or monitor nozzles. Do not allow water to get inside containers. Cool containers with flooding quantities of water until well after fire is out. Withdraw immediately in the case of rising sound from venting safety devices or discoloration of tank. *Always* stay away from tanks engulfed in fire. For massive fire, use unmanned hose holders or monitor nozzles; if this is impossible, withdraw from area and let fire burn.

Disposal Method Suggested: Do not discharge into drains or sewers. Dispose of waste material as hazardous waste using a licensed disposal contractor to an approved landfill. Consult with environmental regulatory agencies for guidance on acceptable disposal practices. Incineration with effluent gas scrubbing is recommended. Containers must be disposed of properly by following package label directions or by contacting your local or federal environmental control agency, or by contacting your regional EPA office.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- U.S. Environmental Protection Agency, "Reregistration Eligibility Decision (RED), Chloroxylenol," Office of Prevention, Pesticides and Toxic Substances, Washington DC (September 1994). http://www.epa.gov/REDs/3045.pdf
- Agency for Toxic Substances and Disease Registry "Toxicological profile for chlorophenols," 1999, Atlanta, GA

Chlorpropham C:1068

Use Type: Herbicide, Plant growth regulator

CAS Number: 101-21-3

Formula: $C_{10}H_{12}ClNO_2$

Synonyms: Carbamic acid, (3-chlorophenyl)-, 1-methylethyl ester; Chlor-IFC; Chlor-IPC; *m*-Chlorocarbanilic acid, isopropyl ester; 3-Chlorocarbanilic acid, isopropyl ester; Chloro IPC; *N*-3-Chlorophenylisopropylcarbamate;

N-(3-Chlorophenyl)carbamic acid, isopropyl ester; (3-Chlorophenyl)carbamic acid, 1-methylethyl ester; Chloropropham; CICP; CI-IPC; CIPC; ENT 18,060; Isopropyl-*m*-chlorocarbanilate; Isopropyl-3-chlorophenylcarbamate; Isopropyl-*N*-(3-chlorophenyl) carbamate

Trade Names: ATLAS® CIPC 40; BEET-KLEEN® (with Fenuron® and isopropyl carbanilate); BUD-NIP®; CAMPBELL'S® CIPC 40%; CHLORO IPC®; ELBANIL®; FASCO® WY-HOE; FURLOE®; FURLOE® 4EC; JACK WILSON® CHLORO 51 (OIL); LIRO METOXON®; MIRVALE®; MORCRAN® (with *n*-1-naphthylphthalamic acid); MSS® CICP; NEXOVAL®; PREVENOL® 56; PREVENTOL®; PREVENTOL® 56; PREWEED®; RESIDUREN®; RESIDUREN® EXTRA; SPROUT NIP®; SPROUT-NIP® EC; SPUD-NIC®; SPUD-NIE®; STOPGERME®-S; TATERPEX®; TRIPEC® (with carbamic acid, phenyl-, 1-methylethyl ester); TRIHERBICIDE® CIPC; UNICROP® CIPC; WAREFOG®; Y3®

Chemical class: Carbamate

EPA/OPP PC Code: 018301

California DPR Chemical Code: 141

HSDB Number: 981

UN/NA & ERG Number: UN2757 (solid)/151; UN2992/151 (liquid)

RTECS® Number: FD8050000

EC Number: 202-925-7 [*Annex I Index No.:* 006-096-00-0]

Uses: Chlorpropham is a plant growth regulator that is used primarily in the U.S. to inhibit post-harvest potato sprouting. Other uses include pre-emergence control of grass weeds in alfalfa, beans, blueberries, cane berries, carrots, cranberries, ladino clover, garlic, seed grass, onions, spinach, sugar beets, tomatoes, safflower, soybeans, gladioli and woody nursery stock. It is used to control suckers in tobacco

Human toxicity (long-term)[101]: Very low–350.00 ppb, Health Advisory.

U.S. Maximum Allowable Residue Levels for Chlorpropham (40 CFR 180.275): Tolerances are established for residues of the plant regulator and herbicide CIPC (isopropyl m-chlorocarbanilate) and its metabolite 1-hydroxy-2-propyl 3'-chlorocarbanilate (calculated as CIPC) in or on the following raw agricultural commodities: potato, post-harvest 50 ppm.

Fish toxicity (threshold)[101]: Low–424.62703 ppb, MATC (Maximum Acceptable Toxicant Concentration)

Regulatory Authority and Advisory Information:
Carcinogenicity: EPA Group E, evidence of non-carcinogenicity for humans; EU GHS Category 2: Suspected human carcinogen; IARC, Group 3 not classifiable as to its carcinogenicity in humans
Acute Oral Category: 4, Caution
Health Advisory: Nerve Toxin (S!)
AB 1803 Well monitoring chemical (CAL)
DHS drinking water action levels (CAL)
European/International Regulations: Hazard Symbol: Xn, N; risk phrases: R40; R48/22; safety phrases: S2; S36/37; S61 (see Appendix 1)

Description: Chlorpropham is a light-tan or crystalline solid or powder. Commercial liquid formulations can be supplied as liquids and as emulsifiable concentrates. Molecular weight 213.66; Specific gravity (H_2O:1) = 1.18 @ 30 °C; Boiling point = 149 °C @ 2 mmHg; Freezing/Melting point = 41–42 °C; Vapor pressure = 1.8 × 10^{-4} mmHg @ 20 °C; 2 mmHg @ 149 °C. Hazard Identification (based on NFPA-704 M Rating System): Health 1, Flammability 0, Reactivity 0. Moderate solubility in water. Solubility 89 mg/L @ 25 °C.

Incompatibilities: Decomposes above 150 °C. Carbamates are incompatible with strong oxidizing acids, peroxides, and hydroperoxides; strong reducing agents such as hydrides; strong acids and bases. Contact with nitrides or chemically active metals (aluminum, copper, magnesium, neptunium, sodium, tin, titanium, zinc, etc.) causes the release of potentially explosive hydrogen gas and a metal salt.

Permissible Exposure Limits in Air: No standards set.

Determination in Water: Log K_{ow} = 3.5–3.9. Values above 3.0 are likely to bioaccumulate in aquatic organisms.

Routes of Entry: Skin absorption, ingestion, inhalation

References:

Short Term Exposure: Eye pupils are small; blurred vision; eye watering; runny nose; cough; shortness of breath; salivation; nausea, stomach cramps, diarrhea, and vomiting; increased blood pressure; profuse sweating; hypermotility, hallucinations; agitation; tingling of the skin; slow heartbeat; convulsions; fluid in lungs; loss of consciousness; incontinence; breathing stops; death. Carbamate insecticides inhibit the cholinesterase activity of enzymes, causing accumulation of acetylcholine at synapses and altering the way in which nervous impulses are transmitted. However, within several hours carbamates spontaneously detach from the enzymes. Because this material has a low vapor pressure, significant inhalation of vapors is unlikely at ordinary temperatures. LD_{50} (oral, rat) = 1200 mg/kg.

Long Term Exposure: A potent acetylcholinesterase (AChE) inhibitor; cumulative effect is possible. This chemical may damage the nervous system with repeated exposure, resulting in convulsions, respiratory failure. May cause liver, kidney, spleen, bone marrow damage.

Points of Attack: Respiratory system, lungs, central nervous system, cardiovascular system, skin, eyes, plasma and red blood cell cholinesterase. In animals, kidney, spleen, liver, and bone marrow toxicity[103].

Medical Surveillance: Routine biological monitoring of pesticide applicators and field workers includes testing of plasma and red blood cell acetylcholinesterase levels (for enzyme poisoned by this chemical). These tests are normally accurate only if done within about two hours of exposure. If exposure stops, plasma levels return to normal in 1–2 weeks while red blood cell levels may be reduced for 1–3 months. When acetylcholinesterase enzyme levels are reduced by 25% or more below preemployment levels, risk of poisoning is increased, even if results are in lower ranges of "normal." Reassignment to work not involving carbamate pesticides is recommended until enzyme levels recover. Cigarette smoking may exacerbate pulmonary injury and should be discouraged for at least 72 hours following exposure. Also consider complete blood count and chest x-ray following acute overexposure.

First Aid: Speed in removing material from eyes and skin is of extreme importance. *Eyes:* Eye contact can cause dangerous amounts of these chemicals to be quickly absorbed through the mucous membrane into the bloodstream. Immediately and gently flush eyes with plenty of warm or cold water (NO hot water) for at least 15 minutes, occasionally lifting the upper and lower eyelids. Get medical aid immediately. *Skin:* Get medical aid. Dermal contact can cause dangerous amounts of these chemicals to be absorbed into the bloodstream. Wearing the appropriate PPE equipment and respirator for carbamate pesticides, immediately flush skin with plenty of soap and water for at least 15 minutes while removing contaminated clothing and shoes. Shampoo hair promptly if contaminated; protect eyes. *Ingestion:* Call poison control. Loosen all clothing. Never give anything by mouth to an unconscious person. Get medical aid. Do NOT induce vomiting. * If conscious, alert, and able to swallow, rinse mouth and have victim drink 4 to 8 ounces of water. Check to see if poison control instructs you to use ipecac syrup, otherwise administer slurry of activated charcoal (2 oz in 8 oz of water). If victim is *UNCONSCIOUS OR HAVING CONVULSIONS,* do nothing except keep victim warm. **In some cases you may be specifically instructed by poison control to induce vomiting by way of 2 tablespoons of syrup of ipecac (adult) washed down with a cup of water.* Do NOT give activated charcoal before or with ipecac syrup. *Inhalation:* Get medical aid. Do not contaminate yourself. Wearing the appropriate PPE equipment and respirator for carbamate pesticides, immediately remove the victim from the contaminated area to fresh air. If the victim is not breathing, administer artificial respiration. Do not use mouth-to-mouth method if victim ingested or inhaled the substance; give artificial respiration with the aid of a pocket mask equipped with a one-way valve or other proper respiratory medical device. If breathing is difficult, administer oxygen through bag/mask apparatus until medical help arrives. Do not leave victim unattended. *Note to physician or authorized medical personnel.* Administer atropine, 2 mg (1/30 gr) intramuscularly or intravenously as soon as any local or systemic signs or symptoms of an intoxication are noted; repeat the administration of atropine every 3 to 8 minutes until signs of atropinization (mydriasis, dry mouth, rapid pulse, hot and dry skin) occur; initiate treatment in children with 0.05 mg/kg of atropine; repeat at 5 to 10 minute intervals. Watch respiration, and remove bronchial secretions if they appear to be obstructing the airway; intubate if necessary. *Medical note:* 2-PAMCI may be contraindicated in the case of some carbamate poisonings.

Personal Protective Methods: Wear protective gloves and clothing to prevent any reasonable probability of dermal contact. Safety equipment suppliers/manufacturers can provide recommendations on the most protective glove/clothing material for your operation. DuPont™ Tychem® suit fabrics[88]. All protective clothing (suits, gloves, footwear, headgear) should be clean, available each day, and put on before work. Contact lenses should not be worn when working with this chemical. Wear dust-proof chemical goggles and face shield unless full facepiece respiratory protection is worn. Employees should wash immediately with soap when skin is wet or contaminated. Provide emergency showers and eyewash.

Respirator Selection: *At concentrations above the NIOSH REL, or where there is no REL, at any detectable concentration:* SCBAF:Pd,Pp (APF = 10,000): (any self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode); or SaF:Pd,Pp:ASCBA (APF = 10,000) (any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary self-contained positive-pressure breathing apparatus). *Escape*: GmFOv100 (APF = 50) [any air-purifying, full facepiece respirator (gas mask) with a chin-style, front- or back-mounted organic vapor canister having an N100, R100, or P100 filter]; or SCBAE (any appropriate escape-type, self-contained breathing apparatus).

Storage: Color Code-Blue: Health Hazard/Poison. Store in a secure poison location. Prior to working with this chemical you should be trained on its proper handling and storage. Store in tightly closed containers in a cool, well-ventilated area away from strong alkalis (such as sodium hydroxide, sodium bicarbonate, etc.).

Shipping: The solid toxic carbamate should be labeled "poisonous materials." It falls into Hazard Class 9.

Spill Handling: For solids, isolate spill or leak area in all directions for at least 25 meters/75 feet. Increase, in the downwind direction, as necessary. For liquids, isolate spill or leak area in all directions for at least 50 meters/150 feet. Increase, in the downwind direction, as necessary. Do not touch damaged containers or spilled material unless wearing appropriate protective clothing. Stop leak if you can do it without risk. Prevent entry into waterways, sewers, basements or confined areas. Cover with plastic sheet to prevent spreading. Absorb or cover with dry earth, sand or other non-combustible material and transfer to containers. Do not allow water to get inside containers.

Fire Extinguishing: Decomposition products include oxides of nitrogen and carbon and hydrogen chloride gas. *On a small fire:* use dry chemical powder, carbon dioxide, water spray, or foam. *On a large fire:* use water spray, fog or alcohol-resistant foam. Do not scatter material using straight water jet streams. Dike fire-control water for later disposal; do not scatter the material. Move containers from fire area if you can do it without risk. *Fire involving storage or vehicular tanks:* isolate for 800 meters/0.5 mile in all directions; also, consider initial evacuation for 800 meters/0.5 mile in all directions. Fight fire from maximum distance or use unmanned hose holders or monitor nozzles. Do not allow water to get inside containers. Cool containers with flooding quantities of water until well after fire is out. Withdraw immediately in the case of rising sound from venting safety devices or discoloration of tank. *Always* stay away from tanks engulfed in fire. For massive fire, use unmanned hose holders or monitor nozzles; if this is impossible, withdraw from area and let fire burn.

Disposal Method Suggested: Do not discharge into drains or sewers. Dispose of waste material as hazardous waste using a licensed disposal contractor to an approved landfill. Consult with environmental regulatory agencies for guidance on acceptable disposal practices. Incineration with effluent gas scrubbing is recommended. Containers must be disposed of properly by following package label directions or by contacting your local or federal environmental control agency, or by contacting your regional EPA office.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- U.S. Environmental Protection Agency, "Reregistration Eligibility Decision (RED), Chlorpropham", Office of Prevention, Pesticides and Toxic Substances, Washington DC (October 1996). http://www.epa.gov/REDs/0271red.pdf
- EXTOXNET, Extension Toxicology Network, "Pesticide Information Profile, Chlorpropham," Oregon State University, Corvallis, OR (June 1996). http://extoxnet.orst.edu/pips/choropro.htm

Chlorpyrifos C:1070

Use Type: Insecticide, Nematicide

CAS Number: 2921-88-2

Formula: $C_9H_{11}Cl_3NO_3PS$

Synonyms: α-Chlorpyrifos 48EC (α); *O,O*-Diethyl; ENT 27311; *O*-3,5,6-Trichloro-2-pyridylphosphorothioate; *O,O*-Dimethyl *O*-(3,5,6-trichloro-2-pyridinyl)phosphorothioate; Phosphorothioic acid, *O*. *O*-diethyl *O*-(3,5,6-trichloro-2-pyridinyl)ester; 2-Pyridinol, 3,5,6-trichloro-,*O*-ester with *O,O*-diethylphosphorothioate, **Dursban**™

Trade Names: (Note: EPA Office of Pesticide Programs lists 2135 products, both active and past-registered) ALUDOR®; BAR 500 EC®; BRODAN®; CHLORBAN®; CHLORPIRIFOS 480 CE MILENIA®; CHOIR®; COROBAN®; CURIGNA®; CYREN®; DETMOL U. A. ®; DORSAN®; DORSAN®-C; DOWCO® 179; DURSBAN®; EF 121®; EMPIRE®; ERADEX®; GLOBAL CRAWLING INSECT BAIT®; KENSBAN®; LORSBAN®; MURPHY SUPER ROOT GUARD®; PAQEANT®; PILOT®; PYRINEX®); SCOUT®; SPANNIT®; STIPEND; TALON®; TAFABAN®; TERIAL®; TWINSPAN®

Chemical class: Organophosphate

EPA/OPP PC Code: 059101

California DPR Chemical Code: 253

HSDB Number: 389

UN/NA & ERG Number: UN2783 (solid)/152; UN3018 (liquid)/152; UN2784 (flammable liquid

RTECS® Number: TF6300000

EC Number: 220-864-4 [*Annex I Index No.:* 015-084-00-4]

Uses: A U.S. EPA restricted Use Pesticide (RUP). Chlorpyrifos is one of the most widely used insecticides in the U.S., both around the home and in agriculture. A broad-spectrum insecticide, originally used primarily to kill mosquitoes but no longer registered for that use. Chlorpyrifos is effective in controlling cutworms, corn rootworms, cockroaches, grubs, flea beetles, flies, termites, fire ants, and lice. It is used as an insecticide on grain, cotton, field, fruit, nut and vegetable crops, as well as on lawns and ornamental plants. It is also registered for direct use on sheep and turkeys, for horse site treatment, dog kennels, domestic dwellings, farm buildings, storage bins, and commercial establishments. Chlorpyrifos acts on pests primarily as a contact poison, with some action as a stomach poison. It is available as granules, wettable powder, dustable powder and emulsifiable concentrate. Top crop uses in California include cotton, alfalfa, almonds, and oranges.

U.S. Maximum Allowable Residue Levels for Chlorpyrifos [40 CFR 180.342(a)(1)]: almond 0.2 ppm; almond, hulls 12.0 ppm; apple 1.5 ppm; bean, lima 0.05 ppm; bean, snap, succulent 0.05 ppm; beet, sugar, molasses 15.0 ppm; beet, sugar, dried pulp 5.0 ppm; beet, sugar, roots 1.0 ppm; beet, sugar, tops 8.0 ppm; blueberry 2 ppm (of which not > 1 ppm is chlorpyrifos); citrus, dried pulp 5.0 ppm; citrus, oil 25.0 ppm; corn, field, refined oil 3.0 ppm; corn, sweet, kernel plus cob with husks removed 0.1 ppm; cranberry 1.0 ppm; fruit, citrus 1.0 ppm; kiwifruit 2.0 ppm; nut, tree, group 14, 0.2 ppm; onion, dry buld 0.5 ppm; pepper 1.0 ppm; sorghum, forage 1.5 ppm; sorghum, grain, grain 0.75 ppm; sorghum, grain, stover 6.0 ppm; sunflower, seed 0.25 ppm; tomato 0.5 ppm; vegetable, brassica, leafy, group 5, 2.0 ppm; (of which not > 1.0 ppm; ppm is chlorpyrifos walnut 0.2. ***[40CFR 180.342(a)(2)]:*** alfalfa, forage 3 ppm; alfalfa, hay 13 ppm; banana 0.1 ppm; banana, pulp 0.01 ppm; broccoli 1 ppm; Brussels sprouts 1 ppm; cabbage 1 ppm; cabbage, chinese 1 ppm; cattle, fat 0.3 ppm; cattle, meat and meat byproducts 0.05 ppm; cauliflower 1 ppm; cherry 1 ppm; corn, field, grain 0.05 ppm; corn, forage and fodder 8 ppm; cotton, undelinted seed 0.2 ppm; cucumber 0.05 ppm; egg 0.01 ppm; Fig 0.01 ppm; goat, fat 0.2 ppm; goat, meat and meat byproducts 0.05 ppm; hog, fat 0.2 ppm; hog, meat and meat byproducts 0.05 ppm; horse, meat, fat, and meat byproducts 0.25 ppm; legume vegetables, succulent or dried (except soybean) 0.05 ppm; milk, fat 0.25 ppm; milk, whole 0.01 ppm; milling fractions (except flour) of wheat 1.5 ppm; mint, hay 0.8 ppm; mint oil 8 ppm; nectarine 0.05 ppm; peach 0.05 ppm; peanut oil 0.4 peanut 0.2 ppm; pear 0.05 ppm; plum 0.05 ppm; poultry, meat, fat, and meat byproducts (including turkeys) 0.1 ppm; pumpkin 0.05 ppm; radish 2 ppm; rutabagas 0.5 ppm; sheep, fat 0.2 ppm; sheep, meat and meat byproducts 0.05 ppm; soybean, forage 0.7 soybean, seed 0.3 ppm; strawberry 0.2 ppm; sweet potato, roots 0.05 ppm; turnip, greens 0.3 ppm; turnip 1 ppm; wheat, grain 0.5 ppm;

wheat, straw 6 wheat, forage 3 ppm. ***[40CFR 180.342(a)(3)]*** chlorpyrifos may be safely used in accordance with the following prescribed conditions. (i) Application shall be limited solely to spot and/or crack and crevice treatment in food handling establishments where food and food products are held, processed, prepared or served. Contamination of food or food contact surfaces shall be avoided. Food must be removed or covered during treatment. (ii) Spray concentration for spot treatment shall be limited to a maximum of 0.5 percent of the active ingredient by weight. A coarse, low-pressure spray shall be used to avoid atomization or splashing of the spray. (iii) Paint-on application for spot treatment shall be limited to a maximum of 2 percent of the active ingredient by weight. (iv) Crack and crevice treatment shall be limited to a maximum of 2 percent of the active ingredient by weight. Equipment capable of delivering a pin-stream of insecticide shall be used. (v) Application via adhesive strips shall contain a maximum of 10% by weight of the controlled-release product in food-handling establishments where food and food products are held, processed, prepared, or served. A maximum of 36 strips (or 5.15 grams of chlorpyrifos) is to be used per 100 square feet of floor space. the strips are not to be placed in exposed areas where direct contact with food, utensils, and food-contact surfaces would be likely to occur. (vi) To ensure safe use of the insecticide, its label and labeling shall conform to that registered by the U.S. Environmental Protection Agency, and it shall be used in accordance with such label and labeling. ***[40CFR 180.342(a)(4)]:*** A tolerance of 0.1 ppm is established for residues of chlorpyrifos *per se*, in or on food commodities (other than those already covered by a higher tolerance as a result of use on growing crops) in food service establishments where food and food products are prepared and served, as a result of the application of chlorpyrifos in microencapsulated form. (i) Application of a microencapsulated product shall be limited solely to spot and/or crack and crevice treatment in food handling establishments where food and food products are prepared and served. All treatments shall be applied in such a manner as to avoid contamination of food or food contact surfaces. (ii) Spray concentrations shall be limited to a maximum of 0.5 percent of the active ingredient by weight. (iii) For crack and crevice treatment, equipment capable of delivering a pin stream of spray directly into cracks and crevices or capable of applying small amounts of insecticide into cracks and crevices shall be used. (iv) For spot treatment, an individual spot shall not exceed 2 square feet. (v) To ensure safe use of the insecticide, its label and labeling shall conform to that registered by the U.S. Environmental Protection Agency, and it shall be used in accordance with such label and labeling.

Human toxicity (long-term)[101]: Intermediate–20.00 ppb, Health Advisory

Fish toxicity (threshold)[101]: Extra high–0.36660 ppb, MATC (Maximum Acceptable Toxicant Concentration)

Regulatory Authority and Advisory Information: Carcinogenicity: U.S. EPA Group E, evidence of non-carcinogenicity for humans.Acute Oral Category: 2, WARNING

Health Advisory: Nerve Toxin, Mutagen, Developmental/Reproductive Toxin, Endocrine disruptor (S!)

Clean Water Act: Section 311 Hazardous Substances/RQ 40CFR117.3 (same as CERCLA, see below)

Reportable Quantity (RQ): 1 lb (0.454 kg)

US DOT Regulated Marine Pollutant (49CFR172.101, appendix B), severe pollutant

US DOT 49CFR172.101, Inhalation Hazardous Chemical as organophosphates. European/International Regulations: Hazard Symbol: T, N; risk phrases: R24/25; R50/53; safety phrases: S1/2; S45; S60; S61 (see Appendix 1)

WGK (German Aquatic Hazard Class): 3-Severe hazard to waters

Description: Chlorpyrifos is a colorless crystalline compound (liquid @ 43 °C). Commercial formulations may be combined with combustible liquids. It has a mild mercaptan odor (like sulfur); the odor is also described as like natural gas. Molecular weight = 350.59; Specific gravity (H_2O:1) = 1.40 (liquid @ 43 °C); Boiling point = (decomposes) 160 °C; Freezing/Melting point = 42.2 °C; Vapor pressure = 0.00003 mmHg @ 25 °C. Practically insoluble in water. Physical and toxicological properties may be affected by the carrier solvents used in commercial formulations.

Incompatibilities: Above 130 °C this chemical may undergo violent exothermic decomposition. The substance decomposes on heating at approximately 160 °C and on burning, producing toxic and corrosive fumes including hydrogen chloride, nitrogen oxides, phosphorus oxides, sulfur oxides. Reacts with strong acids, strong bases, causing hydrolysis. Attacks copper and brass.

Permissible Exposure Limits in Air: OSHA PEL: None

NIOSH REL: 0.2 mg/m^3 TWA; 0.6 mg/m^3 STEL

ACGIH TLV®[1]: 0.1 mg/m^3 TWA inhalable fraction and vapor [skin]; not classifiable as a human carcinogen; BEI issued. (2000)

Protective Action Criteria (PAC) Ver. 27[89]

PAC-1: 0.6 mg/m^3
PAC-2: 11 mg/m^3
PAC-3: 8.8 mg/m^3

Determination in Air: OSHA versatile sampler-2; Toluene/Acetone; Gas chromatography/Flame photometric detection for sulfur, nitrogen, or phosphorus; NIOSH IV Method #5600, Organophosphorus pesticides[18].

Permissible Concentration in Water: Federal Drinking Water Guidelines: 10 ppb[14].

Determination in Water: EAD Method 1657. The determination of organophosphorus pesticides in municipal and industrial wastewater by gas chromatography. Detection limit = 6.0 ng/L.

Routes of Entry: Skin absorption, inhalation of dust, ingestion.

Harmful Effects and Symptoms

Organophosphates are highly toxic. Symptoms may develop rapidly, or there may be a delay of several hours following exposure before they become noticeable. The delay tends to be longer in the case of some compounds that dissolve fats, lipids, oils and non-polar solvents such as toluene. Symptoms may increase in severity for more than a single day and last for several days. In severe cases of of organophosphate intoxication, respiratory failure may occur.

Short Term Exposure: May cause eye and skin irritation. Acetylcholinesterase inhibitor. Exposure at high levels may result in death. The effects may be delayed. Chlorpyrifos can affect you when breathed in and quickly enters the body by passing through the skin. Severe poisoning can occur from dermal contact. It is a moderately toxic organophosphate chemical. Exposure can cause rapid severe poisoning with headache, sweating, nausea and vomiting, diarrhea, loss of coordination, and death. Delayed pulmonary edema may occur after inhalation. LD_{50} (oral, rat) = 95–270 mg/kg[83,USDA]; LD_{50} (dermal, rat) = >2 g/kg[83].

Long Term Exposure: Cholinesterase inhibitor; cumulative effect is possible. A neurotoxin; chlorpyrifos may damage the nervous system with repeated exposure, resulting in convulsions, respiratory failure. May cause liver damage. Some studies, findings support the hypothesis that organophosphates, including chlorpyrifos and its metabolites, may contribute to ADHD and learning disabilities in children.

Points of Attack: Respiratory system, central nervous system, peripheral nervous system, plasma cholinesterase.

Medical Surveillance: Medical observation is recommended for 24 to 48 hours after breathing overexposure, as pulmonary edema may be delayed. Routine biological monitoring of pesticide applicators and field workers includes testing of plasma and red blood cell acetylcholinesterase levels (for enzyme poisoned by this chemical). These tests are normally accurate only if done within about two hours of exposure. If exposure stops, plasma levels return to normal in 1–2 weeks while red blood cell levels may be reduced for 1–3 months. When acetylcholinesterase enzyme levels are reduced by 25% or more below preemployment levels, risk of poisoning is increased, even if results are in lower ranges of "normal." Reassignment to work not involving organophosphate pesticides is recommended until enzyme levels recover. Do not drink any alcoholic beverages before or during use as it promotes absorption of organophosphates.

First Aid: **Treatment for organophosphate poisoning consists of thorough decontamination, cardiorespiratory support, and administration of the antidotes atropine and pralidoxime. In cases of severe poisoning, diazepam, an anticonvulsant, should also be administered. Antidotes should be administered as prevention even if the diagnosis is in doubt**. Speed in removing material from eyes and skin is of extreme importance. *Eyes:* Eye contact can cause dangerous amounts of these chemicals to be quickly absorbed through the mucous membrane into the bloodstream. Immediately and gently flush eyes with plenty of warm or cold water (NO hot water) for at least 15 minutes, occasionally lifting the upper and lower eyelids. Get medical aid immediately. *Skin:* Get medical aid. Dermal contact can cause dangerous amounts of these chemicals to be absorbed into the bloodstream. Wearing the appropriate PPE equipment and respirator for organophosphate/carbamate pesticides, immediately flush skin with plenty of soap and water for at least 15 minutes while removing contaminated clothing and shoes. Shampoo hair promptly if contaminated. The removed, contaminated clothing and shoes should be double-bagged and left in Hot Zone for later disposal by hazardous materials experts. Skin may also be decontaminated with diluted hypochlorite solution. *Inhalation:* Get medical aid. Do not contaminate yourself. Wearing the appropriate PPE equipment and respirator for organophosphate pesticides, immediately remove the victim from the contaminated area to fresh air. If the victim is not breathing, administer artificial respiration. Do not use mouth-to-mouth method if victim ingested or inhaled the substance; give artificial respiration with the aid of a pocket mask equipped with a one-way valve or other proper respiratory medical device. If breathing is difficult, administer oxygen through bag/mask apparatus until medical help arrives. Do not leave victim unattended. *Ingestion:* Call poison control. Loosen all clothing. Never give anything by mouth to an unconscious person. If victim is *unconscious or having convulsions,* do nothing except keep victim warm. Get medical aid. Transfer promptly to a medical facility. In cases of ingestion, **do not induce vomiting**. If the victim is alert and asymptomatic, administer a slurry of activated charcoal at a dose of 1 g/kg (infant, child, and adult dose). A soda can and straw may be of assistance when offering charcoal to a child. *In some cases you may be specifically instructed by poison control to induce vomiting by way of 2 tablespoons of syrup of ipecac (adult) washed down with a cup of water*. Do NOT give activated charcoal before or with ipecac syrup

Note to physician or authorized medical personnel: Treat cases of respiratory compromise, coma, or excessive pulmonary secretions with respiratory support using protocols and techniques available and within the scope of training. Some cases may necessitate procedures such as endotracheal intubation or cricothyrotomy by properly trained and equipped personnel. When possible, atropine (see *Antidotes*, below) should be given under medical supervision. Patients who are comatose, hypotensive, or having seizures or cardiac arrhythmias should be treated according to advanced life support protocols. *Antidotes:* Two antidotes are administered to treat organophosphate poisoning. Atropine is a competitive antagonist of acetylcholine at muscarinic receptors and is used to control the excessive bronchial secretions which are often responsible for death. Pralidoxime relieves both the nicotinic and muscarine effects of organophosphate poisoning by regenerating acetylcholinesterase and can reduce both the bronchial secretions and the muscle weakness associated with poisoning. The initial intravenous dose of atropine in adults should be determined by the severity of symptoms: An initial adult dose of 1.0 to 2.0 mg or pediatric dose of 0.01 mg/kg (minimum 0.01 mg) should be administered intravenously. If intravenous access cannot be established, atropine may also be given intramuscularly, subcutaneously or via endotracheal tube. Doses should be repeated every 15 minutes until excessive secretions and sweating have been controlled. Once bronchial secretion has been controlled, atropine administration should be repeated whenever the secretions begin to recur. In seriously poisoned patients, very large doses may be required. Alterations of pulse rate and pupillary size should not be used as indicators of treatment adequacy. Pralidoxime should be administered as early in poisoning as possible as its efficacy may diminish when given more than 24 to 36 hours after exposure. Doses are as follows: adult 1.0 g; pediatric 25 to 50 mg/kg. The drug should be administered intravenously over 30 to 60 minutes, but in a life-threatening situation one-half of the total dose can be given per minute for a total administration time of 2 minutes. Treatment should begin to take effect within 40 minutes with a reduction in symptoms and the amount of atropine necessary to control bronchial secretion. The initial dose can be repeated in 1 hour and then every 8 to 12 hours until the patient is clinically well and no longer requires atropine. If intravenous access cannot be established, pralidoxime may also be given intramuscularly. Early administration of diazepam in addition to the combined atropine and pralidoxime treatment may help prevent the onset of seizures and potential brain and cardiac morphologic damage following high-level organophosphate poisoning.

Personal Protective Methods: *Clothing:* Avoid dermal contact with chlorpyrifos. Wear protective gloves and clothing. Safety equipment suppliers/manufacturers can provide recommendations on the most protective glove/clothing material for your operation. All protective clothing (suits, gloves, footwear, headgear) should be clean, available each day, and put on before work. *Eye Protection:* Wear splash-proof chemical goggles and face shield when working with liquid, unless full facepiece respiratory protection is worn. Wear dust-proof goggles and face shield when working with powders or dust, unless full facepiece respiratory protection is worn.

Respirator Selection: SCBA >0.6 mg/m^3. Where there is potential exists for exposures over *0.2 mg/m*^{3}, use a NIOSH/MSHA- or European Standard EN149-approved full facepiece respirator with a pesticide cartridge. Greater protection is provided by a powered air-purifying respirator. *Where potential for high exposures exists*, use a NIOSH/MSHA- or European Standard EN149-approved supplied-air respirator with a full facepiece operated in the positive-pressure mode, or with a full facepiece, hood, or helmet in the continuous-flow mode; or use a NIOSH/MSHA- or European Standard EN149-approved self-contained breathing apparatus with a full facepiece, hood, or helmet in the continuous-flow mode; or use a NIOSH/MSHA- or European Standard EN149-approved self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive-pressure mode.

Storage: Color Code-Blue: Health Hazard/Poison. Store in a secure poison location. Prior to working with chlorpyrifos you should be trained on its proper handling and storage. Chlorpyrifos must be stored to avoid contact with strong bases, or acids, or acid fumes, since violent reactions occur. Store in tightly closed containers in a cool, well-ventilated area away from sources of heat.

Shipping: Organophosphorus pesticides, solid or liquid (nonflammable), require a "poisonous materials" label. This chemical falls in Hazard Class 6.1.

Spill Handling: First remove all sources of ignition. Evacuate persons not wearing protective equipment from area of spill or leak until clean up is complete. Remove all ignition sources. Collect powdered material in the most convenient and safe manner and deposit in sealed containers. Ventilate area after clean up is complete. Absorb liquid containing chlorpyrifos in vermiculite, dry sand, earth, or similar material. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable. Soil Adsorption Index (K_{oc}) = 6070.

Fire Extinguishing: Poisonous and corrosive gases are produced in fire including hydrogen chloride and oxides of phosphorus, sulfur, and nitrogen. This chemical may burn, but does not readily ignite. Use dry chemical, carbon dioxide; water spray; or standard foam extinguishers. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies. Heat above 130 °C may cause violent exothermic reaction. Containers may explode in fire. From a secure, explosion-proof location, use water spray to cool exposed containers. If cooling streams are ineffective (venting sound increases in volume and pitch, tank discolors, or shows any signs of deforming), withdraw immediately to a secure position. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode.

Disposal Method Suggested: This compound is 50% hydrolyzed in aqueous methanol solution @ pH 6 in 1930 days, and in 7.2 days at pH 9.96. Spray mixtures of <1% concentration are destroyed with an excess of 5.25% sodium hypochlorite in <30 minutes @ 100 °C, and in 24 hours @ 30 °C. Concentrated (61.5%) mixtures are essentially destroyed by treatment with 100:1 volumes of the above sodium hypochlorite solution and steam in 10 minutes. Containers must be disposed of properly by following package label directions or by contacting your local or federal environmental control agency, or by contacting your regional EPA office.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov

- EXTOXNET, Extension Toxicology Network, “Pesticide Information Profile, Chlorpyrifos,” Oregon State University, Corvallis, OR (June 1996). http://ace.orst.edu/info/extoxnet/pips/chlorpyr
- USEPA, Office of Pesticide Programs, Pesticide Residue Limits, “Chlorpyrifos”, 40 CFR 180.342. http://www.epa.gov/cgi-bin/oppsrch
- USEPA, Office of Prevention, Pesticides and Toxic Substances, “Chlorpyrifos Revised Risk Assessment and Agreement with Registrants” (June 2000). http://www.epa.gov/pesticides/op/chlorpyrifos/agreement.pdf
- New Jersey Department of Health and Senior Services and Senior Services, “Hazardous Substance Fact Sheet: Chlorpyrifos,” Trenton, NJ (July 1996, rev. July 2002). http://www.state.nj.us/health/eoh/rtkweb/0426.pdf
- Agency for Toxic Substances and Disease Registry, U. S. Department of Health and Human Services, Public Health Service, “Managing Hazardous Materials Incidents,” Atlanta, GA (June 2003)
- U.S. Department of the Interior, Fish and Wildlife Service. *Handbook of Toxicity of Pesticides to Wildlife. Resource,* Publication 153, p. 23. Washington DC (1984)
- Christensen, K.; Harper, B.; Luukinen, B.; Buhl, K.; Stone, D. 2009. *Chlorpyrifos Technical Fact Sheet*; National Pesticide Information Center, Oregon State University Extension Services, Corvallis OR (2009)

Chlorpyrifos-methyl C:1073

Use Type: Insecticide
CAS Number: 5598-13-0
Formula: $C_7H_7Cl_3NO_3PS$
Synonyms: Clorpirifos metil (Spanish); Chlormethylfos; *O,O*-Dimethyl O-(3,5,6-trichloro-2-pyridyl)phosophorothioate; Dursban methyl; ENT 27,520; Methyl chlorpyrifos; Methyl dursban; NSC-60380; OMS 1155; Phosphorothioic acid, *O,O*-dimethyl O-(3,5,6-trichloro-2-pyridyl)ester; Trichlormethylfos
Trade Names: DOWCO-217®; NOLTRAN®; RELDAN®; RELDANE®, STORCIDE®; ZERTELL®
Chemical class: Organophosphate
EPA/OPP PC Code: 059102
California DPR Chemical Code: 2468
HSDB Number: 6981
UN/NA & ERG Number: UN2783 (solid)/152; UN3018 (liquid)/152; UN3077 (solid)/171
RTECS® Number: TG0700000
EC Number: 227-011-5 [*Annex I Index No.:* 015-186-00-9]
Uses: Chlorpyrifos-methyl is used on stored grain (for protection of stored food, feed oil, and seed grains against injury from stored grain weevils, moths, borers, beetles and mealworms including granary weevil, rice weevil, red flour beetle, confused flour beetle, saw-toothed grain beetle, Indian meal moth, and Angoumois grain moth, lessor grain borers), seed treatment, grain bin and warehouse.[14] In 2000, the registrants of chlorpyrifos-methyl requested voluntary cancellation of their products rather than committing to develop additional data for reregistration
Human toxicity (long-term)[101]: Low–70.00 ppb, Health Advisory.
U.S. Maximum Allowable Residue Levels for Chlorpyrifos-methy (40 CFR 180.275): barley, grain 6.0 ppm; cattle, fat 0.5 ppm; cattle, meat 0.5 ppm; cattle, meat byproducts 0.5 ppm; eggs 0.1 ppm; goats, fat 0.5 ppm; goats, meat 0.5 ppm; goats, meat byproducts 0.5 ppm; hogs, fat 0.5 ppm; hogs, meat 0.5 ppm; hogs, meat products 0.5 ppm; horses, fat 0.5 ppm; horses, meat 0.5 ppm; horses, meat products 0.5 ppm; milk, fat (0.05 ppm (N) in whole milk) 1.25 ppm; oats, grain 6.0 ppm; poultry, fat 0.5 ppm; poultry, meat 0.5 ppm; poultry, meat byproducts 0.5 ppm; rice, grain 6.0 ppm; sheep, fat 0.5 ppm; sheep, meat 0.5 ppm; sheep, meat byproducts 0.5 ppm; sorghum, grain 6.0 ppm; wheat, grain 6.0 ppm; stored grains, including barley milling fractions (except flour) 90 ppm; oats milling fractions (except flour) 130 ppm; rice milling fractions (except flour) 30 ppm; sorghum milling fractions (except flour) 90 ppm; and wheat milling fractions (except flour) 30 ppm.
Fish toxicity (threshold)[101]: High–1.02425 ppb, MATC (Maximum Acceptable Toxicant Concentration)
Regulatory Authority and Advisory Information:
NIOSH Category: Nerve Toxin, Skin irritant/sensitizer
Acute Oral Category: 3, CAUTION
U.S. DOT 49CFR172.101, Inhalation Hazard Chemical as organophosphates
EPCRA Section 313 Form R *de minimis* concentration reporting level: 1.0%
European/International Regulations: Hazard Symbol: Xi, N; risk phrases: R43; R50/53; safety phrases: S2; S36/37; S60; S61 (see Appendix 1)
WGK (German Aquatic Hazard Class): 3-Severe hazard to waters *as Chlorpyrifos*
Description: White or amber chrystalline solid. May be dissolved in a flammable or combustible carrier solvent. Molecular weight = 327.5; Specific gravity (H_2O:1) = 1.64; Freezing/Melting point = 46 °C; Vapor pressure = 4.2×10^{-5} mmHg @ 25 °C; Specific gravity (H_2O:1) = 1.39 @ 50 °C. Low solubility in water; solubility = 5 mg/L. Physical and toxicological properties may be affected by the carrier solvents used in commercial formulations.
Incompatibilities: Strong oxidizers, strong acids and alkalies. In the presence of strong reducing agents such as hydrides, organophosphates form highly toxic and flammable phosphine gas. Contact with oxidizers can cause the release of toxic oxides of phosphorus. Corrosive to copper, brass, iron, and tin plate[88].
Permissible Exposure Limits in Air: No standards established.
Determination in Air: OSHA versatile sampler-2; Toluene/Acetone; Gas chromatography/Flame ionization detection; NIOSH IV, Method #5600, Organophosphorus Pesticides[18].
Determination in Water: Log K_{ow} = >4.0. Values above 3.0 are likely to bioaccumulate in aquatic organisms.

Harmful Effects and Symptoms

Organophosphates are highly toxic. Symptoms may develop rapidly, or there may be a delay of several hours following exposure before they become noticeable. The delay tends to be longer in the case of some compounds that dissolve fats, lipids, oils and non-polar solvents such as toluene. Symptoms may increase in severity for more than a single day and last for several days. In severe cases of of organophosphate intoxication, respiratory failure may occur.

Short Term Exposure: Eye pupils are small; blurred vision; eye watering; runny nose; cough; shortness of breath; salivation; dizziness; nausea, stomach cramps, diarrhea, and vomiting; increased blood pressure; profuse sweating; hypermotility, hallucinations; irritability; tingling of the skin; drowsiness; slow heartbeat; convulsions; fluid in lungs; loss of consciousness; incontinence; breathing stops; death. Organophosphates inhibit the action of acetylcholinesterase enzymes, and alter the way in which nervous impulses are transmitted. The effects can last for hours, days, or much longer. The action of the enzymes is reestablished after new enzymes are formed. LD_{50} (oral, rat) = 1500–18508 mg/kg; LD_{50} (dermal, rat) = >3500 mg/kg.

Long Term Exposure: Cholinesterase inhibitor; cumulative effect is possible. Organophosphates may damage the nervous system with repeated exposure, resulting in convulsions, respiratory failure. May cause liver, cardiovascular and blood damage. Skin sensitizer. Some studies' findings support the hypothesis that organophosphates, including chlorpyrifos and its metabolites, may contribute to ADHD and learning disabilities in children.

Points of Attack: Skin. Respiratory system, central nervous system, cardiovascular system, blood cholinesterase.

Medical Surveillance: Medical observation is recommended for 24 to 48 hours after breathing overexposure, as pulmonary edema may be delayed. Cigarette smoking may exacerbate pulmonary injury and should be discouraged for at least 72 hours following exposure. Routine biological monitoring of pesticide applicators and field workers includes testing of plasma and red blood cell acetylcholinesterase levels (for enzyme poisoned by this chemical). These tests are normally accurate only if done within about two hours of exposure. If exposure stops, plasma levels return to normal in 1–2 weeks while red blood cell levels may be reduced for 1–3 months. When acetylcholinesterase enzyme levels are reduced by 25% or more below preemployment levels, risk of poisoning is increased, even if results are in lower ranges of "normal." Reassignment to work not involving organophosphate pesticides is recommended until enzyme levels recover. Do not drink any alcoholic beverages before or during use as it promotes absorption of organophosphates. Evaluation by a qualified allergist, including exposure history and testing, may help diagnose allergy.

First Aid: **Treatment for organophosphate poisoning consists of thorough decontamination, cardiorespiratory support, and administration of the antidotes atropine and pralidoxime. In cases of severe poisoning, diazepam, an anticonvulsant, should also be administered. Antidotes should be administered as prevention even if the diagnosis is in doubt**. Speed in removing material from eyes and skin is of extreme importance. *Eyes:* Eye contact can cause dangerous amounts of these chemicals to be quickly absorbed through the mucous membrane into the bloodstream. Immediately and gently flush eyes with plenty of warm or cold water (NO hot water) for at least 15 minutes, occasionally lifting the upper and lower eyelids. Get medical aid immediately. *Skin:* Get medical aid. Dermal contact can cause dangerous amounts of these chemicals to be absorbed into the bloodstream. Wearing the appropriate PPE equipment and respirator for organophosphate/carbamate pesticides, immediately flush skin with plenty of soap and water for at least 15 minutes while removing contaminated clothing and shoes. Shampoo hair promptly if contaminated. The removed, contaminated clothing and shoes should be double-bagged and left in Hot Zone for later disposal by hazardous materials experts. Skin may also be decontaminated with diluted hypochlorite solution. *Inhalation:* Get medical aid. Do not contaminate yourself. Wearing the appropriate PPE equipment and respirator for organophosphate pesticides, immediately remove the victim from the contaminated area to fresh air. If the victim is not breathing, administer artificial respiration. Do not use mouth-to-mouth method if victim ingested or inhaled the substance; give artificial respiration with the aid of a pocket mask equipped with a one-way valve or other proper respiratory medical device. If breathing is difficult, administer oxygen through bag/mask apparatus until medical help arrives. Do not leave victim unattended. *Ingestion:* Call poison control. Loosen all clothing. Never give anything by mouth to an unconscious person. If victim is *unconscious or having convulsions,* do nothing except keep victim warm. Get medical aid. Transfer promptly to a medical facility. In cases of ingestion, **do not induce vomiting**. If the victim is alert and asymptomatic, administer a slurry of activated charcoal at a dose of 1 g/kg (infant, child, and adult dose). A soda can and straw may be of assistance when offering charcoal to a child. *In some cases you may be specifically instructed by poison control to induce vomiting by way of 2 tablespoons of syrup of ipecac (adult) washed down with a cup of water*. Do NOT give activated charcoal before or with ipecac syrup

Note to physician or authorized medical personnel: Treat cases of respiratory compromise, coma, or excessive pulmonary secretions with respiratory support using protocols and techniques available and within the scope of training. Some cases may necessitate procedures such as endotracheal intubation or cricothyrotomy by properly trained and equipped personnel. When possible, atropine (see *Antidotes*, below) should be given under medical supervision. Patients who are comatose, hypotensive, or having seizures or cardiac arrhythmias should be treated according to advanced life support protocols. *Antidotes:* Two antidotes are administered to treat organophosphate poisoning. Atropine is a competitive antagonist of acetylcholine at muscarinic receptors and is used to control the excessive bronchial secretions which are often responsible for death. Pralidoxime relieves both the nicotinic and muscarine effects of organophosphate poisoning by regenerating acetylcholinesterase and can reduce both the bronchial secretions and the muscle weakness associated with poisoning. The initial intravenous dose of atropine in adults should be determined by the severity of symptoms: An initial adult dose of 1.0 to 2.0 mg or pediatric dose of 0.01 mg/kg (minimum 0.01 mg) should be administered intravenously. If intravenous access cannot be established, atropine may also be given intramuscularly, subcutaneously or via endotracheal tube. Doses should be repeated every 15 minutes until excessive secretions and sweating have been controlled. Once bronchial secretion has been controlled, atropine administration should be repeated whenever the secretions begin to recur. In seriously poisoned patients, very large doses may be required. Alterations of pulse rate and pupillary size should not be used as indicators of treatment adequacy. Pralidoxime should be administered as early in poisoning as possible as its efficacy may diminish when given more than 24 to 36 hours after exposure. Doses are as follows: adult 1.0 g; pediatric 25 to 50 mg/kg. The drug should be administered intravenously over 30 to 60 minutes, but in a life-threatening situation one-half of the total dose can be given per minute for a total administration time of 2 minutes. Treatment should begin to take effect within 40 minutes with a reduction in symptoms and the amount of atropine necessary to control bronchial secretion. The initial dose can be repeated in 1 hour and then every 8 to 12 hours until the patient is clinically well and no longer requires atropine. If intravenous access cannot be established, pralidoxime may also be given intramuscularly. Early administration of diazepam in addition to the combined atropine and pralidoxime treatment may help prevent the onset of seizures and potential brain and cardiac morphologic damage following high-level organophosphate poisoning.

Personal Protective Methods: *Clothing:* Avoid dermal contact with chlorpyrifos. Wear protective gloves and clothing. Safety equipment suppliers/manufacturers can provide recommendations on the most protective glove/clothing material for your operation. All protective clothing (suits, gloves, footwear, headgear) should be clean, available each day, and put on before work. *Eye Protection:* Wear splash-proof chemical goggles and face shield when working with liquid, unless full facepiece respiratory protection is worn. Wear dust-proof goggles and face shield when working with powders or dust, unless full facepiece respiratory protection is worn.

Respirator Selection: Where potential exists for exposures over *0.2 mg/m*^{3}, use a NIOSH/MSHA- or European Standard EN149-approved full facepiece respirator with a pesticide cartridge. Greater protection is provided by a powered air-purifying respirator. *Where potential for high exposures exists*, use a NIOSH/MSHA- or European Standard EN149-approved supplied-air respirator with a full facepiece operated in the positive-pressure mode, or with a full facepiece, hood, or helmet in the continuous-flow mode; or use a NIOSH/MSHA- or European Standard EN149-approved self-contained breathing apparatus with a full facepiece, hood, or helmet in the continuous-flow mode; or use a NIOSH/MSHA- or European Standard EN149-approved self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive-pressure mode.

Storage: Color Code-Blue: Health Hazard/Poison. Store in a secure poison location. Prior to working with chlorpyrifos you should be trained on its proper handling and storage. Chlorpyrifos must be stored to avoid contact with strong bases, or acids, or acid fumes, since violent reactions occur. Store in tightly closed containers in a cool, well-ventilated area away from sources of heat.

Shipping: Organophosphorus pesticides, solid or liquid (nonflammable), require a "poisonous materials" label. This chemical falls in Hazard Class 6.1.

Spill Handling: First remove all sources of ignition. Evacuate persons not wearing protective equipment from area of spill or leak until clean up is complete. Remove all ignition sources. Collect powdered material in the most convenient and safe manner and deposit in sealed containers. Ventilate area after clean up is complete. Absorb liquid containing chlorpyrifos in vermiculite, dry sand, earth, or similar material. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable. Soil Adsorption Index (K_{oc}) = 6070.

Fire Extinguishing: Poisonous and corrosive gases are produced in fire including hydrogen chloride and oxides of phosphorus, sulfur, and nitrogen. This chemical may burn, but does not readily ignite. Use dry chemical, carbon dioxide; water spray; or standard foam extinguishers. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies. Heat above 130 °C may cause violent exothermic reaction. Containers may explode in fire. From a secure, explosion-proof location, use water spray to cool exposed containers. If cooling streams are ineffective (venting sound increases in volume and pitch, tank discolors, or shows any signs of deforming), withdraw immediately to a secure position. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode.

Disposal Method Suggested: This compound is 50% hydrolyzed in aqueous methanol solution @ pH 6 in 1930 days, and in 7.2 days at pH 9.96. Spray mixtures of <1% concentration are destroyed with an excess of 5.25% sodium hypochlorite in <30 minutes @ 100 °C, and in 24 hours @ 30 °C. Concentrated (61.5%) mixtures are essentially destroyed by treatment with 100:1 volumes of the above sodium hypochlorite solution and steam in 10 minutes. Containers must be disposed of properly by following package label directions or by contacting your local or federal environmental control agency, or by contacting your regional EPA office.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- U.S. Environmental Protection Agency, "Reregistration Chlorpyrifos-methyl Facts," Office of Prevention, Pesticides and Toxic Substances, Washington DC (October 2000). http://www.epa.gov/REDs/factsheets/cpm_fs.htm

Chlorsulfuron C:1077

Use Type: Herbicide
CAS Number: 64902-72-3
Formula: $C_{12}H_{12}ClN_5O_4S$
Synonyms: 2-Chloro-*N*-[((4-methoxy-6-methyl-1,3,5-triazin-2-yl)amino)carbonyl]benzenesulfonamide; 2-Chloro-*N*-[(4-methoxy-6-methyl-1,3,5-triazin-2-yl)aminocarbonyl]-benzenesulfonamide; 1-[(O-Chlorophenyl) sulfonyl)-3-(4-methoxy-6-methyl-*S*-triazin-2-yl)urea; Benzenesulfonamide, 2-chloro-*N*-[((4-methoxy-6-methyl-1,3, 5-triazin-2-yl)amino)carbonyl]-; Urea, 1-[(ochlorophenyl)sulfonyl]-3-(4-methoxy-6-methyl-*S*-triazin-2-yl)-
Trade Names: DPX 4189®; FINESSE®; GLEAN®; GLEAN 20DF®; LANDMARK® MP; LASHER®; RIVERDALE CORSAIR®; TELAR® DF
Chemical class: Sulfonylurea
EPA/OPP PC Code: 118601
California DPR Chemical Code: 2143
HSDB Number: 6847
UN/NA & ERG Number: UN3077 (solid)/171
RTECS® Number: YS6640000
EC Number: 265-268-5 [*Annex I Index No.:* 613-121-00-4]
Uses: A selective systemic herbicide used to control most broadleaf weeds and some annual grasses in wheat, barley, oats, duram, rye, triticale and flax. Applied to non-crop sites such as rights-of-way, fence rows and roadsides.
U.S. Maximum Allowable Residue Levels for Chlorsulfuron and its metabolite, 2-chloro-5-hydroxy-N-[(4-methoxy-6-methyl-1,3,5-triazin-2-yl)aminocarbonyl]benzenesulfonamide [40 CFR 180.405(a)(1)]: in or on the following raw agricultural commodities: barley, grain 0.1 ppm; barley, straw 0.5 ppm; oat, forage 20.0 ppm; oat, grain 0.1 ppm; oat, straw 0.5 ppm; wheat, forage 20 ppm; wheat, grain 0.1 ppm; and wheat, straw 0.5 ppm. ***[40 CFR 180.405(a)(2)]:*** Tolerances are established for residues of chlorsulfuron in or on the following raw agricultural commodities: cattle, fat 0.3 ppm; cattle, meat 0.3 ppm; cattle, meat byproducts 0.3 ppm; goat, fat 0.3 ppm; goat, meat 0.3 ppm; goat, meat byproducts 0.3 ppm; grass, forage 11.0 ppm; grass, hay 19.0 ppm; hog, fat 0.3 ppm; hot, meat 0.3 ppm; hog, meat byproducts 0.3 ppm; horse, fat 0.3 ppm; horse, meat 0.3 ppm; horse, meat byproducts 0.3 ppm; milk 0.1 ppm; sheep, fat 0.3 ppm; sheep, meat 0.3 ppm; and sheep, meat byproducts 0.3 ppm.
Human toxicity (long-term)[101]: Very low–350.00 ppb, Health Advisory
Fish toxicity (threshold)[101]: Very low–45107.62902 ppb, MATC (Maximum Acceptable Toxicant Concentration)
Regulatory Authority and Advisory Information:
Carcinogenicity: EPA Group E, evidence of non-carcinogenicity for humans.
California Proposition 65 Chemical: Developmental, female, (5/14/1999); "male" delisted 2013
Health Advisory: Developmental toxin.
Acute Oral Category: 4, Caution
Potential Ground Water Pollutant [California FAC Section 13145(d)/12811, active]
EPCRA Section 313 Form R *de minimis* concentration reporting level: 1.0%
European/International Regulations: Hazard Symbol: N; risk phrases: R50/53; safety phrases: S60; S61 (see Appendix 1)
Description: Colorless, odorless crystals. Molecular weight = 357.79; Freezing/Melting point = 176 °C; decomposes @ 192 °C; Vapor pressure = 4.6×10^{-6} mmHg @ 20 °C. Soluble in water; solubility = 113 mg/L @ 25 °C.
Incompatibilities: Slowly hydrolyzes in water, releasing ammonia and forming acetate salts. When heated to decomposition, emits oxides of sulfur and nitrogen and chlorine fumes.
Permissible Exposure Limits in Air: Protective Action Criteria (PAC) Ver. 27[89]
PAC-1: 3.9 mg/m^3
PAC-2: 43 mg/m^3
PAC-3: 260 mg/m^3
Routes of Entry: Inhalation, dermal contact, ingestion
Harmful Effects and Symptoms: Human health effects from the sulfonylurea herbicides at low environmental doses or at biomonitored levels from low environmental exposures are unknown. The sulfonylurea herbicides are generally of low toxicity in mammalian studies. Animal studies showed low acute toxicity and little chronic, reproductive, or developmental toxicity or teratogenic effects. Developmental or teratogenic effects tended only to occur at high or maternally toxic doses. At high sublethal, chronic oral doses, such nonspecific effects as weight loss and anemia were observed. Some chemical-specific effects were noted at high doses in animals[96].
Short Term Exposure: May cause skin and eye irritation. Moderately poisonous if ingested or inhaled. LD_{50} (oral, rat) = >5000 mg/kg; LD_{50} (dermal, rabbit) = >3000 mg/kg.
Long Term Exposure: May cause developmental problems.
Medical Surveillance: Preliminary medical exam to detect chronic diseases of central nervous system, liver, heart, kidneys, lung and skin, as well as endocrinological or immunological disturbances, should protect susceptible individuals. Periodical medical exams of internal organs, skin and eyes are important to avoid chronic occupational intoxications.

They should include lab and patch tests when necessary[83]. In addition to comprehensive initial medical and work histories emphasizing reproductive experience and menstrual history, patient should have physical examination and testing of genito-urinary tract, sperm count, motility and morphology. If required, other tests, such as serum testosterone, serum follicle stimulating hormone (FSH), and serum lutenizing hormone (LH), may be indicated. Urinary levels of the sulfonylurea herbicides reflect recent exposure. The urinary metabolites dimethoxypyrimidine and dimethylpyrimidine can be used as nonspecific markers of exposure to the pyrimidinylsulfonylureas, a group that includes bensulfuron-methyl, halosulfuron, primisulfuron-methyl, and sulfosulfon. The urinary metabolite methoxymethyl triazine can be used as a nonspecific marker of exposure to the triazinylsulfonylureas, a group that includes chlorosulfuron, prosulfuron, and triasulfuron[96].

Routes of Entry: Inhalation, passing through the skin, ingestion.

Harmful Effects and Symptoms:

Short Term Exposure: Contact with eyes or skin may cause irritation or burns. Inhalation of dust should be avoided; use NIOSH- or CEN (UK)-approved air-purifying respirators for pesticides. Because this material has a low vapor pressure, significant inhalation of vapors is unlikely at ordinary temperatures. May be harmful if swallowed. Dermal contact may cause allergic reaction. LD_{50} (oral, rat) = >5 g/kg; LD_{50} (dermal, rabbit) = >3 g/kg.

Long Term Exposure: Repeated or prolonged contact may cause skin and lung sensitization, resulting in allergies.

Points of Attack: Skin

Medical Surveillance: Evaluation by a qualified allergist, including exposure history and testing, may help diagnose allergy.

First Aid: If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least 15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately. If this chemical contacts the skin, remove contaminated clothing and wash immediately with soap and water. Seek medical attention immediately. If this chemical has been inhaled, remove from exposure, begin rescue breathing (using universal precautions) if breathing has stopped, and CPR if heart action has stopped. Transfer promptly to a medical facility. When this chemical has been swallowed, get medical attention. Give large quantities of water and induce vomiting. Do not make an unconscious person vomit.

Personal Protective Methods: Wear protective gloves and clothing to prevent any reasonable probability of dermal contact. Safety equipment suppliers/manufacturers can provide recommendations on the most protective glove/clothing material for your operation. All protective clothing (suits, gloves, footwear, headgear) should be clean, available each day, and put on before work. Contact lenses should not be worn when working with this chemical. Wear dust-proof chemical goggles and face shield unless full facepiece respiratory protection is worn. Employees should wash immediately with soap when skin is wet or contaminated. Provide emergency showers and eyewash.

Respirator Selection: Wherever and whenever workplace conditions warrant respirator use, a respiratory protection program must be followed that meets one or more of the following requirements: OSHA's 29 CFR 1910.134, ANSI Z88.2, or European Standard EN 149.

Storage: Color Code-Blue: Health Hazard/Poison. Store in a secure poison location. Store in a refrigerator and protect from exposure to oxidizers or moisture[52]. A regulated, marked area should be established where this chemical is handled, used, or stored in compliance with OSHA Standard 1910.1045.

Shipping: Environmentally hazardous substances, solid or liquid, usually fall in Hazard Class 9.

Spill Handling: Evacuate and restrict persons not wearing protective equipment from area of spill or leak until clean up is complete. Remove all ignition sources. Dampen spilled material with alcohol to avoid dust. Collect powdered material in the most convenient and safe manner and deposit in sealed containers. Ventilate area of spill or leak after clean up is complete. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable.

Fire Extinguishing: Use dry chemical, carbon dioxide; water spray; or alcohol-resistant foam extinguishers. Hazardous decomposition includes sulfur oxides. Prevent water from entering containers. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode.

Disposal Method Suggested: It is the responsibility of chemical waste generators to determine the toxicity and physical properties and of a discarded chemical and to properly identify its classification and certification as a hazardous waste and to determine the disposal method. U.S. EPA guidelines for the classification determination are listed in 40 CFR Parts 261.3. Additionally, waste generators must consult and follow all regional, national, state and local hazardous waste laws to ensure complete and accurate classification and disposal methods. Recycle any unused portion of the material for its approved use or return it to the manufacturer or supplier. Ultimate disposal of the chemical must consider: the material's impact on air quality; potential migration in soil or water; effects on animal, aquatic, and plant life; and conformance with environmental and public health regulations[83].

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- USEPA, Office of Pesticide Programs, Pesticide Residue Limits, "Chlorsulfuron", 40 CFR 180.405. http://www.epa.gov/pesticides/food/viewtols.htm

Cholecalciferol C:1086

Use Type: Rodenticide
CAS Number: 67-97-0
Formula: $C_{27}H_{44}O$
Synonyms: Colecalciferol; 7-Dehydrochloesterol; Oleovitamin D3; 9,10-Secocholesta-5,7,10(19)-trien-3-β-ol; 9,10-Secocholesta-5,7,10(19)-trien-3-ol, (3. β,5Z,7E)-; Vitamin D_3
Trade Names: DELSTEROL®; DEPARAL®; D3-VIGANTOL®; QUINTOX®; RAMPAGE®; RICKETON®; TRIVITAN®; VIGORSAN®; VITINC DAN-DEE-3®
Chemical class: Sterol
EPA/OPP PC Code: 202901; (208700 former EPA code)
California DPR Chemical Code: 2232
HSDB Number: 820
UN/NA & ERG Number: UN2811/154
RTECS® Number: VS2900000
EC Number: 200-673-2 [*Annex I Index No.:* 604-140-00-4]
Uses: Used in bait for vermin control. Vitamin D is a steroid hormone that has an important role in regulating body levels of calcium and phosphorus, and in mineralization of bone. Not approved for use in EU countries[115]. Registered for use in the U.S. and other countries.
Regulatory Authority and Advisory Information:
European/International Regulations: Hazard Symbol: T+; risk phrases: R24/25; R26; R48/25; safety phrases: S1/2; S28; S36/37; S45 (see Appendix 1)
WGK (German Aquatic Hazard Class): 2-Hazard to waters
Description: White or colorless crystalline solid. Odorless; Molecular weight = 384.62; Specific gravity (H_2O:1) = 0.963; Freezing/Melting point = 84–85 °C; 87 °C; Vapor pressure = 2.4×10^{-9} mmHg @ 25 °C (est.)[83]; Henry's Law constant = 2.3×10^{-4} atm-cu m/mole @ 25 °C(est.)[83]. Practically insoluble in water.
Incompatibilities: Keep away from strong oxidizers; moisture, light, air.
Permissible Exposure Limits in Air: No standards established.
Determination in Air: Liquid chromatography with ultraviolet detection.
Permissible Concentration in Water:
Determination in Water: Log K_{ow} = 10.2 (est.)[83]. Values above 3.0 are likely to bioaccumulate in aquatic organisms.
Routes of Entry: Inhalation, ingestion, dermal contact.
Harmful Effects and Symptoms
Short Term Exposure: Massive doses are highly toxic to humans; may cause irritability, weakness, fatigue, sleepiness, headache, dry mouth, nausea, abdominal cramps, vomiting, constipation, diarrhea. LD_{50} (oral, rat) = 1426 mg/kg.
Long Term Exposure: May cause hypertension, kidney effects, anorexia, tinnitus.
Medical Surveillance: Tests for urinary calcium, phosphate, and albumin; Blood urea nitrogen (BUN) levels; serum cholesterol. There may be a decrease in serum alkaline phosphatase concentrations[83].
First Aid: If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least 15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately. If this chemical contacts the skin, remove contaminated clothing and wash immediately with soap and water. Seek medical attention immediately. If this chemical has been inhaled, remove from exposure, begin rescue breathing (using universal precautions) if breathing has stopped, and CPR if heart action has stopped. Transfer promptly to a medical facility. When this chemical has been swallowed, get medical attention. *Do not induce vomiting when formulations containing petroleum solvents are ingested*. Otherwise, give large quantities of water and induce vomiting. Do not make an unconscious person vomit.
Personal Protective Methods: Applicators and other handlers must wear: Coveralls worn over long-sleeved shirt and long pants; Chemical-resistant gloves such as DuPont™ Tychem® suit fabrics, barrier laminate, or Viton®; Chemical-resistant footwear plus socks; Protective eye wear; Chemical-resistant headgear for overhead exposure; Chemical-resistant apron when cleaning equipment, mixing, or loading[83]. Agricultural Use/Engineering Controls: When handlers use closed systems, enclosed cabs, or aircraft in a manner that meets the requirements listed in the Worker Protection Standard (WPS) for agricultural pesticides, 40 CFR 170.240(d)(4-6), the handler PPE requirements may be reduced or modified as specified in the Worker Protection Standard. Firefighters should wear NIOSH approved self-contained breathing apparatus and full protective clothing.
Respirator Selection: Wherever and whenever workplace conditions warrant respirator use, a respiratory protection program must be followed that meets one or more of the following requirements: OSHA's 29 CFR 1910.134, ANSI Z88.2, or European Standard EN 149.
Shipping: Toxic solids, organic n.o.s. require a "poisonous materials" label. It usually falls in Hazard Class 6.1 and Packing Group II or III.
Storage: Color Code-Blue: Health Hazard/Poison: Store in a tightly closed container in a dry, well-ventilated and secure poison location. Prior to working with this chemical you should be trained on its proper handling and storage. Where possible, automatically transfer material from other storage containers to process containers.
Spill Handling: As an immediate precautionary measure, isolate spill or leak area in all directions for at least 50 meters/150 feet for liquids and at least 25 meters/75 feet for solids. Increase, in the downwind direction, as necessary, the isolation distance shown above. Eliminate all ignition

sources (no smoking, flares, sparks or flames in immediate area). Do not touch damaged containers or spilled material unless wearing appropriate protective clothing. Stop leak if you can do it without risk. Prevent entry into waterways, sewers, basements or confined areas. Absorb or cover with dry earth, sand or other non-combustible material and transfer to containers. Do not get water inside containers.

Fire Extinguishing: Hazardous decomposition includes oxides of carbon. *Fire involving storage or vehicular tanks:* isolate for 800 meters/0.5 mile in all directions; also, consider initial evacuation for 800 meters/0.5 mile in all directions. *Small fire:* dry chemical, carbon dioxide or water spray. *Large fire:* dry chemical, carbon dioxide, alcohol-resistant foam or water spray. Move containers from fire area if you can do it without risk. Dike fire-control water for later disposal; do not scatter the material. *Fire involving tanks or car/trailer loads:* fight fire from maximum distance or use unmanned hose holders or monitor nozzles. Do not get water inside containers. Cool containers with flooding quantities of water until well after fire is out. Withdraw immediately in the case of rising sound from venting safety devices or discoloration of tank. Always stay away from tanks engulfed in fire. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode.

Disposal Method Suggested: Recycle any unused portion of the material for its approved use or return it to the manufacturer or supplier. Ultimate disposal of the chemical must consider: the material's impact on air quality; potential migration in soil or water; effects on animal, aquatic, and plant life; and conformance with environmental and public health regulations[83].

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- USEPA, "Reregistration Eligibility Decision (RED), Rodenticide Cluster," Office of Prevention, Pesticides and Toxic Substances, Washington DC (July 1998). http://www.epa.gov/REDs/2100red.pdf

Cinnamaldehyde C:1258

Use Type: Fungicide, Insecticide

CAS Number: 104-55-2; 14371-10-9 (*trans*-isomer)

Formula: C_9H_8O

Synonyms: Benzylideneacetaldehyde; Cassia aldehyde; Cinnamal; Cinnamyl aldehyde; Cinnimic aldehyde; NCI-C56111; Phenylacrolein; β-Phenylacrolein; 3-Phenylacrolein; 3-Phenylpropenal; 3-Phenyl-2-propenal; Mixture of cinnamaldehyde, cinnamyl alcohol, 4-methoxycinnamaldehyde, 3-phenyl-1-propanol, 4-methoxyphenethyl alcohol, indole, and 1,2,4-trimethoxybenzene. trans-isomer: (*E*)-Cinnamaldehyde; *trans*-Cinnamaldehyde; *trans*-Cinnamic aldehyde; *trans*-Cinnamylaldehyde; (*E*)-3-Phenylpropenal; (*E*)-3-Phenyl-2-propenal; 2-Propenal, 3-phenyl-, (*E*)-

Trade Names: ADIOS®; ZIMTALDEHYDE®; ZIMTALDEHYDE® LIGHT

Chemical class: Botanical

EPA/OPP PC Code: 040506; 040516 (*trans*-isomer)

California DPR Chemical Code: 2277

HSDB Number: 209 (CAS: 104-55-2)

UN/NA & ERG Number: UN8027/

RTECS® Number: GD6475000; GD6476000 (*trans*-isomer)

EC Number: 203-213-9

Uses: Used as an antifungal agent, corn rootworm attractant, and dog and cat repellent. Can be used on soil casing for mushrooms, row crops, turf and all food commodities. Not listed for use in EU countries[115].

U.S. Maximum Allowable Residue Levels for Cinnamaldehyde (40 CFR 180.1127 and 1156): Exempt from the requirement of a tolerance in or on the following raw agricultural commodities: the following field crops: alfalfa, clover, cotton, dandelion, peanuts (including hay), rice, sorghum (milo), soybeans, sunflower, sweet potatoes, and wheat; the following vegetable crops: asparagus, beans (including forage hay), beets, carrots, celery, cole crops (cabbage, broccoli, Brussels sprouts, cauliflower), collards (kale, mustard greens, turnip greens, kohlrabi), corn, fresh (field, sweet, pop, seed), corn fodder and forage, chinese cabbage, cowpeas, cucurbitis (cucumbers, squash, pumpkin), egg plant, endive (escarole), horseradish (radish, rutabagas, turnip roots), leafy greens (spinach, swiss chard), lettuce (head leaf), okra, parsley, parsnip, peas, peas with pods, peppers, potatoes, sugar beets, tomatoes; the following tree fruit, berry and nut crops: almonds, apples, apricots, berries, (blackberry, boysenberry, dewberry, loganberry, raspberry), blueberry, cherry, citrus (grapefruit, kumquat, lemon, lime, orange, tangelo, and tangerine), cranberry, grapes, melons (watermelon, honeydew, crenshaw, cantaloupe, casaba, persian), nectarines, pears, pecans, peaches, and strawberry as dispersed from the end-use product Corn Rootworm Bait, a pesticidal bait, in accordance with the prescribed conditions in paragraph (a) of this section, *July 13, 2009*; Cumulative yearly application cannot exceed 20 grams of each floral/attractant/acre/application; Exempted from the requirement of a tolerance in or on all food commodities, when used as a fungicide, insecticide, and algaecide in accordance with good agricultural practices, *July 21, 2009*.

Regulatory Authority and Advisory Information:

WGK (German Aquatic Hazard Class): 1-Low hazard to waters. (104-55-2)

Description: Combustible, yellowish, oily liquid (thickens on exposure to air). Strong pungent, spicy, cinnamon odor. Molecular weight = 132.15; 132.17 (*trans*); Specific gravity (H_2O:1) = 1.048–1.052 @ 25 °C; Freezing/Melting point = –7.5 °C; Boiling point = 253 °C; 252 °C (*trans*); Flash point = 120 °C (cc); Vapor pressure = 1 mmHg @ 76.1 °C, 40 mmHg @ 152 °C. Soluble in water.

Incompatibilities: May react violently with bromine, ketones. Incompatible with strong acids, azo dyes, caustics, ammonia, amines, boranes, hydrazines, strong oxidizers.

Permissible Exposure Limits in Air:

Protective Action Criteria (PAC) Ver. 27[89]

(CAS: 104-55-2)

PAC-1: 14 mg/m^3

PAC-2: 150 mg/m^3

PAC-3: 670 mg/m^3

[CAS: 14371-10-9 (*trans*-isomer)]

PAC-1: 5.5 ppm (30 mg/m^3)

PAC-2: 60 ppm (330 mg/m^3)

PAC-3: 120 ppm (660 mg/m^3)

Determination in Water: Log K_{ow} (CAS: 104-55-2) = 1.9. Unlikely to bioaccumulate in aquatic organisms.

Harmful Effects and Symptoms

Short Term Exposure: Contact with eyes or skin may cause severe irritation or injury. Skin sensitization may occur. Inhalation should be avoided; use NIOSH- or CEN (UK)-approved air-purifying respirators for pesticides. May be harmful if swallowed. Has anesthetic properties. Fatal dose is between 1 oz and one lb/pt for a 150 lb person. LD_{50} (oral, rat) = >3000 mg/kg; LD_{50} (dermal, rat) = >1200 mg/kg[83].

Long Term Exposure: May cause tumors. Mutagen; may cause reproductive and fetal effects.

Points of Attack: Inhalation, dermal contact, ingestion. Reproductive cells.

Medical Surveillance: In addition to comprehensive initial medical and work histories emphasizing reproductive experience and menstrual history, patient should have physical examination and testing of genito-urinary tract, sperm count, motility and morphology. If required, other tests, such as serum testosterone, serum follicle stimulating hormone (FSH), and serum lutenizing hormone (LH), may be indicated. Evaluation by a qualified allergist, including exposure history and testing, may help diagnose allergy.

First Aid: If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least 15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately. If this chemical contacts the skin, remove contaminated clothing and wash immediately with soap and water. Seek medical attention immediately. If this chemical has been inhaled, remove from exposure, begin rescue breathing (using universal precautions) if breathing has stopped, and CPR if heart action has stopped. Transfer promptly to a medical facility. When this chemical has been swallowed, get medical attention. Give large quantities of water and induce vomiting. Do not make an unconscious person vomit.

Personal Protective Methods: Applicators and other handlers must wear: Coveralls worn over long-sleeved shirt and long pants; Chemical-resistant gloves such as DuPont™ Tychem® suit fabrics, barrier laminate, or Viton®; Chemical-resistant footwear plus socks; Protective eye wear; Chemical-resistant headgear for overhead exposure; Chemical-resistant apron when cleaning equipment, mixing, or loading[83]. Agricultural Use/Engineering Controls: When handlers use closed systems, enclosed cabs, or aircraft in a manner that meets the requirements listed in the Worker Protection Standard (WPS) for agricultural pesticides, ***40 CFR 170.240(d)(4-6),*** the handler PPE requirements may be reduced or modified as specified in the Worker Protection Standard. Firefighters should wear NIOSH approved self-contained breathing apparatus and full protective clothing.

Respirator Selection: SCBA >14 mg/m^3 (CAS: 104-55-2); 5.5 ppm (30 mg/m^3) [14371-10-9 (*trans*-isomer)]. Wherever and whenever workplace conditions warrant respirator use, a respiratory protection program must be followed that meets one or more of the following requirements: OSHA's 29 CFR 1910.134, ANSI Z88.2, or European Standard EN 149.

Spill Handling: Wastewater from contaminant suppression, cleaning of protective clothing/equipment, or contaminated sites should be contained and evaluated for subject chemical or decomposition product concentrations. Concentrations shall be lower than applicable environmental discharge or disposal criteria. Alternatively, pretreatment and/or discharge to a POTW is acceptable only after review by the governing authority. Due consideration shall be given to remediation worker exposure (inhalation, dermal and ingestion) as well as fate during treatment, transfer and disposal. If it is not practicable to manage the chemical in this fashion, it must meet Hazardous Material Criteria for disposal.

Fire Extinguishing: Irritating gases are produced in fire. Use dry chemical, carbon dioxide, or alcohol-resistant foam extinguishers. Vapors are heavier than air and will collect in low areas. Vapors may travel long distances to ignition sources and flashback. Vapors in confined areas may explode when exposed to fire. Storage containers and parts of containers may rocket great distances, in many directions. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies. From a secure, explosion-proof location, use water spray to cool exposed containers. If cooling streams are ineffective (venting sound increases in volume and pitch, tank discolors, or shows any signs of deforming), withdraw immediately to a secure position. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode.

Disposal Method Suggested: Incineration. In accordance with 40CFR165, follow recommendations for the disposal of pesticides and pesticide containers.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- U.S. Environmental Protection Agency, Office of Pesticide Programs, "Cinnamaldehyde Fact Sheet (040506)," Washington DC (December 2000).

http://www.epa.gov/oppbppd1/biopesticides/ingredients/factsheets/factsheet_040506.htm

- USEPA, Office of Pesticide Programs, Pesticide Residue Limits, "Cinnamaldehyde", 40 CFR 180.1127, 1156. http://www.epa.gov/pesticides/food/viewtols.htm

Clethodim C:1263

Use Type: Herbicide
CAS Number: 99129-21-2
Synonyms: 2-Cyclohexen-1-one, 2-[1-(((3-chloro-2-propenyl)oxy)imino)propyl]-5-[2-(ethylthio)propyl]-3-hydroxy-; *(E)*-2-[1-(((3-Chloro-2-propenyl)oxy)imino)propyl]-5-[2-(ethylthio)propyl]-3-hydroxy-2-cyclohexen-1-one
Trade Names: CLETODIME®; PRISM®; RE 45601; SELECT®
Chemical class: Cyclohexanedione; Cyclohexanone derivative
EPA/OPP PC Code: 121011
California DPR Chemical Code: 3566
HSDB Number: 7960
UN/NA & ERG Number: UN3082 (environmentally hazardous substances, liquid, n. o. s.)/171
Uses: Not approved for use in EU countries[115]. A selective post-emergence herbicide used to control annual and perennial grasses to a range of crops including cotton, flax, peanuts, soybeans, sugarbeets, potatoes, alfalfa, sunflowers and most vegetables.
U.S. Maximum Allowable Residue Levels for Clethodim [(40 CFR 180.458 (a)]: alfalfa, forage 6.0 ppm; alfalfa, hay 10 ppm; artichoke, globe 1.2 ppm; asparagus 1.7 ppm; bean, dry, seed 2.5 ppm; beet, sugar, molasses 1.0 ppm; beet, sugar, roots 0.20 ppm; beet, sugar, tops 1.0 ppm; brassica, head and stem, subgroup 5A, 3.0 ppm; brassica, leafy greens, subgroup 5B, 3.0 ppm; bushberry subgroup 13-07B, 0.20 ppm; caneberry subgroup 13-07A, 0.30 ppm; canola, meal 1.0 ppm; canola, seed 0.50 ppm; cattle, fat 0.2 ppm; cattle, meat 0.2 ppm; cattle, meat byproducts 0.2 ppm; clover, forage 10.0 ppm; clover, hay 20.0 ppm; corn, field, forage 0.2 ppm; corn, field, grain 0.2 ppm; corn, field, stover 0.2 ppm; cotton, meal 2.0 ppm; cotton, undelinted seed 1.0 ppm; cranberry 0.50 ppm; egg 0.2 ppm; flax, meal 1.0 ppm; flax, seed 0.6 ppm; goat, fat 0.2 ppm; goat, meat 0.2 ppm; goat, meat byproducts 0.2 ppm; herb subgroup 19A, 12.0 ppm; hog, fat 0.2 ppm; hog, meat 0.2 ppm; hog, meat byproducts 0.2 ppm; hops, dried cones 0.5 ppm; horse, fat 0.2 ppm; horse, meat 0.2 ppm; horse, meat byproducts 0.2 ppm; leaf petioles subgroup 4B, 0.60 ppm; leafy greens subgroup 4A, 2.0 ppm; melon subgroup 9A, 2.0 ppm; milk 0.05 ppm; mustard, seed 0.50 ppm; onion, bulb 0.20 ppm; onion, green 2.0 ppm; peach 0.20 ppm; peanut 3.0 ppm; peanut, hay 3.0 ppm; peanut, meal 5.0 ppm; peppermint, tops 5.0 ppm; potato 0.5 ppm; potato, granules/flakes 2.0 ppm; poultry, fat 0.2 ppm; poultry, meat 0.2 ppm; poultry, meat byproducts 0.2 ppm; radish, tops 0.70 ppm; safflower, meal 10.0 ppm; safflower, seed 5.0 ppm; sesame, seed 0.35 ppm; sheep, fat 0.2 ppm; sheep, meat 0.2 ppm; sheep, meat byproducts 0.2 ppm; soybean 10.0 ppm; soybean, soapstock 15.0 ppm; spearmint, tops 5.0 ppm; squash/cucumber subgroup 9B, 0.50 ppm; strawberry 3.0 ppm; sunflower, meal 10.0 ppm; sunflower, seed 5.0 ppm; turnip, greens 3.0 ppm; vegetable, fruiting group 8, 1.0 ppm; vegetable, legume, group 6, except soybean 3.5 ppm; vegetable, root, except sugar beet, subgroup 1B, 1.0 ppm; vegetable, tuberous and corm, subgroup 1C, 1.0 ppm.
Human toxicity (long-term)[101]: Low–70.00 ppb, Health Advisory
Fish toxicity (threshold)[101]: Very low–3210.91612 ppb, MATC (Maximum Acceptable Toxicant Concentration)
Regulatory Authority and Advisory Information:
European/International Regulations: Hazard Symbol: Xn; risk phrases: R22 (see Appendix 1)
Description: Depending on purity, clethodim can range from amber to green-yellow viscous liquid. Commercial product may be in a flammable solvent*. Molecular weight = 359.91; Specific gravity (H_2O:1) = 0.965; Boiling point = (decomposes); Freezing/Melting point = – 80 °C; Vapor pressure = 3×10^{-9} mmHg @ 25 °C (est); Flash point = >60 °C; 72 °C*. Hazard Identification (based on NFPA-704 M Rating System): Health 2, Flammability 1, Reactivity 0. Soluble in water; solubility = 12 mg/L @ 25 °C (est.). *Physical and toxicological properties may be affected by the carrier solvents used in commercial formulations.
Incompatibilities: A weak acid, keep away from bases and alkalies. Incompatible with oxidizers. Decomposes at about 100 °C.
Determination in Air: Use high-performance liquid chromotography (HPLC).
Permissible Concentration in Water:
Determination in Water: Log K_{ow} = 4.21 (est.)[83]. Values above 3.0 are likely to bioaccumulate in aquatic organisms.
Routes of Entry: Inhalation, dermal contact.
Harmful Effects and Symptoms
Short Term Exposure: Contact with eyes or skin may cause irritation or injury. Inhalation should be avoided; use NIOSH- or CEN (UK)-approved air-purifying respirators for pesticides. May be harmful if swallowed. LD_{50} (oral, rat) = >1100 mg/kg;1630 mg/kg.
Medical Surveillance: Preliminary medical exam to detect chronic diseases of central nervous system, liver, heart, kidneys, lung and skin, as well as endocrinological or immunological disturbances, should protect susceptible individuals. Periodical medical exams of internal organs, skin and eyes are important to avoid chronic occupational intoxications. They should include lab and patch tests when necessary[83].
First Aid: If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least 15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately. If this chemical contacts the skin, remove contaminated clothing and wash immediately with soap and water. Seek medical attention immediately. If this chemical has been inhaled, remove from exposure, begin rescue breathing (using universal precautions) if breathing has stopped, and CPR if heart action has stopped.

Transfer promptly to a medical facility. When this chemical has been swallowed, get medical attention. Give large quantities of water and induce vomiting. Do not make an unconscious person vomit.

Personal Protective Methods: Applicators and other handlers must wear: Coveralls worn over long-sleeved shirt and long pants; Chemical-resistant gloves such as DuPont^{TM} Tychem® suit fabrics, barrier laminate, or Viton®; Chemical-resistant footwear plus socks; Protective eye wear; Chemical-resistant headgear for overhead exposure; Chemical-resistant apron when cleaning equipment, mixing, or loading[83]. Agricultural Use/Engineering Controls: When handlers use closed systems, enclosed cabs, or aircraft in a manner that meets the requirements listed in the Worker Protection Standard (WPS) for agricultural pesticides, 40 CFR 170.240(d)(4-6), the handler PPE requirements may be reduced or modified as specified in the Worker Protection Standard. Firefighters should wear NIOSH approved self-contained breathing apparatus and full protective clothing.

Respirator Selection: Wherever and whenever workplace conditions warrant respirator use, a respiratory protection program must be followed that meets one or more of the following requirements: OSHA's 29 CFR 1910.134, ANSI Z88.2, or European Standard EN 149.

Storage: Color Code-Blue: Health Hazard/Poison. Store in a secure poison location. Prior to working with this chemical you should be trained on its proper handling and storage. Where possible, automatically transfer material from other storage containers to process containers.

Shipping: Environmentally hazardous substances, solid or liquid, usually fall in Hazard Class 9.

Spill Handling: Wearing protective equipment, clean up with dampened absorbent paper and transfer material to a suitable trash container. Seal the absorbent paper and your clothing in a vapor-tight plastic bag for eventual disposal. Wash all contaminated surfaces with a soap and water solution. Do not re-enter the contaminated area until and expert verifies that the area has been properly cleaned.

Fire Extinguishing: Decomposition products in fire include toxic hydrogen chloride gas and oxides of carbon, nitrogen, and sulfur. *On a small fire:* use dry chemical powder, alcohol-resistant foam, carbon dioxide or water spray.

Disposal Method Suggested: Recycle any unused portion of the material for its approved use or return it to the manufacturer or supplier. Ultimate disposal of the chemical must consider: the material's impact on air quality; potential migration in soil or water; effects on animal, aquatic, and plant life; and conformance with environmental and public health regulations[83].

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- EXTOXNET, Extension Toxicology Network, "Pesticide Information Profile, Clethodim," Oregon State University, Corvallis, OR (July 1995). http://ace.orst.edu/cgi-bin/mfs/01/pips/clethodi.htm
- USEPA, Office of Pesticide Programs, Pesticide Residue Limits, "Clethodim", 40 CFR 180.458. http://www.epa.gov/pesticides/food/viewtols.htm

Clofentezine C:1265

Use Type: Miticide

CAS Number: 74115-24-5

Formula: $C_{14}H_8Cl_2N_4$

Synonyms: 3,6-Bis(2-chlorophenyl)-1,2,4,5-tetrazine; Bisclofentezin; NC-21314; 1,2,4,5-Tetrazine, 3,6-bis(2-chlorophenyl)-; NC

Trade Names: APOLLO®; OVATION®

Chemical class: Tetrazine

EPA/OPP PC Code: 125501

California DPR Chemical Code: 2249

UN/NA & ERG Number: UN3077 (solid)/171

RTECS® Number: XF6860000

EC Number: 277-228-2

Uses: A U.S. EPA restricted Use Pesticide (RUP). Used on a wide variety of crops – fruit, cereals, rangeland, ornamentals, etc

Human toxicity (long-term)[101]: High–9.10 ppb, Health Advisory

Fish toxicity (threshold)[101]: High–7.00003 ppb, MATC (Maximum Acceptable Toxicant Concentration)

Regulatory Authority and Advisory Information:

Acute Oral Category: 4, Caution

SARA 311/312: Acute & Chronic health hazard

European/International Regulations: Hazard Symbol: N; risk phrases: R52; R53; safety phrases: S22; S24/25; S60; S61 (see Appendix 1)

WGK (German Aquatic Hazard Class): 3-Severe hazard to waters.

Description: Magenta crystalline solid. Molecular weight = 303.15; Boiling point = (decomposes); Freezing/Melting point = 180 °C; Vapor pressure = 1×10^{-9} mmHg @ 20 °C. Low solubility in water.

Incompatibilities: Oxidizers (chlorates, nitrates, peroxides, permanganates, perchlorates, chlorine, bromine, fluorine, etc); strong acids. Decomposes above 185 °C.

Determination in Water: Log K_{ow} = >3. Values above 3.0 are likely to bioaccumulate in aquatic organisms.

Routes of Entry: Inhalation, dermal contact.

Harmful Effects and Symptoms

Short Term Exposure: Contact with eyes or skin may cause irritation or injury. Can be absorbed by the skin. Inhalation should be avoided; use NIOSH- or CEN (UK)-approved air-purifying respirators for pesticides. May be harmful if swallowed. LD_{50} (oral, rat) = >3 g/kg; LD_{50} (dermal, rat) = >1 g/kg.

Long Term Exposure: May cause liver and/or thyroid damage.

Medical Surveillance: Consider the points of attack in preplacement and periodic physical examinations.

First Aid: If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least

15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately. If this chemical contacts the skin, remove contaminated clothing and wash immediately with soap and water. Seek medical attention immediately. If this chemical has been inhaled, remove from exposure, begin rescue breathing (using universal precautions) if breathing has stopped, and CPR if heart action has stopped. Transfer promptly to a medical facility. When this chemical has been swallowed, get medical attention. Give large quantities of water and induce vomiting. Do not make an unconscious person vomit.

Personal Protective Methods: Applicators and other handlers must wear: Coveralls worn over long-sleeved shirt and long pants; Chemical-resistant gloves such as DuPont™ Tychem® suit fabrics, barrier laminate, or Viton®; Chemical-resistant footwear plus socks; Protective eye wear; Chemical-resistant headgear for overhead exposure; Chemical-resistant apron when cleaning equipment, mixing, or loading[83]. Agricultural Use/Engineering Controls: When handlers use closed systems, enclosed cabs, or aircraft in a manner that meets the requirements listed in the Worker Protection Standard (WPS) for agricultural pesticides, 40 CFR 170.240(d)(4-6), the handler PPE requirements may be reduced or modified as specified in the Worker Protection Standard. Firefighters should wear NIOSH-approved self-contained breathing apparatus and full protective clothing.

Respirator Selection: Wherever and whenever workplace conditions warrant respirator use, a respiratory protection program must be followed that meets one or more of the following requirements: OSHA's 29 CFR 1910.134, ANSI Z88.2, or European Standard EN 149.

Storage: Color Code-Blue: Health Hazard/Poison. Store in a tightly closed container in a dry, well-ventilated and secure poison location. Prior to working with this chemical you should be trained on its proper handling and storage. Where possible, automatically transfer material from other storage containers to process containers.

Shipping: Environmentally hazardous substances, solid or liquid, usually fall in Hazard Class 9.

Spill Handling: For solids, isolate spill or leak area in all directions for at least 25 meters/75 feet. Increase, in the downwind direction, as necessary. Do not touch damaged containers or spilled material unless wearing appropriate protective clothing. Stop leak if you can do it without risk. Prevent entry into waterways, sewers, basements or confined areas. Cover with plastic sheet to prevent spreading. Absorb or cover with dry earth, sand or other non-combustible material and transfer to containers. Do not allow water to get inside containers.

Fire Extinguishing: *On a small fire:* use alcohol-resistant foam, dry chemical powder, carbon dioxide or water spray.*On a large fire:* use water spray, fog or alcohol-resistant foam. Move containers from fire area if you can do it without risk. Dike fire-control water for later disposal. Use water spray or fog; do not scatter material using straight water jet streams. *Fire involving storage or vehicular tanks:* isolate for 800 meters/0.5 mile in all directions; also, consider initial evacuation for 800 meters/0.5 mile in all directions. Fight fire from maximum distance or use unmanned hose holders or monitor nozzles. Do not allow water to get inside containers. Cool containers with flooding quantities of water until well after fire is out. Withdraw immediately in the case of rising sound from venting safety devices or discoloration of tank. *Always* stay away from tanks engulfed in fire. For massive fire, use unmanned hose holders or monitor nozzles; if this is impossible, withdraw from area and let fire burn.

Disposal Method Suggested: Do not discharge into drains or sewers. Consult with environmental regulatory agencies for guidance on acceptable disposal practices. In accordance with 40CFR165, follow recommendations for the disposal of pesticides and pesticide containers. Containers must be disposed of properly by following package label directions or by contacting your local or federal environmental control agency, or by contacting your regional EPA office.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- USEPA, Office of Pesticide Programs, Pesticide Residue Limits, “Clofentezine”, 40 CFR 180.446. http://www.epa.gov/pesticides/food/viewtols.htm

Clomazone C:1266

Use Type: Herbicide

CAS Number: 81777-89-1

Formula: $C_{12}H_{14}ClNO_2$

Synonyms: 2-[(2-Chlorophenyl)methyl]-4,4-dimethyl-3-isoxazolidinone; 2-(2-Chlorobenzyl)-4,4-dimethyl-1,2-oxazolidin-3-one; Dimethazone

Trade Names: CERANO®; COLZOR TRIO®; COMMAND®; COMMENCE®, DIBEL®; FMC® 57020; GAMBIT®; MAGISTER®; MERIT®; STRATEGY®

Chemical class: Oxazolidione

EPA/OPP PC Code: 125401

California DPR Chemical Code: 3537

HSDB Number: 6624 (as Dimethazone)

UN/NA & ERG Number: UN2902/151

RTECS® Number: NY2977000

Uses: Clomazone is a broad-spectrum herbicide used on rice, peas, pumpkins, soybeans, sweet potatoes, winter squash, cotton, tobacco and fallow wheat fields to control annual grasses and broadleaf weeds.

U.S. Maximum Allowable Residue Levels for Clomazone (40 CFR 180.425): in or on the following raw agricultural commodities: bean, snap, succulent 0.05 ppm; cabbage 0.1 ppm; cotton, undelinted seed 0.05 ppm; cucumber 0.1 ppm; pea (succulent) 0.05 ppm; pepper 0.05 ppm; peppermint, tops 0.05 ppm; pumpkin 0.1 ppm; rice, grain 0.02 ppm; rice, straw 0.02 ppm; soybean 0.05 ppm; spearmint, tops 0.05 ppm; squash, summer 0.1 ppm; squash, winter 0.1 ppm; sugarcane, cane 0.05 ppm; sweet potato, roots 0.05 ppm; vegetable, cucurbit, group 9, 0.05 ppm; and vegetable, tuberous and corm, except potato, subgroup 1D, 0.05 ppm.

Human toxicity (long-term)[101]***:*** Very low–301.00 ppb, Health Advisory

Fish toxicity (threshold)[101]***:*** Very low–3156.16718 ppb, MATC (Maximum Acceptable Toxicant Concentration)

Regulatory Authority and Advisory Information:

Carcinogenicity: EPA: Not likely to be carcinogenic to humans.

Acute Oral Category: 3, CAUTION

Potential Ground Water Pollutant [California FAC Section 13145(d)/12811, active]

Description: Depending purity, it may be clear and colorless to pale yellow or brownish liquid. Commercially available as emulsifiable concentrates that can be dissolved in water. Molecular weight = 239.71; Specific gravity (H_2O:1) = 1.19; Boiling point = 275–282 °C; Freezing/ Melting point = 25–34 °C; Flash point = 105 °C; Vapor pressure = 1×10^{-4} mmHg @ 20. Highly soluble in water; solubility = >1000 mg/L. Physical and toxicological properties may be affected by the carrier solvents used in commercial formulations.

Incompatibilities: May react with strong oxidizers such as chlorates, peroxides, nitrates, etc.

Permissible Exposure Limits in Air: No occupational exposure limits have been established.

Permissible Concentration in Water:

Determination in Water: Log K_{ow} = 2.5–2.54. Unlikely to bioaccumulate in marine organisms.

Routes of Entry: Dermal, ingestion, inhalation.

Harmful Effects and Symptoms

Short Term Exposure: Contact with eyes or skin may cause irritation or injury. Inhalation should be avoided; use NIOSH- or CEN (UK)-approved air-purifying respirators for pesticides. May be harmful if swallowed.

LD_{50} (oral, rat) = <1500 mg/kg; LD_{50} (dermal, rat) = >2 g/kg.

Long Term Exposure:

Points of Attack:

Medical Surveillance: Preliminary medical exam to detect chronic diseases of central nervous system, liver, heart, kidneys, lung and skin, as well as endocrinological or immunological disturbances, should protect susceptible individuals. Periodical medical exams of internal organs, skin and eyes are important to avoid chronic occupational intoxications. They should include lab and patch tests when necessary[83].

First Aid: If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least 15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately. If this chemical contacts the skin, remove contaminated clothing and wash immediately with soap and water. Seek medical attention immediately. If this chemical has been inhaled, remove from exposure, begin rescue breathing (using universal precautions) if breathing has stopped, and CPR if heart action has stopped. Transfer promptly to a medical facility. When this chemical has been swallowed, get medical attention. Give large quantities of water and induce vomiting. Do not make an unconscious person vomit.

Personal Protective Methods: Applicators and other handlers must wear: Coveralls worn over long-sleeved shirt and long pants; Chemical-resistant gloves such as DuPont™ Tychem® suit fabrics, barrier laminate, or Viton®; Chemical-resistant footwear plus socks; Protective eye wear; Chemical-resistant headgear for overhead exposure; Chemical-resistant apron when cleaning equipment, mixing, or loading[83]. Agricultural Use/Engineering Controls: When handlers use closed systems, enclosed cabs, or aircraft in a manner that meets the requirements listed in the Worker Protection Standard (WPS) for agricultural pesticides, 40 CFR 170.240(d)(4-6), the handler PPE requirements may be reduced or modified as specified in the Worker Protection Standard. Firefighters should wear NIOSH approved self-contained breathing apparatus and full protective clothing.

Respirator Selection: Wherever and whenever workplace conditions warrant respirator use, a respiratory protection program must be followed that meets one or more of the following requirements: OSHA's 29 CFR 1910.134, ANSI Z88.2, or European Standard EN 149.

Storage: Color Code-Blue: Health Hazard/Poison. Store in a tightly closed container in a dry, well-ventilated and secure poison location. Prior to working with this chemical you should be trained on its proper handling and storage. Where possible, automatically transfer material from other storage containers to process containers.

Shipping: PG III.

Spill Handling: If a spill occurs, clean it up promptly. Don't wash it away. Instead, sprinkle the spill with sawdust, vermiculite, or kitty litter. Sweep it into a plastic garbage bag, and dispose of it as directed on the pesticide product label. Wash all contaminated surfaces with a soap and water solution. Do not re-enter the contaminated area until and expert verifies that the area has been properly cleaned.

Fire Extinguishing: *On a small fire:* use alcohol-resistant foam, dry chemical powder, carbon dioxide or water spray. *On a large fire:* use water spray, fog or alcohol-resistant foam. Move containers from fire area if you can do it without risk. Dike fire-control water for later disposal. Use water spray or fog; do not scatter material using straight water jet streams. *Fire involving storage or vehicular tanks:* isolate for 800 meters/0.5 mile in all directions; also, consider initial evacuation for 800 meters/0.5 mile in all directions. Fight fire from maximum distance or use unmanned hose holders or monitor nozzles. Do not allow water to get inside containers. Cool containers with flooding quantities of water until well after fire is out. Withdraw immediately in the case of rising sound from venting safety devices or discoloration of tank. *Always* stay away from tanks engulfed in fire. For massive fire, use unmanned hose holders or monitor nozzles; if this is impossible, withdraw from area and let fire burn.

Disposal Method Suggested: Do not discharge into drains or sewers. Dispose of waste material as hazardous waste using a licensed disposal contractor to an approved landfill. Consult with environmental regulatory agencies for guidance on acceptable disposal practices. In accordance with 40CFR165, follow recommendations for the disposal of pesticides and pesticide containers. Containers must be disposed of properly by following package label directions or by contacting your local or federal environmental control agency, or by contacting your regional EPA office.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- EXTOXNET, Extension Toxicology Network, "Pesticide Information Profile, Clomazone," Oregon State University, Corvallis, OR (June 1996). http://extoxnet.orst.edu/pips/clomazon.htm
- USEPA, Office of Pesticide Programs, Pesticide Residue Limits, "Clomazone", 40 CFR 180.425. http://www.epa.gov/pesticides/food/viewtols.htm

Clonitralid C:1268

Use Type: Molluscicide

CAS Number: 1420-04-8

Formula: $C_{15}H_{15}Cl_2N_3O_5$

Synonyms: 2-Aminoethanol salt of 2',5-dichloro-4'-nitrosalicylanilide; 5-Chloro-*N*-(2-chloro-4-nitrophenyl)-2-hydroxybenzamide with 2-aminoethanol (1:1); 5-Chloro-*N*-(2-chloro-4-nitrophenyl)-2-hydroxybenzamide, 2-aminoethanol salt; 2',5-Dichloro-4'-nitrosalicylanilide, 2-aminoethanol salt; 5,2'-Dichloro-4'-nitrosalicylanilide ethanolamine salt; 5,2-Dichloro-4-nitrosalicylicanilide-2-aminoethanol salt; 2',5-Dichloro-4'-nitrosalicyloylanilide ethanolamine salt; Ethanolamine salt of 5,2'-Dichloro-4'-nitrosalicyclicanilide; NCI-C00431; **Niclosamide**; 2-Aminoethanol salt of 5-chloro-*N*-(2-chloro-4-nitrophenyl)-2-hydroxybenzamide

Trade Names: BAY 73® and U.S. Fish and Wildlife Service; BAY 6076®; BAYER 73®; BAYER 25648®; BAYLUSCID®[C]; BAYLUSCIDE® and U.S. Fish and Wildlife Service; M 73®; MOLLUSCICIDE BAYER 73®; NICLOSAMIDE®; SR 73®

Chemical class: Chloronitrophenol derivative; Chlorinated aromatic amide

EPA/OPP PC Code: 077401

California DPR Chemical Code: 2472

HSDB Number: 4045

UN/NA & ERG Number: UN2588 (Pesticide, solid, poisonous, n.o.s.)/151; UN2902 (Pesticide, liquid, poisonous, n.o.s.)/151

RTECS® Number: VN8575000

EC Number: 215-811-7; Not classified in Annex I

Uses: Niclosamide, the parent chemical, is a relatively selective, non-cumulative chlorinated aromatic amide pesticide. Clonitralid (ethanolamine salt of Niclosamide) is used principally against molluscs, especially fresh water snails and to control sea lamprey larvae and also as an antiparasitic drug in human, pets and livestock. Niclosamide is toxic to all fish species at 0.5 mg/L (48 hours). A U.S. EPA restricted Use Pesticide as Niclosamide. Limited to use by a certified applicator ***[40 CFR 152.175 (a) (7/1/94)]***. Not listed for use in EU countries[115]. Registered for use in the U.S.

Regulatory Authority and Advisory Information:

Health Advisory: Developmental/Reproductive Toxin

Acute Oral Category: 4, Caution

European/International Regulations: Hazard Symbol: Xn; risk phrases: R22; safety phrases: None found.

WGK (German Aquatic Hazard Class): 3-Severe hazard to waters

Description: Depending on purity, a bright yellow or brownish-yellow crystalline solid or powder. Odorless. Soluble in water. Molecular weight = 388.23; Freezing/Melting point = 191 °C; 216 °C; Vapor pressure = 8×10^{-8} mmHg @ 20 °C; 3×10^{-4} mmHg @ 20 °C. Practically insoluble in water; solubility = 0.2 mg/L @ 20 °C.

Incompatibilities: Incompatible with strong oxidizers; hydrolyzed by strong acids, and alkalies. Slowly hydrolyzes in water, releasing ammonia and forming acetate salts. Decomposes at about 200–205 °C.

Determination in Water: Log K_{ow} = 1. Unlikely to bioaccumulate in marine organisms.

Routes of Entry: Dermal contact, ingestion

Harmful Effects and Symptoms:

Short Term Exposure: May cause severe eye irritation. Ingestion may result in nausea and abdominal pain. May be absorbed through the mucous membrane. LD_{50} (oral, rat) = >5000 mg/kg; LD_{50} (dermal, rat) = >2000 mg/kg.

Long Term Exposure: May cause reproductive and fetal effects. May cause tumors, gastrointestinal discomfort, anorexia and hair loss.

Points of Attack: Gastrointestinal system. Reproductive cells.

Medical Surveillance: In addition to comprehensive initial medical and work histories emphasizing reproductive experience and menstrual history, patient should have physical examination and testing of genito-urinary tract, sperm count, motility and morphology. If required, other tests, such as serum testosterone, serum follicle stimulating hormone (FSH), and serum lutenizing hormone (LH), may be indicated.

First Aid: If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least 15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately. Give artificial respiration if victim is not breathing. *Do not* use mouth-to-mouth method if victim ingested or inhaled the substance; give artificial respiration with the aid of a pocket mask equipped with a one-way valve or other proper respiratory medical device. Administer oxygen if breathing is difficult. Remove and isolate contaminated clothing and shoes. In cases of contact with substance, immediately flush skin or eyes with running water for at least 20 minutes. For minor skin contact, avoid spreading material on unaffected skin. Keep victim warm and quiet. Effects of exposure (inhalation, ingestion or skin contact) to substance may be delayed. Ensure that medical personnel are aware of the material(s) involved and take precautions to protect themselves.

Respirator Selection: Wherever and whenever workplace conditions warrant respirator use, a respiratory protection program must be followed that meets one or more of the following requirements: OSHA's 29 CFR 1910.134, ANSI Z88.2, or European Standard EN 149.

Storage: Color Code-Blue: Health Hazard/Poison. Store in a tightly closed container in a dry, well-ventilated and secure poison location. Prior to working with this chemical you should be trained on its proper handling and storage. Where possible, automatically transfer material from other storage containers to process containers.

Shipping: Pesticides, solid, toxic/poisonous, n.o.s require a shipping label of "poisonous materials" and fall in Hazard Class 6.1. Technical name required.

Spill Handling: Wearing protective clothing, dampen the spilled material with water. Clean up with dampened absorbent paper and transfer material to a suitable trash container. Seal the absorbent paper and your clothing in a vapor-tight plastic bag for eventual disposal. Wash all contaminated surfaces with a soap and water solution. Do not re-enter the contaminated area until and expert verifies that the area has been properly cleaned.

Fire Extinguishing: Decomposition products include oxides of oxygen and nitrogen, hydrogen chloride gas, and possibly hydrogen cyanide. *On a small fire:* use dry chemical, CO_2 or water spray. *On a large fire:* use water spray, fog or regular foam. Move containers from fire area if you can do it without risk. Dike fire-control water for later disposal; do not scatter the material. Use water spray or fog; do not use straight streams. *Fire involving storage or vehicular tanks:* isolate for 800 meters/0.5 mile in all directions; also, consider initial evacuation for 800 meters/0.5 mile in all directions. Fight fire from maximum distance or use unmanned hose holders or monitor nozzles. Do not get water inside containers. Cool containers with flooding quantities of water until well after fire is out. Withdraw immediately in the case of rising sound from venting safety devices or discoloration of tank. ALWAYS stay away from tanks engulfed in fire. For massive fire, use unmanned hose holders or monitor nozzles; if this is impossible, withdraw from area and let fire burn. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies.

Disposal Method Suggested: Do not discharge into drains or sewers. Containers must be disposed of properly by following package label directions or by contacting your local or federal environmental control agency, or by contacting your regional EPA office. Burn in incinerator specifically designed for pesticide disposal or dispose as a hazardous waste in a landfill approved and licensed for the disposal of pesticides. Consult with environmental regulatory agencies for guidance on acceptable disposal practices. Ultimate disposal of the chemical must consider: the material's impact on air quality; potential migration in soil or water; effects on animal, aquatic, and plant life; and conformance with environmental and public health regulations[83].

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov

Clopyralid C:1274

Use Type: Herbicide

CAS Number: 1702-17-6

Formula: $C_7H_3Cl_2NO_2$

Synonyms: 3,6-Dichloropicolinic acid; 3,6-Dichloro-2-pyridinecarboxylic acid; 2-Pyridinecarboxylic acid, 3,6-dichloro-; 3,6-Dichloro-2-picolinic acid; 3,6-DCP; Picolinic acid, 3,6-dichloro-

Trade Names: ACCENT®; CONFRONT®; CURTAIL®; CURTAIL M®; DOWCO®-290; HORNET®; LONTREL®; LONTREL® 3; LONTRIL® F; LONTRIL® T; MATRIGON®; MILLENNIUM®; NAF®-280; PARADIGM®; RECLAIM®; REDEEM®; RIVERDALE®; SCORPION®; STINGER®; TRANSLINE®; WIDEMATCH®; XRM-3972®

Chemical class: Pyridinecarboxylic acid; Pyridine compound; Chlorophenoxy; Pyralid

EPA/OPP PC Code: 117403

California DPR Chemical Code: 5135

HSDB Number: 6593

UN/NA & ERG Number: UN3077 (solid)/171

RTECS® Number: TJ750700

EC Number: 216-935-4 [*Annex I Index No.:* 607-231-00-1]

Uses: Clopyralid is used to control annual and perennial broadleaf weeds on rangeland, pastures, turf and lawns, rights-of-way and a few agricultural products such as sugar beets, oats, barley, mint and wheat.

U.S. Maximum Allowable Residue Levels for clopyralid (3,6-dichloro-2-pyridinecarboxylic acid): barley, forage 9.0 ppm; barley, grain 3.0 ppm; barley, straw 9.0 ppm; cattle (fat, meat, meat byproducts except kidney) 1.0 ppm; cattle (kidney) 12.0 ppm; eggs 0.1 ppm; goats (fat, meat, meat byproducts except kidney) 1.0 ppm; goats (kidney) 12.0 ppm; grasses (forage and hay) 500 ppm; hogs (fat, meat, meat byproducts) 0.2 ppm; horses (fat, meat, meat byproducts except kidney) 1.0 ppm; horses (kidney) 12.0 ppm; milk: 0.1 ppm: oats, forage 9.0 ppm; oats, grain 3.0 ppm; oats, straw 9.0 ppm: poultry (fat, meat, meat byproducts) 0.2 ppm; sheep (fat, meat, meat byproducts except kidney) 1.0 ppm; sheep (kidney) 12.0 ppm; sugar beets (roots and tops) 0.5 ppm; wheat, forage 9.0 ppm; wheat, grain 3.0 ppm; and wheat, straw 9.0 ppm. [***40 CFR 180.431(a) (7/1/91)***]. Barley, milled fractions (except flour), oats, milled fractions (except flour), and wheat, milled fractions (except flour) 12.0 ppm; sugar beet molasses 7.0 ppm [***40 CFR 186.1100(a) (7/1/1991)***].

Human toxicity (long-term)[101]: Very low–3500.00 ppb, Health Advisory

Fish toxicity (threshold)[101]: Very low–20832.27357 ppb, MATC (Maximum Acceptable Toxicant Concentration)

Regulatory Authority and Advisory Information:

Carcinogenicity: EPA: Not likely to be a carcinogen to humans.

Health Advisory: Developmental/Reproductive Toxin

AB 2588-Air Toxics "Hot Spots" Chemicals (CAL) as chlorophenoxy pesticides

European/International Regulations: Hazard Symbol: Xi; risk phrases: R41; safety phrases: S2; S26; S39

Description: Odorless and colorless crystalline solid. Odorless. Available as a soluble concentrate that is usually mixed ith water. Combustible. Molecular weight = 192.00; Boiling point = (decomposes); Freezing/Melting point = 150–152 °C; Vapor pressure = 1×10^{-5} mmHg @ 25 °C; Flash point = >100 °C. Hazard Identification (based on NFPA-704 M Rating System): Health 2, Flammability 1, Reactivity 0. High solubility in water; solubility = 1000 ppm. Physical and toxicological properties may be affected by the carrier solvents used in commercial formulations.

Incompatibilities: May react violently with strong oxidizers, bromine, 90% hydrogen peroxide, phosphorus trichloride, silver powders or dust. Incompatible with silver compounds. Mixture with some silver compounds forms explosive salts of silver oxalate. Keep away from oxidizers, sulfuric acid, caustics, ammonia, aliphatic amines, alkanolamines, isocyanates, alkylene oxides, epichlorohydrin. Solutions are strong acids; corrosive to aluminum, iron and tin. When heated to decomposition, this chemical may form nitrogen oxides and chlorine gas.

Determination in Water: Log K_{ow} = –3. Negative. Unlikely to bioaccumulate in marine organisms.

Harmful Effects and Symptoms

Short Term Exposure: Poisonous; may be fatal if inhaled, swallowed, or absorbed through skin. Severely irritates eyes, skin and respiratory tract, with burning sensation, pain, redness and swelling. Metabolic stimulant. If inhaled, causes coughing, dilated pupils, headache, profuse persperation, intense thirst, extreme fatigue, rapid pulse, high fever, clammy, flushed skin, rapid breathing, nausea, vomiting, cyanosis (bluish tint to skin and lips), anxiety and confusion, convulsions, risk of lung edema. If swallowed, face and lips turn bluish. Liver injury with associated jaundice, kidney failure, and cardiac arrhythmias are commonly noted. Nerve damage, which may be delayed, may include swelling of legs and feet, muscle twitch and stupor. Severe exposure can cause death from heart failure. Dust or liquid left in contact with the skin for several hours may be absorbed. This may result in severe delayed symptoms as listed above. These symptoms may last for months or years. Can cause permanent impairment of vision or irreversible damage. LD_{50} (oral, rat) = >2500 mg/kg. Low toxicity.

Long Term Exposure: Workers exposed to chlorophenoxy compounds (in the manufacturing process) over a 5 to 10 year period at levels above 10 mg/m^3 complained of weakness, rapid fatigue, headache and vertigo. Liver damage, low blood pressure and slowed heartbeat were also found. Based on animal tests, may affect human reproduction

Points of Attack: Eyes, skin, respiratory system, central nervous system, cardiovascular system, liver and kidney.

Medical Surveillance: If symptoms develop or overexposure is suspected, the following may be useful: Liver and kidney function tests. Exam of the nervous system. Preliminary medical exam to detect chronic diseases of central nervous system, liver, heart, kidneys, lung and skin, as well as endocrinological or immunological disturbances, should protect susceptible individuals. Periodical medical exams of internal organs, skin and eyes are important to avoid chronic occupational intoxications. They should include lab and patch tests when necessary[83].

First Aid: If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least 15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately. If this chemical contacts the skin, remove contaminated clothing and wash immediately with soap and water. Seek medical attention immediately. If this chemical has been inhaled, remove from exposure, begin rescue breathing (using universal precautions) if breathing has stopped, and CPR if heart action has stopped. Transfer promptly to a medical facility. When this chemical has been swallowed, get medical attention. *Do not induce vomiting when formulations containing petroleum solvents are ingested*. Otherwise, give large quantities of water and induce vomiting. Do not make an unconscious person vomit.

Personal Protective Methods: Applicators and other handlers must wear: Coveralls worn over long-sleeved shirt and long pants; Chemical-resistant gloves such as DuPont™ Tychem® suit fabrics, barrier laminate, or Viton®; Chemical-resistant footwear plus socks; Protective eye wear; Chemical-resistant headgear for overhead exposure; Chemical-resistant apron when cleaning equipment, mixing, or loading[83]. Agricultural Use/Engineering Controls: When handlers use closed systems, enclosed cabs, or aircraft in a manner that meets the requirements listed in the Worker Protection Standard (WPS) for agricultural pesticides, ***40 CFR 170.240(d)(4-6),*** the handler PPE requirements may be reduced or modified as specified in the Worker Protection Standard. Firefighters should wear NIOSH approved self-contained breathing apparatus and full protective clothing.

Respirator Selection: Wherever and whenever workplace conditions warrant respirator use, a respiratory protection program must be followed that meets one or more of the following requirements: OSHA's 29 CFR 1910.134, ANSI Z88.2, or European Standard EN 149.

Storage: Color Code-Blue: Health Hazard/Poison. Store in a tightly closed container in a dry, well-ventilated and secure poison location. Prior to working with this chemical you should be trained on its proper handling and storage.

Where possible, automatically transfer material from other storage containers to process containers.

Shipping: Environmentally hazardous substances, solid or liquid, usually fall in Hazard Class 9.

Spill Handling: If a spill occurs, clean it up promptly. Don't wash it away. Instead, sprinkle the liquid spill with sawdust, vermiculite, or kitty litter. Sweep it into a plastic garbage bag, and dispose of it as directed on the pesticide product label. Wash all contaminated surfaces with a soap and water solution.

Fire Extinguishing: Decomposition products include oxides of carbon and nitrogen, hydrogen chloride and chlorine gases. *On a small fire:* use dry chemical, CO_2 or water spray. *On a large fire:* use water spray, fog or regular foam. Move containers from fire area if you can do it without risk. Dike fire-control water for later disposal; do not scatter the material. Use water spray or fog; do not use straight streams. *Fire involving storage or vehicular tanks:* isolate for 800 meters/0.5 mile in all directions; also, consider initial evacuation for 800 meters/0.5 mile in all directions. Fight fire from maximum distance or use unmanned hose holders or monitor nozzles. Do not get water inside containers. Cool containers with flooding quantities of water until well after fire is out. Withdraw immediately in the case of rising sound from venting safety devices or discoloration of tank. ALWAYS stay away from tanks engulfed in fire. For massive fire, use unmanned hose holders or monitor nozzles; if this is impossible, withdraw from area and let fire burn. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies.

Disposal Method Suggested: Containers must be disposed of properly by following package label directions or by contacting your local or federal environmental control agency, or by contacting your regional EPA office. Dissolve or mix the material with a combustible solvent and burn in a chemical incinerator equipped with an afterburner and scrubber. In accordance with 40CFR165, follow recommendations for the disposal of pesticides and pesticide containers.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- "Clopyralid Herbicide Fact Sheet," Caroline Cox, *Journal of Pesticide Reform,* Northwest Coalition for Alternatives to Pesticides, Eugene, OR (1998)

Copper naphthenate C:1385

Use Type: Fungicide, Insecticide

CAS Number: 1338-02-9

Formula: $C_{22}H_{14}CuO_4$

Synonyms: CNC; Copper uversol; Naphthenic acids, copper salts

Trade Names: CHAPCO® Cu-NAP; CUNAPSOL®; CUPRINOL®; TROYSAN® COPPER 8%; TROYSAN® COPPER 11.5%; WILTZ®-65; WITTOX®-C

Chemical class: Inorganic copper compound

EPA/OPP PC Code: 023102; (006000 and 006300 are old EPA code numbers)

California DPR Chemical Code: 153

HSDB Number: 245

UN/NA & ERG Number: UN1993/128

RTECS® Number: QK9100000

EC Number: 029-003-00-5

Uses: Mercaptan scavenger in technical pesticide. Not listed for use in EU countries[115]. Registered for use in the U.S.

U.S. Maximum Allowable Residue Levels for copper naphthenate [40 CFR 180.920]: Residues are exempted from the requirement of a tolerance when used in accordance with good agricultural practice as inert (or occasionally active) ingredients in pesticide formulations applied to growing crops only. Limit: Not more than 2.5% of formulation; application limited to before edible portions of plants begin to form.

Regulatory Authority and Advisory Information:

AB 2588-Air Toxics "Hot Spots" Chemicals (CAL) (as copper compounds)

The "Director's List" (CAL/OSHA) (as copper compounds)

Clean Water Act: Toxic Pollutant (Section 401.15) as copper and compounds

RCRA Ground Water Monitoring List. Suggested test method(s) (PQL ug/L): 6010(60); 7210(200) Note: All species in the ground water that contain copper are included

EPCRA (Section 313): Includes any unique chemical substance that contains copper as part of that chemical's infrastructure. This category does not include copper phthalocyanide compounds that are substituted with only hydrogen, and/or chlorine, and/or bromine

Form R *de minimis* concentration reporting level: 1.0%

Description: Dark green, thick liquid or blue-green solid. Generally used only as a solution, usually in oils or mineral spirits. Gasoline-like odor (liquid). Insoluble in water; Specific gravity (H_2O:1) = 0.93 to 1.055 @ 25 °C; Boiling point = 154–202 °C. Flash point (typical) = 38 °C (cc); Autoignition temperature = 282.2 °C. Explosive limits (mineral spirits): LEL = 0.8%; UEL 5%[86]. Hazard Identification (based on NFPA-704 M Rating System): Health Hazards (Blue): 0; Flammability (Red): 2; Reactivity (Yellow): 0.

Incompatibilities: Flammable liquid. Forms explosive mixture with air. Reaction with strong oxidizers may be violent.

Permissible Exposure Limits in Air:

As copper

ACGIH TLV 0.2 mg/m^3 (fume); 1 mg/m^3 (dusts and mists); NIOSH/OSHA 0.1 mg/m^3 (fume); 1 mg/m^3 as (dusts and mists).

Determination in Air: Copper dusts and mists are collected on a filter, worked up with acid, measured by atomic absorption. See NIOSH Method #7029 for copper. For copper fume: filter collection, acid digestion, measurement by atomic absorption.

Permissible Concentration in Water: The U.S. EPA (6) has set a maximum of 1.0 mg/L in water to protect human health.

Determination in Water: Total copper may be determined by digestion followed by atomic absorption or by colorimetry (using neocuproine) or by Inductively Coupled Plasma Optical Emission Spectrometry. Dissolved copper may be determined by 0.45 μ filtration followed by the preceding methods.

Harmful Effects and Symptoms

Short Term Exposure: LD_{50} (oral, rat) = 4–6 g/kg.

Long Term Exposure: May cause mutations in humans. May damage the testes and decrease fertility in both males and females. May cause skin allergy and thickening of the skin; copper deposits can cause discoloration in the skin and hair, leaving a green color. Repeated exposure can cause shrinking of the lining of the inner nose with watery discharge, liver damage. Individuals with Wilson's disease absorb, retain, and store copper excessively

Points of Attack: Skin, reproductive system, liver.

Medical Surveillance: Serum and urine copper level. Liver and kidney tests. Examination by a qualified allergist. More than light alcohol consumption may exacerbate the liver damage caused by copper sulfate.

First Aid: If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least 15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately. If this chemical contacts the skin, remove contaminated clothing and wash immediately with soap and water. Seek medical attention immediately. If this chemical has been inhaled, remove from exposure, begin rescue breathing (using universal precautions) if breathing has stopped, and CPR if heart action has stopped. Transfer promptly to a medical facility. When this chemical has been swallowed, get medical attention. Give large quantities of water and induce vomiting. Do not make an unconscious person vomit. Do not induce vomiting when formulations containing petroleum solvents are ingested

Respirator Selection: Wherever and whenever workplace conditions warrant respirator use, a respiratory protection program must be followed that meets one or more of the following requirements: OSHA's 29 CFR 1910.134, ANSI Z88.2, or European Standard EN 149.

Storage: Color Code-Red Stripe: Flammability Hazard: Store separately from all other flammable materials. Prior to working with this chemical you should be trained on its proper handling and storage. Before entering confined space where this chemical may be present, check to make sure that an explosive concentration does not exist. Store in tightly closed containers in a cool, well-ventilated area away from chlorine compounds, oxidizing agents, and combustible materials. Sources of ignition, such as smoking and open flames, are prohibited where thei chemical is handled, used, or stored, Use only non-sparking tools and equipment, especially when opening and closing containers. Wherever this chemical is used, handled, manufactured, or stored, use explosion-proof electrical equipment and fittings. Piping should be electrically bonded and grounded.

Shipping: Flammable liquids, n.o.s. require a label of "FLAMMABLE LIQUIDS." They usually fall in Hazard Class 3 and Packing Group II.

Spill Handling: As an immediate precautionary measure, isolate spill or leak area for at least 50 meters/50 feet in all directions. *Small spill*: consider initial downwind evacuation for at least 300 meters/1000 feet. *Eliminate* all ignition sources (no smoking, flares, sparks or flames in immediate area). All equipment used when handling the product must be grounded. Do not touch or walk through spilled material. Stop leak if you can do it without risk. Prevent entry into waterways, sewers, basements or confined areas. A vapor-suppressing foam may be used to reduce vapors. Absorb or cover with dry earth, sand or other non-combustible material and transfer to containers. Use clean non-sparking tools to collect absorbed material. *Large spill*: dike far ahead of liquid spill for later disposal. Water spray may reduce vapor; but may not prevent ignition in closed spaces.

Fire Extinguishing: Hazardous decomposition includes oxides of carbon and copper. As an immediate precautionary measure, isolate spill or leak area in all directions for at least 50 meters/150 feet for liquids and at least 25 meters/75 feet for solids. *Fire involving storage or vehicular tanks:* isolate for 800 meters/0.5 mile in all directions; also, consider initial evacuation for 800 meters /0.5 mile in all directions.

CAUTION: (1) This product may have a very low flash point: Use of water spray when fighting fire may be inefficient. (2) For mixtures containing alcohol or polar solvent, alcohol-resistant foam may be more effective. *Small fire*: dry chemical, CO_2, water spray or regular foam. *Large fire:* water spray, fog or regular foam. Do not use straight streams. Move containers from fire area if you can do it without risk. *Fire involving tanks or vehicle loads:* fight fire from maximum distance or use unmanned hose holders or monitor nozzles. Cool containers with flooding quantities of water until well after fire is out. Withdraw immediately in the case of rising sound from venting safety devices or discoloration of tank. ALWAYS stay away from tanks engulfed in fire. For massive fire, use unmanned hose holders or monitor nozzles; if this is impossible, withdraw from area and let fire burn.

Disposal Method Suggested: Copper-containing wastes can be concentrated through the use of ion-exchange, reverse osmosis, or evaporators to the point where copper can be electrolytically removed and sent to a reclaiming firm. Details of copper recovery from a variety of industrial wastes have been published. If recovery is not feasible, the copper can be precipitated by the use of caustics and the sludge deposited in a chemical waste landfill. Recommendable methods: Precipitation, solidification, landfill, discharge to sewer, & incineration. Peer-review: Precipitate copper with alkali, filter, solidify precipitate. (Do not use ammonia as alkali.) Cation exchange will allow recovery of copper. Eluate from cation exchanger can be passed through anion exchanger to remove (or reduce) naphthenic acid content. Exhausted ion-exchange resins can be landfilled. (Peer-review conclusions of an IRPTC expert consultation[UN].)

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- USEPA, Toxicology of Metals, Vol. II: Copper, Report EPA-600/1-77-022, pp 206-221, Research Triangle Park, NC (May 1977)
- USEPA, Copper: Ambient Water Quality Criteria, Washington DC (1980)

Copper oxychloride C:1388

Use Type: Fungicide

CAS Number: 1332-40-7; 1332-65-6; 1344-71-4; 74315-47-2

Formula: $Cl_2Cu_4H_6O_6$

Synonyms: Basic copper chloride; Basic cupric chloride; Blue copper; Copper chloride, basic; Copper chloride, mixed with copper oxide, hydrate; Copper chloride oxide; Copper chloride oxide, hydrate; Copper chloroxide; Copper OC fungicide; Cupric oxide chloride

Trade Names: AGRIZAN®; BASF® GRUNKUPFER; BLITOX®; BLITOX® 50; BLUE COPPER-50®; CHEMOCIN®; CHEMPAR®; COBOX®; COBOX BLUE®; COLLOIDOX®; COPPERSAN®; COPPESAN®; COPPESAN BLUE®; COPRANTOL®; COPREX®; COPROSAN BLUE®; COP-TOX®; COXYSAN®; CU-56®; CUPRAL 45®; CUPRAMAR®; CUPRAMER®; CUPRANTOL®; CUPRAVET®; CUPRAVIT®; CUPRAVIT® FORTE; CUPRAVIT GREEN®; CUPRICOL®; CUPRITOX®; CUPROKYLT®; CUPROL®; CUPROSAN®; CUPROSANA®; CUPROSAN BLUE®; CUPROVINOL; CUPROX®; CUPROXOL®; DEVICOPPER®; FALIGRUEN®; FYCOL 8®; FYTOLAN®; KAURITIL®; KILEX®; KT 35®; KUPRICOL®; KUPRIKOL®; MICROCOP®; MIEDZIAN®; MIEDZIAN 50®; NEORAM BLU®; OXICOB®; OXIVOR®; OXYCLOR®; OXYCUR®; PARRYCOP®; PEPROSAN; RECOP®; RHODIACUIVRE®; SUTOX®; TAMRAGHOL®; TRICOP 50®; VIRICUIVRE®; VITIGRAN®; VITIGRAN BLUE®

Chemical class: Inorganic copper

EPA/OPP PC Code: 008001

California DPR Chemical Code: 156

UN/NA & ERG Number: UN3077 (solid)/171

RTECS® Number: GL7020000

EC Number: 215-572-9

Uses: Used to control fungi on beets, fruit crops, grapes, olive trees, potatoes, vegetables, tomatoes, ornamental plants and many more. Used as a bird repellant.

U.S. Maximum Allowable Residue Levels for Copper Oxychloride ($Cu_2Cl(OH)_3$) [40 CFR 180.1021]: Raw agricultural commodities Exempted (as fungicide)

Regulatory Authority and Advisory Information:

Acute Oral Category: 2, WARNING

Clean Water Act: Toxic Pollutant (Section 401.15) as copper and compounds

RCRA Ground Water Monitoring List. Suggested test method(s) (PQL *ug*/L): 6010(60); 7210(200) Note: All species in the ground water that contain copper are included

EPCRA (Section 313): Includes any unique chemical substance that contains copper as part of that chemical's infrastructure

Form R *de minimus* concentration reporting level: 1.0%

Description: Bluish-green, odorless powder. Soluble in acids, ammonia; insoluble in water. Molecular weight = 427.12.

Incompatibilities: When heated to decomposition or on contact with acids or acid fumes, may produce highly toxic chloride fumes; deadly phosgene gas may be formed. May cause pitting of some metals.

Harmful Effects and Symptoms

Short Term Exposure: Contact with eyes or skin may cause irritation or injury. Inhalation should be avoided; use NIOSH- or CEN (UK)-approved air-purifying respirators for pesticides. May be harmful if swallowed. LD_{50} (oral, human) = 200 mg/kg.

First Aid: If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least 15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately. If this chemical contacts the skin, remove contaminated clothing and wash immediately with soap and water. Seek medical attention immediately. If this chemical has been inhaled, remove from exposure, begin rescue breathing (using universal precautions) if breathing has stopped, and CPR if heart action has stopped. Transfer promptly to a medical facility. When this chemical has been swallowed, get medical attention. Give large quantities of water and induce vomiting. Do not make an unconscious person vomit.

Personal Protective Methods: Applicators and other handlers must wear: Coveralls worn over long-sleeved shirt and long pants; Chemical-resistant gloves such as DuPont™ Tychem® suit fabrics, barrier laminate, or Viton®; Chemical-resistant footwear plus socks; Protective eye wear; Chemical-resistant headgear for overhead exposure; Chemical-resistant apron when cleaning equipment, mixing, or loading[83]. Agricultural Use/Engineering Controls: When handlers use closed systems, enclosed cabs, or aircraft in a manner that meets the requirements listed in the Worker Protection Standard (WPS) for agricultural pesticides, 40 CFR 170.240(d)(4-6), the handler PPE requirements may be reduced or modified as specified in the Worker Protection Standard. Firefighters should wear NIOSH approved self-contained breathing apparatus and full protective clothing.

Respirator Selection: Wherever and whenever workplace conditions warrant respirator use, a respiratory protection program must be followed that meets one or more of the following requirements: OSHA's 29 CFR 1910.134, ANSI Z88.2, or European Standard EN 149.

Storage: Color Code-Blue: Health Hazard/Poison: Store in a tightly closed container in a dry, well-ventilated and secure poison location. Prior to working with this chemical you should be trained on its proper handling and storage. Where possible, automatically transfer material from other storage containers to process containers.

Shipping: Environmentally hazardous substances, solid or liquid, usually fall in Hazard Class 9.

Spill Handling: Do not touch or walk through spilled material. Stop leak if you can do it without risk. Prevent dust cloud. Avoid inhalation of asbestos dust. *Small dry spill:* with clean shovel place material into clean, dry container and cover loosely; move containers from spill area. *Small spill:* take up with sand or other non-combustible absorbent material and place into containers for later disposal. *Large spill*: dike far ahead of liquid spill for later disposal. Cover powder spill with plastic sheet or tarp to minimize spreading. Prevent entry into waterways, sewers, basements or confined areas.

Fire Extinguishing: Hazardous decomposition includes oxides of copper and carbon and hydrogen chloride gas. As an immediate precautionary measure, isolate spill or leak area in all directions for at least 50 meters/150 feet for liquids and at least 25 meters/75 feet for solids. *Fire involving storage or vehicular tanks:* isolate for 800 meters/0.5 mile in all directions; also, consider initial evacuation for 800 meters (0.5 mile) in all directions. *On a small fire:* use dry chemical, CO_2, water spray or regular foam. *On a large fire:* use water spray, fog or regular foam. Do not scatter spilled material with high-pressure streams of water. Move containers from fire area if you can do it without risk. Dike fire-control water for later disposal. *Fire involving tanks:* from a secure, explosion-proof location, use water spray to cool exposed containers. If cooling streams are ineffective (venting sound increases in volume and pitch, tank discolors, or shows any signs of deforming), withdraw immediately to a secure position. Always stay away from tanks engulfed in fire. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode.

Disposal Method Suggested: Copper-containing wastes can be concentrated through the use of ion-exchange, reverse osmosis, or evaporators to the point where copper can be electrolytically removed and sent to a reclaiming firm. Details of copper recovery from a variety of industrial wastes have been published. If recovery is not feasible, the copper can be precipitated by the use of caustics and the sludge deposited in a chemical waste landfill. Recommendable methods: Precipitation, solidification, landfill, discharge to sewer, & incineration. Peer-review: Precipitate copper with alkali, filter, solidify precipitate. (Do not use ammonia as alkali.) Cation exchange will allow recovery of copper. Eluate from cation exchanger can be passed through anion exchanger to remove (or reduce) naphthenic acid content. Exhausted ion-exchange resins can be landfilled. (Peer-review conclusions of an IRPTC expert consultation[UN].)

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- USEPA, Office of Pesticide Programs, Pesticide Residue Limits, "Copper Oxychloride," 40 CFR 180.1001 (b), 180.1021. http://www.epa.gov/pesticides/food/viewtols.htm
- USEPA, Copper: Ambient Water Quality Criteria, Washington DC (1980)

Copper sulfate C:1390

Use Type: Fungicide, Algaecide, Bactericide, Herbicide, Molluscicide

CAS Number: 7758-98-7; 7758-99-8 (pentahydrate)

Formula: CuO_4S, $CuSO_4$

Synonyms: Blue copper; Blue stone; Blue vitriol; Copper monosulfate; Copper sulfate (1:1); Copper(II) sulfate; Copper(2+) sulfate; Copper(2+) sulfate (1:1); Copper sulfate pentahydrate; Cu basic sulfate; Cupric sulfate anhydrous; Cupric sulphate; Griffin super Cu; Phyto-bordeaux; Roman vitriol; Sulfuric acid, copper(2+) Salt (1:1); Sulfate of copper; Tri-basic copper sulfate

Trade Names: AGRITOX®; BASICOP®; BCS COPPER FUNGICIDE®; BSC FLOWABLE®[C]; COPSIN®; CP BASIC SULFATE®; CUPROFIX®; FUNGI-SPERSE II[C]; SULTRACOB®; TNCS® 53; TRIANGLE®

Chemical class: Inorganic

EPA/OPP PC Code: 024408; 024401 (pentahydrate)

California DPR Chemical Code: 1778

HSDB Number: 2968 (pentahydrate)

UN/NA & ERG Number: UN9109; UN3077 (solid)/171

RTECS® Number: GL8800000; GL8900000 (pentahydrate)

EC Number: 231-847-6

Uses: Copper sulfate is a fungicide used to control bacterial and fungal diseases of fruit, vegetable, nut, and field crops. These diseases include mildew, leaf spots, blights, and apple scab. It is used as a protective fungicide (Bordeaux mixture) for leaf application and seed treatment. It is also used as an algaecide and herbicide, and to kill slugs and snails in irrigation and municipal water treatment systems. It has been used to control Dutch elm disease. It is available as a dust, wettable powder, or liquid concentrate. Used as a fungicide and algaecide, in veterinary medicine and others. Copper sulfate is also used to detect and to remove trace amounts of water from alcohols and organic compounds.

U.S. Maximum Allowable Residue Levels for copper sulfate pentahydrate [40 CFR 180.1001(b)]: When applied to growing crops, in accordance with good agricultural practice, cuprous oxide is exempt from the requirement of a tolerance. (7/1/2000).

Fish toxicity (threshold)[101]: High–2.85539 ppb, MATC (Maximum Acceptable Toxicant Concentration)

Regulatory Authority and Advisory Information:

Carcinogenicity: IARC: Animal Inadequate Evidence; Human Inadequate Evidence*, not classifiable as carcinogenic to humans*, Group 3; EPA: Not Classifiable as to human carcinogenicity

Health Advisory: Mutagen, Developmental/Reproductive Toxin

Acute Oral Category: 3, CAUTION

As copper compounds:

Clean Water Act: Toxic Pollutant (Section 401.15)

RCRA 40CFR264, appendix 9; TSD Facilities Ground Water Monitoring List. Suggested test method(s) (PQL μg/L): 6010 (60); 7210 (200) Note: All species in the ground water that contain copper are included

EPCRA (Section 313): Includes any unique chemical substance that contains copper as part of that chemical's infrastructure. This category does not include copper phthalocyanide compounds that are substituted with only hydrogen; and/or chlorine; and/or bromine. Form R *de minimis* concentration reporting level: 1.0%

European/International Regulations: Hazard Symbol: N; risk phrases: R51/53; safety phrases: S61 (see Appendix 1)

WGK (German Aquatic Hazard Class): 2-Hazard to waters

Description: Copper sulfate is a greenish-white crystalline solid; the pentahydrate is blue powder or granules, or ultramarine crystalline solid. Molecular weight = 159.60; 249.70 (pentahydrate); Specific gravity (H_2O:1) = 2.284; Boiling point = 150 °C (pentahydrate) with – $5H_2O$; Freezing/Melting point = (decomposes) > 200 °C; decomposes > 110 °C (pentahydrate) with – $4H_2O$; copper sulfate decomposes to CuO @ 650 °C. Hazard Identification (based on NFPA-704 M Rating System): Health 2, Flammability 0, Reactivity 0. Highly soluble in water; forms a bright blue solution.

Incompatibilities: Aqueous solution is an acid. May form explosive materials on contact with acetylene and nitromethane. Incompatible with strong bases, hydroxylamine, magnesium, zirconium, sodium hypobromite, hydrazine.

Permissible Exposure Limits in Air:

Protective Action Criteria (PAC) Ver. 27[89]

PAC-1: 2.5 mg/m^3
PAC-2: 2.5 mg/m^3
PAC-3: 55 mg/m^3

pentahydrate

PAC-1: 12 mg/m^3
PAC-2: 60 mg/m^3
PAC-3: 1200 mg/m^3

NIOSH IDLH: 100 mg[Cu]/m^3

copper and its inorganic compounds

DFG MAK: 0.1 mg/m^3 measured as the inhalable fraction of the aerosol; Peak Limitation Category II(2); Pregnancy Risk Group C

Determination in Air: Copper dusts and mists are collected on a filter, worked up with acid, measured by atomic absorption. See NIOSH Method #7029 for copper[18]. For copper fume: filter collection, acid digestion, measurement by atomic absorption.

Permissible Concentration in Water: The permissible concentration of total recoverable copper in water to protect freshwater aquatic life is 5.6 μg/L as a 24 hr avg. The log of this concentration should not exceed the numerical value of log [0.94 In (hardness) – 1.23]. The corresponding value to protect saltwater aquatic life is 4.0 μg/l as a 24 hr average and should not exceed 23 μg/L at any time.

Short Term Exposure: *Inhalation:* May cause irritation to nose, throat and lungs, causing coughing and wheezing. *Skin:* May cause irritation of skin, localized coloration, itching and burns. *Eyes:* May cause severe irritation, inflammation, burns, excessive tissue fluid and a cloudy cornea; possible permanent damage. *Ingestion:* Poisonous if swallowed. May cause burning and metallic taste in mouth; blue skin coloration; intense inflammation of the stomach and intestines, abdominal pain; vomiting, diarrhea, blood in feces; headache, cold sweat; weak pulse; salivation, nausea, dehydration, low blood pressure; jaundice, and kidney failure. Death may result from a dose of a little as 1 teaspoon for a 150 pound person. LD_{50} (oral, rat) = 450–850 mg/kg; LD_{50} (dermal, rat) = >2 g/kg.

Long Term Exposure: May cause mutations in humans. May damage the testes and decrease fertility in both males and females. May cause skin allergy and thickening of the skin; copper deposits can cause discoloration in the skin and hair, leaving a green color. Repeated exposure can cause shrinking of the lining of the inner nose with watery discharge; liver damage. Individuals with Wilson's disease absorb, retain, and store copper excessively. May cause tumors.

Points of Attack: Skin, reproductive system; liver.

Medical Surveillance: Serum and urine copper level. Liver and kidney tests. Evaluation by a qualified allergist, including exposure history and testing, may help diagnose allergy. More than light alcohol consumption may exacerbate the liver damage caused by copper sulfate. In addition to comprehensive initial medical and work histories emphasizing reproductive experience and menstrual history, patient should have physical examination and testing of genito-urinary tract, sperm count, motility and morphology. If required, other tests, such as serum testosterone, serum follicle stimulating hormone (FSH), and serum lutenizing hormone (LH), may be indicated.

First Aid: If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least 15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately. If this chemical contacts the skin, remove contaminated clothing and wash immediately with soap and water. Seek medical attention immediately.

If this chemical has been inhaled, remove from exposure, begin rescue breathing (using universal precautions, including resuscitation mask) if breathing has stopped and CPR if heart action has stopped. Transfer promptly to a medical facility. When this chemical has been swallowed, get medical attention. Give large quantities of water and induce vomiting. Do not make an unconscious person vomit. *Note to Physician:* Empty stomach by lavage with 0.1% solution of potassium ferrocyanide or milk. Liver or kidney function tests may be indicated. May result in methemoglobinemia.

Personal Protective Methods: Wear protective gloves and clothing to prevent any reasonable probability of skin contact. Safety equipment suppliers/manufacturers can provide recommendations on the most protective glove/clothing material for your operation. Neoprene™ and polyvinyl chloride are among the recommended protective materials. All protective clothing (suits, gloves, footwear, headgear) should be clean, available each day, and put on before work. Contact lenses should not be worn when working with this chemical. When working with liquids, wear splash-proof chemical goggles and face shield unless full facepiece respiratory protection is worn. When working with powders or dusts, wear dust-proof chemical goggles and face shield unless full facepiece respiratory protection is worn. Employees should wash immediately with soap when skin is wet or contaminated. Provide emergency showers and eyewash.

Respirator Selection: *Copper dusts and mists: 5 mg/m^3*: Qm (APF = 25) (any quarter-mask respirator). *10 mg/m^3:* Any particulate respirator equipped with an N95, R95, or P95 filter (including N95, R95, and P95 filtering face-pieces) except quarter-mask respirators. The following filters may also be used: N99, R99, P99, N100, R100, P100; or Sa (APF = 10) (any supplied-air respirator). *25 mg/m^3:* Sa:Cf (APF = 25) (any supplied-air respirator operated in a continuous-flow mode); PaprHie (APF = 25) (any powered, air-purifying respirator with a high-efficiency particulate filter). *50 mg/m^3*: 100 F (APF = 50) (any air-purifying, full facepiece respirator with and N100, R100, or P100 filter); or PaprTHie (APF = 50) (any powered, air-purifying respirator with a tight-fitting face-piece and a high-efficiency particulate filter); or SCBAF (APF = 50) (any self-contained breathing apparatus with a full facepiece); or SaF (APF = 50) (any supplied-air respirator with a full facepiece). *100 mg/m^3:* SaF: Pd,Pp (APF = 2000) (any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode). *Emergency or planned entry into unknown concentrations or IDLH conditions:* SCBAF: Pd,Pp (APF = 10,000) (any self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode); or SaF: Pd,Pp: ASCBA (APF = 10,000) (any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary self-contained breathing apparatus operated in a pressure-demand or other positive-pressure mode). *Escape*: 100 F (APF = 50) (any air purifying, full facepiece respirator with and N100, R100, or P100 filter); or SCBAE (any appropriate escape-type, self-contained breathing apparatus). *Note:* Substance reported to cause eye irritation or damage; may require eye protection.

Storage: Color Code-Green: General storage may be used. Prior to working with this chemical you should be trained on its proper handling and storage. Store in tightly closed containers in a cool, well-ventilated area away from incompatible materials.

Shipping: Environmentally hazardous substances, solid, n.o.s. This chemical requires a shipping label of "CLASS 9." It falls in Hazard Class 9[20][21].

Spill Handling: Evacuate persons not wearing protective equipment from area of spill or leak until clean up is complete. Remove all ignition sources. Collect powdered material in the most convenient and safe manner and deposit in sealed containers. Ventilate area after clean up is complete. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable.

Fire Extinguishing: This chemical is a noncombustible solid. Use dry chemical, carbon dioxide; water spray; or foam extinguishers. Hazardous decomposition includes oxides of sulfur. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies. Containers may explode in fire. From a secure, explosion-proof location, use water spray to cool exposed containers. If cooling streams are ineffective (venting sound increases in volume and pitch, tank discolors, or shows any signs of deforming), withdraw immediately to a secure position. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode.

Disposal Method Suggested: Add soda ash to waste $CuSO_4$ solution; let stand 24 hours. Decant and neutralize solution before flushing to sewer. Landfill sludge[22]. Copper-containing wastes can be concentrated through the use of ion exchange, reverse osmosis, or evaporators to the point where copper can be electrolytically removed and sent to a reclaiming firm. Details of copper recovery from a variety of industrial wastes have been published. If recovery is not feasible, the copper can be precipitated by the use of caustics and the sludge deposited in a chemical waste landfill. Recommendable methods: Precipitation, solidification, landfill, discharge to sewer, & incineration. Peer-review: Precipitate copper with alkali, filter, solidify precipitate. (Do not use ammonia as alkali.) Cation exchange will allow recovery of copper. Eluate from cation exchanger can be passed through anion exchanger to remove (or reduce) naphthenic acid content. Exhausted ion-exchange resins can be landfilled. (Peer-review conclusions of an IRPTC expert consultation[UN].)

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Coumaphos C:1420

Use Type: Insecticide, Nematocide; Veterinary medication
CAS Number: 56-72-4
Formula: $C_{14}H_{16}ClO_5PS$
Synonyms: 3-Chloro-7-hydroxy-4-methyl-coumarin *O,O*-diethyl phosphorothioate; 3-Chloro-7-hydroxy-4-methyl-coumarin-*O,O*-diethylphosphorothionate; 3-Chloro-7-hydroxy-4-methyl-coumarin *O*-ester with *O,O*-diethylphosphorothioate; 3-Chloro-4-methyl-7-coumarinyldiethyl phosphorothioate; *O*-3-Chloro-4-methyl-7-coumarinyl *O,O*-diethyl phosphorothioate; 3-Chloro-4-methyl-7-hydroxycoumarindiethyl thiophosphoric acid ester; 3-Chloro-4-methylumbelliferoneo-ester with *O,O*-diethyl phosphorothioate; Coumafos; *O,O*-Diethylo-(3-chloro-4-methyl-7-coumarinyl)phosphorothioate; *O,O*-Diethylo-(3-chloro-4-methylcoumarinyl-7) thiophosphate; *O,O*-Diethylo-(3-chloro-4-methyl-2-oxo-2H-benzopyran-7-yl)phosphorothioate; *O,O*-Diethyl-3-chloro-4-methyl-7-umbelliferone thiophosphate; *O,O*-Diethylo-(3-chloro-4-methylumbelliferyl)phosphorothioate; Diethyl-3-chloro-4-methylumbelliferyl thionophosphate; Diethylthiophosphoric acid ester of 3-chloro-4-methyl-7-hydroxycoumarin; ENT 17,957; NCI-C08662; Phosphorothioic acid, *O*-(3-chloro-4-methyl-2-oxo-2H-1-benzopyran-7-yl) *O,O*-diethyl ester; Phosphorothioic acid, *O,O*-diethyl ester, *O*-ester with 3-chloro-7-hydroxy-4-methylcoumarin
Trade Names: AGRIDIP®; ASUNTOL®; AZUNTHOL®; BAY® 21/199; BAYER® 21/199; BAYMIX®; BAYMIX® 50; CHECKMITE®; CO-RAL®[C]; DELICE®; MELDANE®; MELDONE®; MUSCATOX®; NEGASHUNT®; DIOLICE®; RESITOX®; SUNTOL®; UMBETHION®
Chemical class: Organophosphate
EPA/OPP PC Code: 036501
California DPR Chemical Code: 165
HSDB Number: 249
UN/NA & ERG Number: UN2783 (solid)/152
RTECS® Number: GN6300000
EC Number: 200-285-3 [*Annex I Index No.:* 015-038-00-3]
Uses: The U.S. EPA classifies the formulations 11.6% EC and 42% flowable concentrate end-use products as Restricted Use Pesticides (RUPs) because they pose a hazard of acute poisoning from ingestion. Coumaphos is an insecticide/acaricide used to control a wide variety of liver stock insects including cattle grubs, fleeceworms, lice scabies, flies, and ticks; the common ectoparasites of beef cattle, dairy cows, sheep, goats, horse, swine, and poultry as well as for screw worms in all these animals. The USDA uses coumaphos in dip vats along the U.S.-Texas border to control ticks that carry Texas Cattle Fever. It is added to cattle and poultry feed to control the development of fly larvae that breed in manure. It has applications in beekeeping.
U.S. Maximum Allowable Residue Levels for Coumaphos and its oxygen analog O,O-diethyl-O-3-chloro-4-methyl-2-oxo-2H-1-benzopyran-7yl phophate (40 CFR 180.189): in or on raw agricultural commodities as follows: 1.0 ppm in or on meat, fat, and meat byproducts of cattle, goats, hogs, horses, poultry, and sheep; 0.5 ppm residues in milk-fat reflecting negligible residues of milk; and 0.1 ppm in eggs.
Human toxicity (long-term)[101]: High–1.75 ppb, Health Advisory
Fish toxicity (threshold)[101]: Intermediate–16.96524 ppb, MATC (Maximum Acceptable Toxicant Concentration)
Regulatory Authority and Advisory Information:
Carcinogenicity: EPA Group E, evidence of non-carcinogenicity for humans.
Acute Oral Category: 1, DANGER–POISON
Health Advisory: Nerve Toxin, Mutagen
Clean Water Act: Section 311 Hazardous Substances/RQ 40CFR117.3 (same as CERCLA, see below)
Superfund/EPCRA 302, Extremely Hazardous Substances: TPQ = 100/10,000 lb (455/4540 kg)
Reportable Quantity (RQ): 10 lb (4.54 kg)
US DOT Regulated Marine Pollutant (49CFR172.101, appendix B), severe pollutant.
European/International Regulations: Hazard Symbol: T+, N; risk phrases: R 21; R28; R50/53; safety phrases: S1/2; S28; S36/37; S45; S60; S61 (see Appendix 1).
WGK (German Aquatic Hazard Class): No value assigned.
Description: Coumaphos is a white to brownish crystalline solid with a slight sulfurous odor. Odor threshold = 0.02 ppm. Molecular weight = 362.78; Specific gravity (H_2O:1) = 1.47 @ 20 °C; Freezing/Melting point = 95 °C. Vapor pressure = 9.7×10^{-8} @20 °C.

Hazard Identification (based on NFPA-704 M Rating System): Health 3, Flammability 1, Reactivity 0. Insoluble in water.

Incompatibilities: Reacts with piperonyl butoxide, oxidizers, strong bases. Slowly reacts with caustics to be hydrolyzed. Keep away from water and heat. In the presence of strong reducing agents such as hydrides, organophosphates form highly toxic and flammable phosphine gas. Contact with oxidizers can cause the release of toxic oxides of phosphorus.

Permissible Exposure Limits in Air:

ACGIH TLV®: 0.05 mg/m^3 TWA, inhalable fraction and vapor [skin]; not classifiable as a human carcinogen; BEI issued (2005)

Protective Action Criteria (PAC) Ver. 27[89]

PAC-1: 0.275 mg/m^3
PAC-2: 3 mg/m^3
PAC-3: 13 mg/m^3

Determination in Air: OSHA versatile sampler-2; Toluene/Acetone; Gas chromatography/Flame photometric detection for sulfur, nitrogen, or phosphorus; NIOSH Method IV Method #5600, Organophosphorus pesticides[18].

Permissible Concentration in Water: Mexico has set a maximum permissible concentration in estuaries of 0.02 mg/Liter.

Determination in Water: EAD Method 1657. The determination of organophosphorus pesticides in municipal and industrial wastewater by gas chromatography. Detection limit = 6.0 ng/L.

Routes of Entry: Inhalation, ingestion; this chemical can be absorbed through the skin, thereby increasing exposure

Harmful Effects and Symptoms

Organophosphates are highly toxic. Symptoms may develop rapidly, or there may be a delay of several hours following exposure before they become noticeable. The delay tends to be longer in the case of some compounds that dissolve fats, lipids, oils and non-polar solvents such as toluene. Symptoms may increase in severity for more than a single day and last for several days. In severe cases of of organophosphate intoxication, respiratory failure may occur.

Short Term Exposure: Contact may cause burns to skin and eyes. Fatal skin absorption can occur even if there is no feeling of irritation after contact. Acetylcholinesterase inhibitor. Exposure can cause rapid, fatal organophosphate poisoning: with headache, sweating, nausea and vomiting, diarrhea, salivation, abdominal cramps, difficult breathing, stiffness of legs, blurring of vision, followed by loss of muscle coordination, muscle twitching, convulsions, coma, and death. May be fatal if inhaled, swallowed, or absorbed through skin. The effects may be delayed. Delayed pulmonary edema may occur after inhalation. The LD_{50} (oral, rat) = <50 mg/kg; LD_{50} (dermal, rat) = <1000 mg/kg.

Long Term Exposure: High or repeated exposure may cause nerve damage causing weakness, poor coordination in the arms and legs. May cause personality changes, depression, memory loss, or irritability. Cholinesterase inhibitor; cumulative effect is possible. This chemical may damage the nervous system with repeated exposure, resulting in convulsions and respiratory failure. May cause liver damage; tumors. A mutagen, may cause reproductive and fetal effects.

Points of Attack: Respiratory system, central nervous system, peripheral nervous system, plasma cholinesterase. Reproductive cells.

Medical Surveillance: Medical observation is recommended for 24 to 48 hours after breathing overexposure, as pulmonary edema may be delayed. Routine biological monitoring of pesticide applicators and field workers includes testing of plasma and red blood cell acetylcholinesterase levels (for enzyme poisoned by this chemical). These tests are normally accurate only if done within about two hours of exposure. If exposure stops, plasma levels return to normal in 1–2 weeks while red blood cell levels may be reduced for 1–3 months. When acetylcholinesterase enzyme levels are reduced by 25% or more below preemployment levels, risk of poisoning is increased, even if results are in lower ranges of "normal." Reassignment to work not involving organophosphate pesticides is recommended until enzyme levels recover. Do not drink any alcoholic beverages before or during use as it promotes absorption of organophosphates. Also consider complete blood count and chest x-ray following acute overexposure. In addition to comprehensive initial medical and work histories emphasizing reproductive experience and menstrual history, patient should have physical examination and testing of genito-urinary tract, sperm count, motility and morphology. If required, other tests, such as serum testosterone, serum follicle stimulating hormone (FSH), and serum lutenizing hormone (LH), may be indicated.

First Aid: **Treatment for organophosphate poisoning consists of thorough decontamination, cardiorespiratory support, and administration of the antidotes atropine and pralidoxime. In cases of severe poisoning, diazepam, an anticonvulsant, should also be administered. Antidotes should be administered as prevention even if the diagnosis is in doubt**. Speed in removing material from eyes and skin is of extreme importance. *Eyes:* Eye contact can cause dangerous amounts of these chemicals to be quickly absorbed through the mucous membrane into the bloodstream. Immediately and gently flush eyes with plenty of warm or cold water (NO hot water) for at least 15 minutes, occasionally lifting the upper and lower eyelids. Get medical aid immediately. *Skin:* Get medical aid. Dermal contact can cause dangerous amounts of these chemicals to be absorbed into the bloodstream. Wearing the appropriate PPE equipment and respirator for organophosphate pesticides, immediately flush skin with plenty of soap and water for at least 15 minutes while removing contaminated clothing and shoes. Shampoo hair promptly if contaminated. The removed, contaminated clothing and shoes should be double-bagged and left in Hot Zone for later disposal by hazardous materials experts. Skin may also be decontaminated with diluted hypochlorite solution. *Inhalation:* Get medical aid. Do not contaminate yourself. Wearing the appropriate PPE equipment and respirator for organophosphate pesticides, immediately remove the victim from the contaminated area to fresh air. If the victim is not breathing, administer artificial respiration. Do not use mouth-to-mouth method if victim ingested or inhaled the substance; give artificial respiration with the aid of a pocket mask equipped with a one-way valve or other proper respiratory medical device. If breathing is difficult, administer oxygen through bag/mask apparatus until medical help arrives. Do not leave victim unattended. *Ingestion:* Call poison control. Loosen all clothing. Never give anything by mouth to an unconscious person. If victim is *unconscious or having convulsions,* do nothing except keep victim warm. Get medical aid. Transfer promptly to a medical facility. In cases of ingestion, **do not induce vomiting**. If the victim is alert and asymptomatic, administer a slurry of activated charcoal at a dose of 1 g/kg (infant, child, and adult dose). A soda can and straw may be of assistance when offering charcoal to a child. *In some cases you may be specifically instructed by poison control to induce vomiting by way of 2 tablespoons of syrup of ipecac (adult) washed down with a cup of water*. Do NOT give activated charcoal before or with ipecac syrup

Note to physician or authorized medical personnel: Treat cases of respiratory compromise, coma, or excessive pulmonary secretions with respiratory support using protocols and techniques available and within the scope of training. Some cases may necessitate procedures such as endotracheal intubation or cricothyrotomy by properly trained and equipped personnel. When possible, atropine (see *Antidotes*, below) should be given under medical supervision. Patients who are comatose, hypotensive, or having seizures or cardiac arrhythmias should be treated according to advanced life support protocols. *Antidotes:* Two antidotes are administered to treat organophosphate poisoning. Atropine is a competitive antagonist of acetylcholine at muscarinic receptors and is used to control the excessive bronchial secretions which are often responsible for death. Pralidoxime relieves both the nicotinic and muscarine effects of organophosphate poisoning by regenerating acetylcholinesterase and can reduce both the bronchial secretions and the muscle weakness associated with poisoning. The initial intravenous dose of atropine in adults should be determined by the severity of symptoms: An initial adult dose of 1.0 to 2.0 mg or pediatric dose of 0.01 mg/kg (minimum 0.01 mg) should be administered intravenously. If intravenous access cannot be established, atropine may also be given intramuscularly, subcutaneously or via endotracheal tube. Doses should be repeated every 15 minutes until excessive secretions and sweating have been controlled. Once bronchial secretion has been controlled, atropine administration should be repeated whenever the secretions begin to recur. In seriously poisoned patients, very large doses may be required. Alterations of pulse rate and pupillary size should not be used as indicators of treatment adequacy. Pralidoxime should be administered as early in poisoning as possible as its efficacy may diminish when given more than 24 to 36 hours after exposure. Doses are as follows: adult 1.0 g; pediatric 25 to 50 mg/kg. The drug should be administered intravenously over 30 to 60 minutes, but in a life-threatening situation one-half of the total dose can be given per minute for a total administration time of 2 minutes. Treatment should begin to take effect within 40 minutes with a reduction in symptoms and the amount of atropine necessary to control bronchial secretion. The initial dose can be repeated in 1 hour and then every 8 to 12 hours until the patient is clinically well and no longer requires atropine. If intravenous access cannot be established, pralidoxime may also be given intramuscularly. Early administration of diazepam in addition to the combined atropine and pralidoxime treatment may help prevent the onset of seizures and potential brain and cardiac morphologic damage following high-level organophosphate poisoning.

Personal Protective Methods: Wear protective gloves and clothing to prevent any reasonable probability of dermal contact. Safety equipment suppliers/manufacturers can provide recommendations on the most protective glove/clothing material for your operation. All protective clothing (suits, gloves, footwear, headgear) should be clean, available each day, and put on before work. Contact lenses should not be worn when working with this chemical. Wear dust-proof chemical goggles and face shield unless full facepiece respiratory protection is worn. Employees should wash immediately with soap when skin is wet or contaminated. Provide emergency showers and eyewash. In cases of poisoning with this substance specific treatment is required; the appropriate means, including instructions, should be available.

Respirator Selection: SCBA > 0.275 mg/m^3. Where potential exists for exposure to coumaphos, use a NIOSH/MSHA- or European Standard EN149-approved supplied-air respirator with a full facepiece operated in the positive-pressure mode, or with a full facepiece, hood, or helmet in the continuous-flow mode; or use a NIOSH/MSHA- or European Standard EN149-approved self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive-pressure mode.

Storage: Color Code-Blue: Health Hazard/Poison. Store in a secure poison location. Store in tightly closed containers in a cool, well-ventilated area.

Shipping: Coumarin derivative pesticides, solid, toxic, requires a shipping label of "poisonous materials". This material falls in the Hazard Class 6.1. Regulated by US DOT as a severe marine pollutant.

Spill Handling: Do not touch spilled material; stop leak if you can do it without risk. First remove all sources of ignition. Evacuate persons not wearing protective equipment from area of spill or leak until clean up is complete. Remove all ignition sources. Use water spray to reduce vapors. *Small spills:* take up with sand or other noncombustible absorbent material and place into containers for later disposal. *Small dry spills:* with clean shovel, place material into clean, dry container and cover; move containers from spill area. *Large spills:* dike far ahead of spill for later disposal. Ventilate area after clean up is complete. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable. Soil Adsorption Index (K_{oc}) = 18,000.

Fire Extinguishing: Poisonous and corrosive gases are produced in fire including hydrogen chloride and oxides of phosphorus, sulfur, and nitrogen. This material may burn but does not ignite easily. Extinguish with water, foam, carbon dioxide, or dry chemicals. This chemical is a combustible solid. Use dry chemical, carbon dioxide; water spray; or alcohol foam extinguishers. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies. From a secure, explosion-proof location, use water spray to cool exposed containers. If cooling streams are ineffective (venting sound increases in volume and pitch, tank discolors, or shows any signs of deforming), withdraw immediately to a secure position. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode.

Disposal Method Suggested: Coumaphos can be decomposed by heating with concentrated alkali. Large amounts should be incinerated in a unit equipped with effluent gas scrubbing. Do not discharge into drains or sewers. Dispose of waste material as hazardous waste using a licensed disposal contractor to an approved landfill. Consult with environmental regulatory agencies for guidance on acceptable disposal practices. Incineration with effluent gas scrubbing is recommended. Containers must be disposed of properly by following package label directions or by contacting your local or federal environmental control agency, or by contacting your regional EPA office.

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Coumatetralyl C:1430

Use Type: Rodenticide

CAS Number: 5836-29-3

Formula: $C_{19}H_{16}O_3$

Synonyms: 2H-1-Benzopyran-2-one, 4-hydroxy-3-(1,2,3,4-tetrahydro-1-naphthalenyl)-; Cumatetralyl; Coumarin, 4-hydroxy-3-(1,2,3,4-tetrahydro-1-naphthyl)-; ENE 11183; 4-Hydroxy-3-(1,2,3,4-tetrahydro-1-napthalenyl)-2H-1-benzopyran-2-one; 4-Hydroxy-3-(1,2,3,4-tetrahydro-1-naphthyl)coumarin; 3-(α-Tetral)-4-oxycoumarin; 3-(α-Tetrayl)-4-hydroxycoumarin; 3-(D-Tetrayl)-4-hydroxycoumarin

Trade Names: BAY® 25634; BAY ENE® 11183B; BAYER® 25,634; ENDOX®; ENDROCID®; ENDROCIDE®; RACUMIN®; RAUCUMIN® 57; RODENTIN®

Chemical class: Coumarin

EPA/OPP PC Code: 496100

UN/NA & ERG Number: UN3027/151

RTECS® Number: GN7630000

EC Number: 227-424-0 [*Annex I Index No.:* 607-059-00-7]

Uses: Coumatetralyl is used for rat control and functions as an anticoagulant, of the warfarin type, that does not induce bait-shyness. Not approved for use in EU countries or the U.S. There are 17 global suppliers[97].

Regulatory Authority and Advisory Information:

Acute Oral Category: 1, DANGER–POISON

Superfund/EPCRA 302 Extremely Hazardous Substances: TPQ = 500/10,000 lb (227/4540 kg)

Reportable Quantity (RQ): 500 lb (227 kg)

European/International Regulations: Hazard Symbol: T+, N; risk phrases: R27/28; R48/24/25; R52/53; safety phrases: S1/2; S28; S36/37; S45; S61 (see Appendix 1)

WGK (German Aquatic Hazard Class): 3-Severe hazard to waters

Description: Coumatetralyl is a yellowish-white, crystalline solid. Molecular weight = 292.35; Specific gravity (H_2O:1) = 1.34; Boiling point = 290 °C; Freezing/Melting point = 174 °C; Vapor pressure = 9×10^{-6} @ 25 °C. Hazard Identification (based on NFPA-704 M Rating System): Health 4, Flammability 1, Reactivity 0. Low solubility in cold water; solubility 10 mg/L. May be soluble in hot water.

Incompatibilities: Oxidizers may cause fire and explosion hazard. Keep away from metals

Permissible Exposure Limits in Air:

Protective Action Criteria (PAC) Ver. 27[89]

PAC-1: 1.5 mg/m^3
PAC-2: 16.5 mg/m^3
PAC-3: 16.5 mg/m^3

Permissible Concentration in Water: No criteria set. Fish Tox = 16.96524000 ppb MATC (INTERMEDIATE); STV (Sediment Toxicity Value): VERY LOW.

Determination in Water: Log K_{ow} = >3.0. Values above 3.0 are likely to bioaccumulate in aquatic organisms.

Routes of Entry: Inhalation, ingestion, dermal contact. Persons with who are taking anticoagulants or are suffering from bleeding disorders must be protected from exposure.

Harmful Effects and Symptoms:

The onset of the symptoms of poisoning may be delayed for a few days following ingestion. Typical symptoms of poisoning include increased bleeding. Coagulation problems may be detected by laboratory analyses only. Large exposures may cause excessive bleeding from minor cuts or abrasions, bleeding from the gums and/or blood in feces. Massive internal bleeding may result in shock. A victim with anemia and/or liver disease may have more severe and persistent poisoning that may be extremely difficult to control.

Short Term Exposure: Inhalation may cause symptoms described in long term exposure. Ingestion may cause gastrointestinal tract acute effects. With a single large ingested dose may cause hemorrhagic shock. This chemical can be absorbed through the skin, thereby increasing exposure or hemorrhagic effect. High exposure can cause death. LD_{50} (oral, rat) = 16.5 mg/kg (highly toxic).

Long Term Exposure: Chronic exposure may cause death by hemorrhagic shock. Absorption by the lungs or after a few days or few weeks of repeated ingestion may cause inhibition of prothrombin synthesis, nose bleeds and bleeding gums, hematoma, small reddish spots like a rash, bruises of the elbows, knees and buttocks, blood in urine and stools, anemia, occasional paralysis due to a stroke. Preexisting blood clotting disease or liver disease are aggravated by coumatetralyl exposure

First Aid: *Emergency Life-Support Procedures:* Acute exposure to this chemical may require decontamination and life support for the victims. Emergency personnel should wear protective clothing appropriate to the type and degree of contamination. Air-purifying or supplied-air respiratory equipment should also be worn, as necessary. Rescue vehicles should carry supplies such as plastic sheeting and disposable plastic bags to assist in preventing spread of contamination. *Inhalation Exposure:* 1. Move victims to fresh air. Emergency personnel should avoid self-exposure to coumatetralyl. 2. Evaluate vital signs including pulse and respiratory rate, and note any trauma. If no pulse is detected, provide CPR. If not breathing, provide artificial respiration. If breathing is labored, administer oxygen or other respiratory support. 3. Obtain authorization and/or further instructions from the local hospital for administration of an antidote or performance of other invasive procedures. 4. RUSH to a health care facility. *Dermal/Eye Exposure:* 1. Remove victims from exposure. Emergency personnel should avoid self-exposure to coumatetralyl. 2. Evaluate vital signs including pulse and respiratory rate, and note any trauma. If no pulse is detected, provide CPR. If not breathing, provide artificial respiration. If breathing is labored, administer oxygen or other respiratory support. 3. Remove contaminated clothing as soon as possible. 4. If eye exposure has occurred, eyes must be flushed with lukewarm water for at least 15 minutes. 5. Wash exposed skin areas twice with soap and water. 6. Obtain authorization and/or further instructions from the local hospital for administration of an antidote or performance of other invasive procedures. 7. RUSH to a health care facility. *Ingestion Exposure:* 1. Evaluate vital signs including pulse and respiratory rate, and note any trauma. If no pulse is detected, provide CPR. If not breathing, provide artificial respiration. If breathing is labored, administer oxygen or other respiratory support. 2. Obtain authorization and/or further instructions from the local hospital for administration of an antidote or performance of other invasive procedures. 3. Vomiting may be induced with syrup of ipecac. If elapsed time since ingestion of coumatetralyl is unknown or suspected to be greater than 30 minutes, do not induce vomiting and RUSH to a health care facility. 4. Ipecac should not be administered to children under 6 months of age. ***Warning:*** Syrup of ipecac should be administered only if victims are alert, have an active gag-reflex, and show no signs of impending seizure or coma. If ANY uncertainty exists, RUSH to a health care facility. 4. The following dosages of ipecac are recommended: children up to 1 year old, 10 mL (1/3 oz); children 1 to 12 years old, 15 mL (1/2 oz); adults, 30 mL (1 oz). Walk the victims and give large quantities of water. If vomiting has not occurred after 15 minutes, ipecac may be re-administered. Continue to ambulate and give water to the victims. If vomiting has not occurred within 15 minutes after second administration of ipecac, administer activated charcoal. 4. Activated charcoal may be administered if victims are conscious and alert. Use 15 to 30 g (1/2 to 1 oz) for children, 50 to 100 g (1-3/4 to 3-1/2 oz) for adults, with 125 to 250 mL (1/2 to 1 cup) of water. 5. Promote excretion by administering a saline cathartic or sorbitol to conscious and alert victims. Children require 15 to 30 g (1/2 to 1 oz) of cathartic; 50 to 100 g (1-3/4 to 3-1/2 oz) is recommended for adults. 6. RUSH to a health care facility[83].

Personal Protective Methods: Wear protective gloves and clothing to prevent any reasonable probability of dermal contact. Safety equipment suppliers/manufacturers can provide recommendations on the most protective glove/clothing material for your operation. All protective clothing (suits, gloves, footwear, headgear) should be clean, available each day, and put on before work. Contact lenses should not be worn when working with this chemical. Wear splash or dust-proof chemical goggles and face shield unless full facepiece respiratory protection is worn. Employees should wash immediately with soap when skin is wet or contaminated. Provide emergency showers and eyewash.

Respirator Selection: SCBA > 1.5 mg/m^3. Specific respirator(s) have not been recommended by NIOSH.

The following might be considered in and emergency: SCBAF: Pd,Pp (APF = 10,000) (any NIOSH/MSHA- or European Standard EN 149-approved self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode); or SaF: Pd,Pp: ASCBA (APF = 10,000) (any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary, self-contained breathing apparatus operated in a pressure-demand or other positive-pressure mode). *Escape:* 100F (APF = 50) (any air-purifying, full facepiece respirator with an N100, R100, or P100 filter); or SCBAE (any appropriate escape-type, self-contained breathing apparatus).

Storage: Color Code-Blue: Health Hazard/Poison. Store in a secure poison location. Prior to working with this chemical you should be trained on its proper handling and storage. Store in tightly closed containers in a cool, well-ventilated area away from oxidizers.

Shipping: Coumarin derivative pesticides, solid, toxic, requires a shipping label of "poisonous materials." This material falls in the Hazard Class 6.1.

Spill Handling: First remove all sources of ignition. Evacuate persons not wearing protective equipment from area of spill or leak until clean up is complete. Remove all ignition sources. Stay upwind; keep out of low areas. Ventilate closed spaces before entering them. Wear positive-pressure breathing apparatus and special protective clothing. Remove and isolate contaminated clothing at the site. Do not touch spilled material. Use water spray to reduce vapors. With clean shovel place material into clean, dry container and cover. Dike far ahead of *large spills* for later disposal. Collect powdered material in the most convenient and safe manner and deposit in sealed containers. Ventilate area after clean up is complete. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable.

Fire Extinguishing: This chemical is a noncombustible solid. *Small fires:* dry chemical, carbon dioxide; water spray or foam. *Large fires:* water spray, fog or foam. Stay upwind, keep out of low areas. Wear positive-pressure breathing apparatus and special protective clothing. Fight fire from maximum distance. Dike fire-control water for later disposal. Hazardous decomposition includes oxides of carbon. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies. From a secure, explosion-proof location, use water spray to cool exposed containers. If cooling streams are ineffective (venting sound increases in volume and pitch, tank discolors, or shows any signs of deforming), withdraw immediately to a secure position. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode.

Disposal Method Suggested: Dissolve in a solvent and burn in a furnace by spraying in the solution. Do not discharge into drains or sewers. Dispose of waste material as hazardous waste using a licensed disposal contractor to an approved landfill. Consult with environmental regulatory agencies for guidance on acceptable disposal practices. Incineration with effluent gas scrubbing is recommended. Containers must be disposed of properly by following package label directions or by contacting your local or federal environmental control agency, or by contacting your regional EPA office.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- U.S. Environmental Protection Agency, "Chemical Profile: Coumatetralyl," Washington, DC, Chemical Emergency Preparedness Program (November 30, 1987)

Crotoxyphos C:1485

Use Type: Insecticide, Acaricide

CAS Number: 7700-17-6

Formula: $C_{14}H_{19}O_6P$

Synonyms: Crotonic acid, 3-hydroxy-, α-methylbenzyl ester, dimethylphosphate, (*E*)-; (*E*)-3-; [(Dimethoxyphosphinyl) oxy]-2-butenoic acid 1-phenylethyl ester; *O,O*-Dimethyl-*O*-(1-methyl-2-carboxy-*α*-phenylethyl)vinyl phosphate; Dimethyl-*cis*-1-methyl-2-(1-phenylethoxycarbonyl)vinyl phosphate; Dimethyl phosphate ester of *α*-methylbenzyl-3-hydroxy-*cis*-crotonate; ENT 24,717; (*E*)-3-Hydroxycrotonic acid, *α*-methylbenzyl ester, dimethyl phosphate; 1-Methylbenzyl-3-(dimethoxyphosphinyloxo)isocrotonate; *α*-Methylbenzyl 3-(dimethoxyphosphinoxy)-*cis*-crotonate; *α*-Methylbenzyl-3-hydroxy-crotonate dimethyl phosphate; *cis*-2-(1-Phenylethoxy)carbonyl-1-methylvinyl dimethylphosphate

Trade Names: CIODRIN®; CIODRIN VINYL PHOSPHATE; CIOVAP®; COOP RTU® CATTLE SPRAY; CYODRIN®; CYPONA E. C. ®; DECROTOX®; DUO-KILL®; PANTOZOL-1®; SD 4294®; SHELL® SD 4294; VAPORIN® DAIRY SPRAY; VOLFAZOL®

Chemical class: Organophosphate

EPA/OPP PC Code: 058801

California DPR Chemical Code: 140

HSDB Number: 1592 as Ciodrin

UN/NA & ERG Number: UN3018 (liquid)/152; UN3077 (solid)/171

RTECS® Number: GQ5075000

EC Number: 331-720-2 [*Annex I Index No.:* 015-109-00-9]

Uses: A contact and stomach poison; controls flies, lice, and ticks on lactating dairy and beef cattle; may also be used on swine, goats, horses, and sheep. Not listed for use in EU countries[115]. Not approved for use in the U.S. There are 13 global suppliers.

Regulatory Authority and Advisory Information:
Health Advisory: Nerve Toxin, Mutagen
U.S. DOT 49CFR172.101, Inhalation Hazard Chemical
European/International Regulations: Hazard Symbol: T, N; risk phrases: R24/25; R50/53; safety phrases: S1/2; S28; S36/37; S45; S60; S61 (see Appendix 1)

Description: Yellowish straw-colored liquid. Mild ester odor. Molecular weight = 314.27; Specific gravity (H_2O:1) = 1.19; 1.2 @ 15 °C; Boiling point = 135 °C @ 0.04 mmHg; Freezing/Melting point = 25.4 °C; Vapor pressure = 1.8×10^{-5} mmHg @ 20 °C. Highly soluble in water; solubility = 1200 ppm.

Incompatibilities: May react violently with antimony(V) pentafluoride. Incompatible with lead diacetate, magnesium, silver nitrate. Corrosive to some metals and plastics. In the presence of strong reducing agents such as hydrides, organophosphates form highly toxic and flammable phosphine gas. Contact with oxidizers can cause the release of toxic oxides of phosphorus.

Determination in Air: OSHA versatile sampler-2; Toluene/Acetone; Gas chromatography/Flame ionization detection; NIOSH IV, Method #5600, Organophosphorus Pesticides[18].

Determination in Water: Log K_{ow} = >3.0. Values above 3.0 are likely to bioaccumulate in aquatic organisms.

Harmful Effects and Symptoms:
Organophosphates are highly toxic. Symptoms may develop rapidly, or there may be a delay of several hours following exposure before they become noticeable. The delay tends to be longer in the case of some compounds that dissolve fats, lipids, oils and non-polar solvents such as toluene. Symptoms may increase in severity for more than a single day and last for several days. In severe cases of of organophosphate intoxication, respiratory failure may occur.

Short Term Exposure: Extremely toxic; a teaspoonful or less can cause death of 150 pound person. Symptoms of exposure include: small eye pupils; blurred vision; eye watering; runny nose; cough; shortness of breath; salivation; dizziness; nausea, stomach cramps, diarrhea, and vomiting; increased blood pressure; profuse sweating; hypermotility, hallucinations; irritability; tingling of the skin; drowsiness; slow heartbeat; convulsions; fluid in lungs; loss of consciousness; incontinence; breathing stops; death. Organophosphates inhibit the action of acetylcholinesterase enzymes, and alter the way in which nervous impulses are transmitted. The effects can last for hours, days, or much longer. The action of the enzymes is reestablished after new enzymes are formed. LD_{50} (oral, rat) = 60 mg/kg.

Long Term Exposure: Cholinesterase inhibitor; cumulative effect is possible. Organophosphates may damage the nervous system with repeated exposure, resulting in convulsions, respiratory failure. May cause liver damage.

Points of Attack: Respiratory system, central nervous system, cardiovascular system, blood cholinesterase

Medical Surveillance: Medical observation is recommended for 24 to 48 hours after breathing overexposure, as pulmonary edema may be delayed. As first aid for pulmonary edema, consider administering a corticosteroid spray. Cigarette smoking may exacerbate pulmonary injury and should be discouraged for at least 72 hours following exposure. Routine biological monitoring of pesticide applicators and field workers includes testing of plasma and red blood cell acetylcholinesterase levels (for enzyme poisoned by this chemical). These tests are normally accurate only if done within about two hours of exposure. If exposure stops, plasma levels return to normal in 1–2 weeks while red blood cell levels may be reduced for 1–3 months. When acetylcholinesterase enzyme levels are reduced by 25% or more below preemployment levels, risk of poisoning is increased, even if results are in lower ranges of "normal." Reassignment to work not involving organophosphate pesticides is recommended until enzyme levels recover. Do not drink any alcoholic beverages before or during use as it promotes absorption of organophosphates. In addition to comprehensive initial medical and work histories emphasizing reproductive experience and menstrual history, patient should have physical examination and testing of genito-urinary tract, sperm count, motility and morphology. If required, other tests, such as serum testosterone, serum follicle stimulating hormone (FSH), and serum lutenizing hormone (LH), may be indicated.

First Aid: **Treatment for organophosphate poisoning consists of thorough decontamination, cardiorespiratory support, and administration of the antidotes atropine and pralidoxime. In cases of severe poisoning, diazepam, an anticonvulsant, should also be administered. Antidotes should be administered as prevention even if the diagnosis is in doubt**. Speed in removing material from eyes and skin is of extreme importance. *Eyes:* Eye contact can cause dangerous amounts of these chemicals to be quickly absorbed through the mucous membrane into the bloodstream. Immediately and gently flush eyes with plenty of warm or cold water (NO hot water) for at least 15 minutes, occasionally lifting the upper and lower eyelids. Get medical aid immediately. *Skin:* Get medical aid. Dermal contact can cause dangerous amounts of these chemicals to be absorbed into the bloodstream. Wearing the appropriate PPE equipment and respirator for organophosphate pesticides, immediately flush skin with plenty of soap and water for at least 15 minutes while removing contaminated clothing and shoes. Shampoo hair promptly if contaminated. The removed, contaminated clothing and shoes should be double-bagged and left in Hot Zone for later disposal by hazardous materials experts. Skin may also be decontaminated with diluted hypochlorite solution. *Inhalation:* Get medical aid. Do not contaminate yourself. Wearing the appropriate PPE equipment and respirator for organophosphate pesticides, immediately remove the victim from the contaminated area to fresh air. If the victim is not breathing, administer artificial respiration.

Do not use mouth-to-mouth method if victim ingested or inhaled the substance; give artificial respiration with the aid of a pocket mask equipped with a one-way valve or other proper respiratory medical device. If breathing is difficult, administer oxygen through bag/mask apparatus until medical help arrives. Do not leave victim unattended. *Ingestion:* Call poison control. Loosen all clothing. Never give anything by mouth to an unconscious person. If victim is *unconscious or having convulsions,* do nothing except keep victim warm. Get medical aid. Transfer promptly to a medical facility. In cases of ingestion, **do not induce vomiting**. If the victim is alert and asymptomatic, administer a slurry of activated charcoal at a dose of 1 g/kg (infant, child, and adult dose). A soda can and straw may be of assistance when offering charcoal to a child. *In some cases you may be specifically instructed by poison control to induce vomiting by way of 2 tablespoons of syrup of ipecac (adult) washed down with a cup of water*. Do NOT give activated charcoal before or with ipecac syrup.

Note to physician or authorized medical personnel: Treat cases of respiratory compromise, coma, or excessive pulmonary secretions with respiratory support using protocols and techniques available and within the scope of training. Some cases may necessitate procedures such as endotracheal intubation or cricothyrotomy by properly trained and equipped personnel. When possible, atropine (see *Antidotes*, below) should be given under medical supervision. Patients who are comatose, hypotensive, or having seizures or cardiac arrhythmias should be treated according to advanced life support protocols. *Antidotes:* Two antidotes are administered to treat organophosphate poisoning. Atropine is a competitive antagonist of acetylcholine at muscarinic receptors and is used to control the excessive bronchial secretions which are often responsible for death. Pralidoxime relieves both the nicotinic and muscarine effects of organophosphate poisoning by regenerating acetylcholinesterase and can reduce both the bronchial secretions and the muscle weakness associated with poisoning. The initial intravenous dose of atropine in adults should be determined by the severity of symptoms: An initial adult dose of 1.0 to 2.0 mg or pediatric dose of 0.01 mg/kg (minimum 0.01 mg) should be administered intravenously. If intravenous access cannot be established, atropine may also be given intramuscularly, subcutaneously or via endotracheal tube. Doses should be repeated every 15 minutes until excessive secretions and sweating have been controlled. Once bronchial secretion has been controlled, atropine administration should be repeated whenever the secretions begin to recur. In seriously poisoned patients, very large doses may be required. Alterations of pulse rate and pupillary size should not be used as indicators of treatment adequacy. Pralidoxime should be administered as early in poisoning as possible as its efficacy may diminish when given more than 24 to 36 hours after exposure. Doses are as follows: adult 1.0 g; pediatric 25 to 50 mg/kg. The drug should be administered intravenously over 30 to 60 minutes, but in a life-threatening situation one-half of the total dose can be given per minute for a total administration time of 2 minutes. Treatment should begin to take effect within 40 minutes with a reduction in symptoms and the amount of atropine necessary to control bronchial secretion. The initial dose can be repeated in 1 hour and then every 8 to 12 hours until the patient is clinically well and no longer requires atropine. If intravenous access cannot be established, pralidoxime may also be given intramuscularly. Early administration of diazepam in addition to the combined atropine and pralidoxime treatment may help prevent the onset of seizures and potential brain and cardiac morphologic damage following high-level organophosphate poisoning.

Respirator Selection: Where potential exists for exposures over *0.2 mg/m*^{3}, use a NIOSH/MSHA- or European Standard EN149-approved full facepiece respirator with a pesticide cartridge. Greater protection is provided by a powered air-purifying respirator. *Where potential for high exposures exists*, use a NIOSH/MSHA- or European Standard EN149-approved supplied-air respirator with a full facepiece operated in the positive-pressure mode, or with a full facepiece, hood, or helmet in the continuous-flow mode; or use a NIOSH/MSHA- or European Standard EN149-approved self-contained breathing apparatus with a full facepiece, hood, or helmet in the continuous-flow mode; or use a NIOSH/MSHA- or European Standard EN149-approved self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive-pressure mode.

Storage: Color Code-Blue: Health Hazard/Poison. Store in a secure poison location. Prior to working with this chemical, you should be trained on its proper handling and storage. Chlorpyrifos must be stored to avoid contact with strong bases, or acids, or acid fumes, since violent reactions occur. Store in tightly closed containers in a cool, well-ventilated area away from sources of heat.

Shipping: Environmentally hazardous substances, solid or liquid, usually fall in Hazard Class 9.

Spill Handling: First remove all sources of ignition. Evacuate persons not wearing protective equipment from area of spill or leak until clean up is complete. Remove all ignition sources. Collect powdered material in the most convenient and safe manner and deposit in sealed containers. Ventilate area after clean up is complete. Absorb liquid containing chlorpyrifos in vermiculite, dry sand, earth, or similar material. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable. Soil Adsorption Index (K_{oc}) = 6070.

Fire Extinguishing: Poisonous gases are produced in fire including oxides of phosphorus and nitrogen. This chemical may burn, but does not readily ignite. Use dry chemical, carbon dioxide; water spray; or standard foam extinguishers. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies. Heat above 130 °C may cause violent exothermic reaction. Containers may explode in fire. From a secure, explosion-proof location, use water spray to cool exposed containers. If cooling streams are ineffective (venting sound increases in volume and pitch, tank discolors, or shows any signs of deforming), withdraw immediately to a secure position. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode.

Disposal Method Suggested: This compound is 50% hydrolyzed in aqueous methanol solution @ pH 6 in 1,930 days; and in 7.2 days at pH 9.96. Spray mixtures of <1% concentration are destroyed with an excess of 5.25% sodium hypochlorite in <30 minutes @ 100 °C, and in 24 hours @ 30 °C. Concentrated (61.5%) mixtures are essentially destroyed by treatment with 100:1 volumes of the above sodium hypochlorite solution and steam in 10 minutes. Containers must be disposed of properly by following package label directions or by contacting your local or federal environmental control agency, or by contacting your regional EPA office.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- Pesticide Management Education Program, "Crotoxyphos (Ciodrin, Ciovap) Chemical Profile 4/85," Cornell University, Ithaca, NY (April 1985). http://pmep.cce.cornell.edu/profiles/insect-mite/cadusafos-cyromazine/crotoxyphos/insect-prof-crotoxyphos.html

Crufomate C:1490

Use Type: Insecticide, Anthelmintic (for cattle)
CAS Number: 299-86-5
Formula: $C_{12}H_{19}ClNO_3P$
Synonyms: 4-*t*-Butyl-2-chlorophenyl methyl methylphosphoramidate; ENT 25,602-x; *O*-Methyl *O*-2-chloro-4-*tert*-butylphenyl *N*-methylamidophosphate; Methylphosphoramidic acid,4-*t*-butyl-2-chlorophenyl methyl ester; Phenol,4-*t*-butyl-2-chloro-, ester with methyl methylphosphoramidate; Phosphoramidic acid, 4-*tert*-butyl-2-chlorophenylphosphor amidate; Phosphoramidic acid, methyl-,2-chloro-4-(1,1-dimethylethyl)phenyl methyl ester; Phosphoramidic acid, methyl-,4-*tert*-butyl-2-chlorophenyl
Trade Names: DOWCO® 132[C]; MONTREL®[C]; RUELENE®[C]; DRENCH®[C]; RULENE®[C]
Chemical class: Organophosphate
EPA/OPP PC Code: 012101
California DPR Chemical Code: 519
HSDB Number: 1547 as Ruelene
UN/NA & ERG Number: UN2783 (solid)/152
RTECS® Number: TB3850000
EC Number: 206-083-1 [*Annex I Index No.:*015-074-00-x]
Uses: All residue limits for crufomate, as listed in 40 CFR 180.295, were revoked by the U.S. EPA on June 9, 1993. All registered uses of crufomate in or on fat, meat, and meat byproducts of cattle, goats, and sheep were canceled It is applied as a spray on plants to kill insects, grubs, and worms on cattle. Not listed for use in EU countries[115].

Regulatory Authority and Advisory Information:
Carcinogenicity: ACGIH Not classified as a human carcinogen
Health Advisory: Nerve Toxin, Reproduction Hazard
US DOT 49CFR172.101, Inhalation Hazardous Chemical as organophosphates
European/International Regulations: Hazard Symbol: Xn, N; risk phrases: R21/22; R50/R53; safety phrases: S2; S36/37; S60; S61 (see Appendix 1)

Description: Crufomate is a white crystalline solid; the commercial product is a yellow oil. Molecular weight = 291.71; Specific gravity (H_2O:1) = 1.16; Boiling point = (decomposes) 118 °C; Freezing/Melting point = (decomposes) 63 °C. Insoluble in water.

Incompatibilities: The substance decomposes on heating, forming corrosive and toxic fumes of hydrogen chloride, nitrogen oxides and phosphorus oxides. Incompatible with strongly alkaline and strongly acidic media. Unstable over long periods in aqueous preparations or above 60 °C.

Permissible Exposure Limits in Air:
OSHA PEL: None
NIOSH REL: 5 mg/m^3 TWA; 20 mg/m^3 STEL
ACGIH TLV®[1]: 5 mg/m^3 TWA; not classifiable as a human carcinogen; BEI$_A$ issued: Acetylcholinesterase inhibiting pesticides
No Protective Action Criteria (PAC) available.

Determination in Air: Filter; none; Gravimetric; NIOSH IV Method #0500, Particulates NOR (total)[18]. OSHA versatile sampler-2; Toluene/Acetone; Gas chromatography/Flame photometric detection for sulfur, nitrogen, or phosphorus; NIOSH Method IV Method #5600, Organophosphorus pesticides[18].

Permissible Concentration in Water: Runoff from spills or fire control may cause water pollution.

Determination in Water: EAD Method 1657. The determination of organophosphorus pesticides in municipal and industrial wastewater by gas chromatography. Detection limit = 6.0 ng/L.

Routes of Entry: Skin absorption, inhalation of dust, ingestion

Harmful Effects and Symptoms

Organophosphates are highly toxic. Symptoms may develop rapidly, or there may be a delay of several hours following exposure before they become noticeable. The delay tends to be longer in the case of some compounds that dissolve fats, lipids, oils and non-polar solvents such as toluene. Symptoms may increase in severity for more than a single day and last for several days. In severe cases of of organophosphate intoxication, respiratory failure may occur.

Short Term Exposure: Acetylcholinesterase inhibitor. Cruformate irritates the eyes, skin, and respiratory tract. Crufomate can affect you when breathed in and quickly enters the body by passing through the skin. Severe poisoning can occur from dermal contact. It is a moderately toxic organophosphate chemical. Exposure can cause effects on the nervous system, rapid severe poisoning with headache, sweating, nausea and vomiting, diarrhea, loss of coordination, convulsions, respiratory failure, and death. The health effects may be delayed. Delayed pulmonary edema may occur after inhalation. LD_{50} (oral, rat) = 460 mg/kg.

Long Term Exposure: Exposure may affect the developing fetus. Crufomate may damage the testes. High or repeated exposure may cause nerve damage and poor coordination in arms and legs. Repeated exposure may cause personality changes of depression, anxiety, or irritability.

Points of Attack: Respiratory system, central nervous system, peripheral nervous system, plasma cholinesterase.

Medical Surveillance: Medical observation is recommended for 24 to 48 hours after breathing overexposure, as pulmonary edema may be delayed. Routine biological monitoring of pesticide applicators and field workers includes testing of plasma and red blood cell acetylcholinesterase levels (for enzyme poisoned by this chemical). These tests are normally accurate only if done within about two hours of exposure. If exposure stops, plasma levels return to normal in 1–2 weeks while red blood cell levels may be reduced for 1–3 months. When acetylcholinesterase enzyme levels are reduced by 25% or more below preemployment levels, risk of poisoning is increased, even if results are in lower ranges of "normal." Reassignment to work not involving organophosphate pesticides is recommended until enzyme levels recover. Do not drink any alcoholic beverages before or during use as it promotes absorption of organophosphates. In addition to comprehensive initial medical and work histories emphasizing reproductive experience and menstrual history, patient should have physical examination and testing of genito-urinary tract, sperm count, motility and morphology. If required, other tests, such as serum testosterone, serum follicle stimulating hormone (FSH), and serum lutenizing hormone (LH), may be indicated.

First Aid: **Treatment for organophosphate poisoning consists of thorough decontamination, cardiorespiratory support, and administration of the antidotes atropine and pralidoxime. In cases of severe poisoning, diazepam, an anticonvulsant, should also be administered. Antidotes should be administered as prevention even if the diagnosis is in doubt**. Speed in removing material from eyes and skin is of extreme importance. *Eyes:* Eye contact can cause dangerous amounts of these chemicals to be quickly absorbed through the mucous membrane into the bloodstream. Immediately and gently flush eyes with plenty of warm or cold water (NO hot water) for at least 15 minutes, occasionally lifting the upper and lower eyelids. Get medical aid immediately. *Skin:* Get medical aid. Dermal contact can cause dangerous amounts of these chemicals to be absorbed into the bloodstream. Wearing the appropriate PPE equipment and respirator for organophosphate pesticides, immediately flush skin with plenty of soap and water for at least 15 minutes while removing contaminated clothing and shoes. Shampoo hair promptly if contaminated. The removed, contaminated clothing and shoes should be double-bagged and left in Hot Zone for later disposal by hazardous materials experts. Skin may also be decontaminated with diluted hypochlorite solution. *Inhalation:* Get medical aid. Do not contaminate yourself. Wearing the appropriate PPE equipment and respirator for organophosphate pesticides, immediately remove the victim from the contaminated area to fresh air. If the victim is not breathing, administer artificial respiration. Do not use mouth-to-mouth method if victim ingested or inhaled the substance; give artificial respiration with the aid of a pocket mask equipped with a one-way valve or other proper respiratory medical device. If breathing is difficult, administer oxygen through bag/mask apparatus until medical help arrives. Do not leave victim unattended. *Ingestion:* Call poison control. Loosen all clothing. Never give anything by mouth to an unconscious person. If victim is *unconscious or having convulsions,* do nothing except keep victim warm. Get medical aid. Transfer promptly to a medical facility. In cases of ingestion, **do not induce vomiting**. If the victim is alert and asymptomatic, administer a slurry of activated charcoal at a dose of 1 g/kg (infant, child, and adult dose). A soda can and straw may be of assistance when offering charcoal to a child. *In some cases you may be specifically instructed by poison control to induce vomiting by way of 2 tablespoons of syrup of ipecac (adult) washed down with a cup of water*. Do NOT give activated charcoal before or with ipecac syrup

Note to physician or authorized medical personnel: Treat cases of respiratory compromise, coma, or excessive pulmonary secretions with respiratory support using protocols and techniques available and within the scope of training. Some cases may necessitate procedures such as endotracheal intubation or cricothyrotomy by properly trained and equipped personnel. When possible, atropine (see *Antidotes*, below) should be given under medical supervision. Patients who are comatose, hypotensive, or having seizures or cardiac arrhythmias should be treated according to advanced life support protocols. *Antidotes:* Two antidotes are administered to treat organophosphate poisoning. Atropine is a competitive antagonist of acetylcholine at muscarinic receptors and is used to control the excessive bronchial secretions which are often responsible for death. Pralidoxime relieves both the nicotinic and muscarine effects of organophosphate poisoning by regenerating acetylcholinesterase and can reduce both the bronchial secretions and the muscle weakness associated with poisoning. The initial intravenous dose of atropine in adults should be determined by the severity of symptoms: An initial adult dose of 1.0 to 2.0 mg or pediatric dose of 0.01 mg/kg (minimum 0.01 mg) should be administered intravenously. If intravenous access cannot be established, atropine may also be given intramuscularly, subcutaneously or via endotracheal tube. Doses should be repeated every 15 minutes until excessive secretions and sweating have been controlled. Once bronchial secretion has been controlled, atropine administration should be repeated whenever the secretions begin to recur. In seriously poisoned patients, very large doses may be required. Alterations of pulse rate and pupillary size should not be used as indicators of treatment adequacy. Pralidoxime should be administered as early in poisoning as possible as its efficacy may diminish when given more than 24 to 36 hours after exposure. Doses are as follows: adult 1.0 g; pediatric 25 to 50 mg/kg. The drug should be administered intravenously over 30 to 60 minutes, but in a life-threatening situation one-half of the total dose can be given per minute for a total administration time of 2 minutes. Treatment should begin to take effect within 40 minutes with a reduction in symptoms and the amount of atropine necessary to control bronchial secretion. The initial dose can be repeated in 1 hour and then every 8 to 12 hours until the patient is clinically well and no longer requires atropine. If intravenous access cannot be established, pralidoxime may also be given intramuscularly. Early administration of diazepam in addition to the combined atropine and pralidoxime treatment may help prevent the onset of seizures and potential brain and cardiac morphologic damage following high-level organophosphate poisoning.

Respirator Selection: Wherever and whenever workplace conditions warrant respirator use, a respiratory protection program must be followed that meets one or more of the following requirements: OSHA's 29 CFR 1910.134, ANSI Z88.2, or European Standard EN 149.

Storage: Color Code-Blue: Health Hazard/Poison. Store in a secure poison location. Prior to working with this chemical you should be trained on its proper handling and storage. Where possible, automatically transfer material from other storage containers to process containers.

Shipping: Organophosphorus pesticides, solid or liquid (nonflammable), require a "poisonous materials" label. This chemical falls in Hazard Class 6.1.

Spill Handling: First remove all sources of ignition. Evacuate persons not wearing protective equipment from area of spill or leak until clean up is complete. Remove all ignition sources. Stay upwind; keep out of low areas. Ventilate area of spill or leak. Remove and isolate contaminated clothing at the site. Do not touch spilled material; stop leak if you can do so without risk. Use water spray to reduce vapors. *Small spills:* absorb with sand or other noncombustible absorbent material and place into containers for later disposal. *Large spills:* dike far ahead of spill for later disposal. Collect powdered material in the most convenient and safe manner and deposit in sealed containers. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable. Seek professional environmental engineering assistance from the U.S. EPA Environmental Response Team at (908) 548-8730 (24-hour response line).

Fire Extinguishing: Poisonous and corrosive gases are produced in fire including hydrogen chloride and oxides of phosphorus, sulfur, and nitrogen. May be fatal if inhaled, ingested or absorbed through skin. Inhalation or contact with some of these materials will irritate or burn skin and eyes. Vapors may cause dizziness or suffocation. *Small fires:* dry chemical, carbon dioxide; water spray; or foam. *Large fires:* water spray, fog, or foam. Stay upwind; keep out of low areas. Ventilate closed spaces before entering them. Firefighting gear (including SCBA) may not provide adequate protection. If exposure occurs, remove and isolate gear immediately and thoroughly decontaminate personnel. Wear positive-pressure breathing apparatus and special protective clothing. Remove and isolate contaminated clothing at the site. Move container from fire area if you can do so without risk. Fight fire from maximum distance. Dike fire control water for later disposal. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies. From a secure, explosion-proof location, use water spray to cool exposed containers. If cooling streams are ineffective (venting sound increases in volume and pitch, tank discolors, or shows any signs of deforming), withdraw immediately to a secure position. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode.

Disposal Method Suggested: Destruction by alkali hydrolysis or incineration. Containers must be disposed of properly by following package label directions or by contacting your local or federal environmental control agency, or by contacting your regional EPA office.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- New Jersey Department of Health and Senior Services and Senior Services, "Hazardous Substance Fact Sheet: Crufomate," Trenton, NJ (May 1998). http://www.state.nj.us/health/eoh/rtkweb/0541.pdf
- Agency for Toxic Substances and Disease Registry, U. S. Department of Health and Human Services, Public Health Service, "Managing Hazardous Materials Incidents," Atlanta, GA (June 2003)

Cyanamide C:1570

Use Type: Herbicide, Plant growth regulator

CAS Number: 420-04-2

Formula: CH_2N_2; H_2NCN

Synonyms: Amidocyanogen; Carbamonitrile; Carbimide; Carbodiimide; Cyanogen nitride; Cyanogenamide; Hydrogen cyanamide

Trade Names: DORMEX®; SKW 83010®

Chemical class: Unclassified

EPA/OPP PC Code: 014002; (011139 old EPA code number)
California DPR Chemical Code: 2238
HSDB Number: 1550
UN/NA & ERG Number: UN2811/154
RTECS® Number: GS5950000
EC Number: [*Annex I Index No.:* 615-013-00-2]
Uses: A U.S. EPA restricted Use Pesticide (RUP). Not currently approved for use in EU countries (re-submitted). Used primarily as a plant growth regulator. Cyanamide may be melted to give a dimer, dicyandiamide or cyanoguanidine. At higher temperatures it gives the trimer, melamine, a raw material for melamine-formaldehyde resins.
Regulatory Authority and Advisory Information:
Carcinogenicity: EPA Group C, Possible human carcinogen
Health Advisory: Reproductive Toxin.
European/International Regulations: Hazard Symbol: T; risk phrases: R21; R25; R36/38; R43; safety phrases: S1/2; S3; S22; S36/37; S45 (see Appendix 1)
WGK (German Aquatic Hazard Class): 2-Hazard to waters
As cyanide compounds:
Clean Air Act: Hazardous Air Pollutants (Title I, Part A, Section 112)
Clean Water Act: 40CFR423, appendix A, Priority Pollutants as cyanide, total
EPCRA (Section 313): x+CN- where x = H+or any other group where a formal dissociation may occur. For example, KCN or $Ca(CN)_2$. Form R *de minimis* concentration reporting level: 1.0%
US DOT Regulated Marine Pollutant (49CFR172.101, appendix B) as cyanide mixtures, cyanide solutions
WGK (German Aquatic Hazard Class): 2-Hazard to waters
Description: Cyanamide is a combustible crystalline solid, but it is usually found as a 25% liquid solution. Molecular weight = 42.04; Specific gravity (H_2O:1) = 1.282; Boiling point = decomposes @ 141 °C; Freezing/Melting point = 45 °C; Flash point = 141 °C (cc)[17]. Hazard Identification (based on NFPA-704 M Rating System): Health 4, Flammability 1, Reactivity 3. Very highly soluble in water; solubility = 78% @ 15 °C.
Incompatibilities: Slowly hydrolyzes in water, releasing ammonia and forming acetate salts. Cyanamide may polymerize at temperatures above 122 °C, or on evaporation of aqueous solutions. Reacts with acids, strong oxidants, strong reducing agents and water, causing explosion and toxic hazard. Attacks various metals. Decomposes when heated above 49 °C, on contact with acids, bases, 1,2-phenylene diamine salts, and moisture, producing toxic fumes including nitrogen oxides and cyanides. Amides react with azo and diazo compounds to generate toxic gases. Flammable gases are formed by the reaction of organic amides with strong reducing agents. Amides are very weak bases (weaker than water). Mixing amides with dehydrating agents such as phosphorus pentoxide or thionyl chloride generates the corresponding nitrile. The combustion of these compounds generates mixed oxides of nitrogen (NOx). This compound is decomposed by strong base or acid[88].
Permissible Exposure Limits in Air:
OSHA PEL: None
NIOSH REL: 2 mg/m^3 TWA
ACGIH TLV®[1]: 2 mg/m^3 TWA
Protective Action Criteria (PAC) Ver. 27[89]
PAC-1: 2 mg/m^3
PAC-2: 2 mg/m^3
PAC-3: 3.3 mg/m^3
DFG MAK: 1 mg/m3, inhalable fraction TWA; Peak Limitation Category II(2) [skin]. Danger of skin sensitization; Pregnancy Risk Group C
Determination in Air: Filter; none; Gravimetric; NIOSH Methods (IV) #0500, Particulates NOR (total)
Determination in Water: Log K_{ow} = <– 1.0. Unlikely to bioaccumulate in marine organisms.
Routes of Entry: Inhalation, skin absorption, ingestion, skin and/or eye contact
References:
Short Term Exposure: Cyanamide is caustic and severely irritates the eyes, skin, and respiratory tract, and may affect the liver. Ingestion or inhalation may cause transitory intense redness of the face, headache, vertigo, increased respiration, tachycardia and hypotensions. The adverse effects of cyanamide are potentiated by the ingestion of alcohol (beer, wine or liquor) within 1–2 days before or after exposure. Cyanamide is a highly reactive chemical and is a dangerous explosion hazard. LD_{50} (oral, rat) = 125 mg/kg; LD_{50} (dermal, rat) = 84 mg/kg.
Long Term Exposure: Repeated or prolonged contact may cause skin sensitization and allergy. Exposure may cause liver and nervous system damage. May cause reproductive and fetal effects.
Points of Attack: Liver and skin. Reproductive cells.
Medical Surveillance: This chemical is a suspected or known human carcinogen. Exposed persons should contact a physician for advice regarding the possible long term health effects and advice for medical monitoring. If overexposure occurs or if illness is suspected, the following are recommended: Liver function tests. Exam of the nervous system. Evaluation by a qualified allergist, including exposure history and testing, may help diagnose allergy. Preliminary medical exam to detect chronic diseases of central nervous system, liver, heart, kidneys, lung and skin, as well as endocrinological or immunological disturbances, should protect susceptible individuals. Periodical medical exams of internal organs, skin and eyes are important to avoid chronic occupational intoxications. They should include lab and patch tests when necessary[83].
First Aid: If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least 15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately. If this chemical contacts the skin, remove contaminated clothing and wash immediately with soap and water. Seek medical attention immediately. If this chemical has been inhaled, remove from exposure, begin rescue breathing (using universal precautions) if breathing has stopped, and CPR if heart action has stopped. Transfer promptly to a medical facility. When this chemical has been swallowed, get medical attention. Give large

quantities of water and induce vomiting. Do not make an unconscious person vomit. Do not induce vomiting when formulations containing petroleum solvents are ingested

Respirator Selection: SCBA > 2 mg/m^3. Where potential exists for exposures over 2 mg/m^3, use a NIOSH/MSHA- or European Standard EN149-approved supplied-air respirator with a full facepiece operated in the positive-pressure mode, or with a full facepiece, hood, or helmet in the continuous-flow mode; or use a NIOSH/MSHA- or European Standard EN149-approved self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive-pressure mode.

Storage: (1) Color Code-Yellow: Reactive Hazard; Store in a location separate from other materials, especially flammables and combustibles. (2) Color Code-Blue: Health Hazard/Poison. Store in a secure poison location. Prior to working with this chemical you should be trained on its proper handling and storage. Store in tightly closed containers in a cool well-ventilated area away from acids or acid fumes. Cyanamide can be stored in glass containers if it is stabilized with phosphoric, acetic, sulfuric, or boric acid; it attacks iron and steel, copper and brass. Sources of ignition, such as smoking and open flames, are prohibited where cyanamide is used, handled, or stored in a manner that could create a potential fire or explosion hazard. Wherever cyanamide is used, handled, manufactured, or stored, use explosion-proof electrical equipment and fittings.

Shipping: Toxic, solids, organic, n.o.s. require a label of "poisonous materials." This material falls in Hazard Class 6.1 and Packing Group III.

Spill Handling: First remove all sources of ignition. Evacuate persons not wearing protective equipment from area of spill or leak until clean up is complete. Remove all ignition sources. Ventilate area of spill or leak. Collect powdered material in the most convenient and safe manner and deposit in sealed containers. Absorb liquids in vermiculite, dry sand, earth, peat, carbon, or a similar material and deposit in sealed containers. It may be necessary to contain and dispose of this chemical as a hazardous waste. Keep cyanamide out of a confined space, such as a sewer, because of the possibility of an explosion, unless the sewer is designed to prevent the build-up of explosive concentrations. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable.

Initial isolation and protective action distances: Distances shown are likely to be affected during the first 30 minutes after materials are spilled and could increase with time. If more than one tank car, cargo tank, portable tank, or large cylinder is involved in the incident is leaking, the protective action distance may need to be increased. You may need to seek emergency information from CHEMTREC at (800) 424-9300 or seek professional environmental engineering assistance from the U.S. EPA Environmental Response Team at (908) 548-8730 (24-hour response line).

Small spills (from a small package or a small leak from a large package)
First: isolate in all directions (feet/meters) 100/30
Then: Protect persons downwind (miles/kilometers)
Day 0.1/0.1
Night 0.1/0.2

Large spills (from a large package or from many small packages)
First: isolate in all directions (feet/meters) 200/60
Then: Protect persons downwind (miles/kilometers)
Day 0.3/0.5
Night 0.5/0.9

Fire Extinguishing: Cyanamide may burn, but does not readily ignite. Hazardous decomposition includes oxides of nitrogen and carbon and hydrogen cyanide gas. *Fire involving storage or vehicular tanks:* isolate for 800 meters/0.5 mile in all directions; also, consider initial evacuation for 800 meters/0.5 mile in all directions. *Small fire:* dry chemical, carbon dioxide or water spray. *Large fire:* dry chemical, carbon dioxide, alcohol-resistant foam or water spray. Move containers from fire area if you can do it without risk. Dike fire-control water for later disposal; do not scatter the material. *Fire involving tanks or car/trailer loads:* fight fire from maximum distance or use unmanned hose holders or monitor nozzles. Do not get water inside containers. Cool containers with flooding quantities of water until well after fire is out. Withdraw immediately in the case of rising sound from venting safety devices or discoloration of tank. Always stay away from tanks engulfed in fire. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode.

Disposal Method Suggested: Add excess alkaline calcium hypochlorite with agitation. Flush to sewer after 24 hours. Cyanamide can also be destroyed in an incinerator equipped with afterburner and scrubber.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- New Jersey Department of Health and Senior Services and Senior Services, "Hazardous Substance Fact Sheet: Cyanamide," Trenton, NJ (November 1994, rev. February 2001). http://www.state.nj.us/health/eoh/rtkweb/0552.pdf
- Sax, N. I., Ed., "Dangerous Properties of Industrial Materials Report," 8, No. 5, 65-68 (1988)

Cyanazine C:1580

Use Type: Herbicide
CAS Number: 21725-46-2
Formula: $C_9H_{13}ClN_6$

Synonyms: 2-Chloro-4-((1-cyano-1-methylethyl)amino)-6-(ethylamino)-*s*-triazine; 2-Chloro-4-(1-cyano-1-methylethylamino)-6-ethylamino-1,3,5-triazine; 2-Chloro-4-ethylamino-6-(1-cyano-1-methyl)ethylamino-*s*-triazine; 2-(4-Chloro-6-ethylamino-1,3,5-triazin-2-ylamino)-2-methylpropionitrile; 2-[(4-Chloro-6-(ethylamino)-*S*-triazin-2-yl)amino]-2-methylpropionitrile; 2-[(4-Chloro-6-(ethylamino)-1,3,5-triazin-2-yl)amino]-2-methylpropanenitrile; 2-((4-Chloro-6-(ethylamino)-*s*-triazin-2-yl)amino)-2-methylpropanenitrile; Cyanazine triazine pesticide; Propanenitrile, 2-((4-Chloro-6-(ethylamino)-1,3,5-triazin-2-yl)amino)-2-methyl-; Propanenitrile, 2-((4-Chloro-6-(ethylamino)-*S*-triazin-2-yl)amino)-2-methyl-; *S*-Triazine, 2-chloro-4-ethylamino-6-(1-cyano-1-methyl)ethylamino-

Trade Names: BLADEX®[C]; BLADEX® 80WP[C]; BULLET®; CYCLE®; CY-PRO®[C]; CYNEX® 41[C]; DW 3418®; EXTRAZINE®[C]; FORTROL®; MATCH®; PAYZE®; SD 15418®; WL 19805®

Chemical class: Triazine; Nitrile

EPA/OPP PC Code: 100101

California DPR Chemical Code: 1640

HSDB Number: 6842

UN/NA & ERG Number: UN2763 (Triazine pesticides, solid, toxic)/151; UN 2998 (Triazine pesticide, liquid, toxic)/151

RTECS® Number: UG1490000

EC Number: 244-544-9 [*Annex I Index No.:* 613-013-00-7]

Uses: On August 2, 1995, the U.S. EPA announced a voluntary phase-out of the use of cyanazine. On January 6, 2000, the U.S. EPA announced the cancellation of all cyanazine registrations. It had been A U.S. EPA restricted Use Pesticide (RUP) because of its teratogenicity and because it has been found in groundwater. Not approved for use in EU countries[115]. Cyanazine is used as a pre- and post-emergent herbicide to control annual grasses and broadleaf weeds. It is used mostly on corn, some on cotton, and less than 1% on grain sorghum and wheat fallow. The compound is formulated as a wettable powder, a flowable suspension, or as granules. In California, major usages are on cotton, corn and corn for forage, almonds, and uncultivated agricultural areas. In 1995, cyanazine was the fourth most widely used synthetic pesticide in the U.S. Cyanazine, atrazine, and simazine are collectively referred to as the triazines and may be alternatively used for each other on corn and in some other situations.

Human toxicity (long-term)[101]: High–1.00 ppb, Health Advisory

Fish toxicity (threshold)[101]: Very low–1411.45410 ppb, MATC (Maximum Acceptable Toxicant Concentration)

Regulatory Authority and Advisory Information:

Carcinogenicity: EPA Group C, Possible human carcinogen

California Proposition 65 Chemical: Developmental/Reproductive toxin (4/1/1990)

Health Advisory: Mutagen, Developmental/Reproductive Toxin, Endocrine disruptor (S!)

Potential Ground Water Pollutant [California FAC Section 13145(d)/12811, inactive)

Acute Oral Category: 2, WARNING

Safe Drinking Water Act: Priority List (55 FR 1470)

EPCRA Section 313 Form R *de minimis* concentration reporting level: 1.0%

Clean Air Act: Hazardous Air Pollutants (Title I, Part A, Section 112)

Clean Water Act: 40CFR423, appendix A, Priority Pollutants as cyanide, total

U.S. EPA Hazardous Waste Number (RCRA No.): P030 as cyanides soluble salts and complexes, n. o. s. RCRA, 40CFR261, Appendix 8 Hazardous Constituents. as cyanides, soluble salts and complexes, n. o. s. EPCRA (Section 313): x+CN- where x = H+or any other group where a formal dissociation may occur. For example, KCN or Ca(CN)2. Form R *de minimis* concentration reporting level: 1.0%

US DOT Regulated Marine Pollutant (49CFR172.101, appendix B) as cyanide mixtures, cyanide solutions or cyanides, inorganic, n. o. s. European/International Regulations: Hazard Symbol: Xn, N; risk phrases: R22; R50/53; safety phrases: S2; S37; S60; S61 (see Appendix 1)

Description: Cyanazine is an off-white to tan crystalline solid. Also available in other forms including a liquid. Molecular weight = 240.73; Freezing/Melting point = 167–169 °C. Hazard Identification (based on NFPA-704 M Rating System): Health 2, Flammability 1, Reactivity 0. Soluble in water; solubility = >150 mg/L. Physical properties may be altered by carrier solvents used in commercial formulations.

Incompatibilities: Incompatible with oxidizers, acids, acid chlorides, acid halides, isocyanates, halogenated organics, peroxides, phenols (acidic), epoxides, anhydrides. Contact with strong reducing agents such as halides may generate explosive flammable gas. Attacks metals in the presence of heat and moisture. Hydrolyzed by strong acids and strong bases.

Permissible Exposure Limits in Air:

NIOSH REL: (nitriles) 2 ppm, Ceiling Concentration, not to be exceeded in any 15-minute work period.

No Protective Action Criteria (PAC) available.

Determination in Air:

NIOSH(2) REL: (Nitriles) TWA 22 mg/m^3; NIOSH(2) REL: (Nitriles); ceiling limit 4 mg/m^3/15 minute. See also NIOSH Criteria Document 78-212 NITRILES

Permissible Concentration in Water: Federal Drinking Water Guidelines: 1 ppb[107]. Federal and State drinking water guidelines for cyanide/cyanide ion: Federal Drinking Water Guidelines: EPA 200 μg/L/cyanide ion; State Drinking Water Standards: California 150 μg/L; State Drinking Water Guidelines: Arizona 220 μg/L

Determination in Water: High-performance liquid chromatography is applicable to the determination of cyanazine in water according to EPA. Log K_{ow} = 2.2. Unlikely to bioaccumulate in marine organisms.

Routes of Entry: Inhalation, passing through the unbroken skin.

References:

Short Term Exposure: This chemical can be absorbed through the skin, thereby increasing exposure. Inhalation of dust can irritate the nose, throat and bronchial tubes.

Because this material has a low vapor pressure, significant inhalation of vapors is unlikely at ordinary temperatures. Contact can irritate the skin or eyes. Overexposure can cause weakness, nausea and difficulty breathing. LD_{50} (oral, rat) = 149 mg/kg; LD_{50} (dermal, rat) = 1200 mg/kg.
Long Term Exposure: Long term effects are unknown. Related chemicals in the triazine chemical groups can cause liver damage, reduce thyroid function and/or cause skin allergy. May cause reproductive toxicity in humans.
Medical Surveillance: Preliminary medical exam to detect chronic diseases of central nervous system, liver, heart, kidneys, lung and skin, as well as endocrinological or immunological disturbances, should protect susceptible individuals. Periodical medical exams of internal organs, skin and eyes are important to avoid chronic occupational intoxications. They should include lab and patch tests when necessary[83]. This chemical is a suspected or known human carcinogen. Exposed persons should contact a physician for advice regarding the possible long term health effects and advice for medical monitoring. In addition to comprehensive initial medical and work histories emphasizing reproductive experience and menstrual history, patient should have physical examination and testing of genito-urinary tract, sperm count, motility and morphology. If required, other tests, such as serum testosterone, serum follicle stimulating hormone (FSH), and serum lutenizing hormone (LH), may be indicated. Liver function tests. Thyroid function tests. Evaluation by a qualified allergist.
First Aid: If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least 15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately. If this chemical contacts the skin, remove contaminated clothing and wash immediately with soap and water. Seek medical attention immediately. If this chemical has been inhaled, remove from exposure, begin rescue breathing (using universal precautions) if breathing has stopped, and CPR if heart action has stopped. Transfer promptly to a medical facility. When this chemical has been swallowed, get medical attention. Give large quantities of water and induce vomiting. Do not make an unconscious person vomit.
Personal Protective Methods: Applicators and other handlers must wear: Coveralls worn over long-sleeved shirt and long pants; Chemical-resistant gloves such as DuPont™ Tychem® suit fabrics, barrier laminate, or Viton®; Chemical-resistant footwear plus socks; Protective eye wear; Chemical-resistant headgear for overhead exposure; Chemical-resistant apron when cleaning equipment, mixing, or loading[83]. Agricultural Use/Engineering Controls: When handlers use closed systems, enclosed cabs, or aircraft in a manner that meets the requirements listed in the Worker Protection Standard (WPS) for agricultural pesticides, ***40 CFR 170.240(d)(4-6)***, the handler PPE requirements may be reduced or modified as specified in the Worker Protection Standard. Firefighters should wear NIOSH approved self-contained breathing apparatus and full protective clothing.
Respirator Selection: *Nitriles*: NIOSH, *10 ppm:* Sa (APF = 10) (any supplied-air respirator); *25 ppm:* Sa:Cf (APF = 25) (any supplied-air respirator operated in a continuous-flow mode); *50 ppm:* SCBAF (APF = 50) (any self-contained breathing apparatus with a full facepiece); or SaF (APF = 50) (any supplied-air respirator with a full facepiece); *250 ppm:* SaF:Pd,Pp (APF = 2000) (any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode). *Emergency or planned entry into unknown concentrations or IDLH conditions:* SCBAF:Pd,Pp (APF = 10,000) (any self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode); or SaF:Pd,Pp:ASCBA (APF = 10,000) (any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary self-contained breathing apparatus operated in a pressure-demand or other positive- pressure mode. *Escape*: GmFOv (APF = 50) [any air-purifying, full facepiece respirator (gas mask) with a chin-style, front- or back-mounted organic vapor canister] or SCBAE (any appropriate escape-type, self-contained breathing apparatus).
Storage: Color Code-Blue: Health Hazard/Poison. Store in a secure poison location. Prior to working with cyanazine you should be trained on its proper handling and storage. Store in tightly closed containers in a cool, well-ventilated area away from heat. Where possible, automatically pump liquid from drums or other storage containers to process containers.
Shipping: Triazine pesticides, solid, toxic, n. o. s. require a shipping label of "poisonous materials." These materials fall in Hazard Class 6.1 and Packing Groups III.
Spill Handling: Issue poison warning.

First: isolate in all directions (feet/meters) 100/30
Then: Protect persons downwind (miles/kilometers)

Day	0.1/0.2
Night	0.1/0.2

Large spills (from a large package or from many small packages)

First: isolate in all directions (feet/meters) 200/60
Then: Protect persons downwind (miles/kilometers)

Day	0.3/0.5
Night	0.5/0.8

First remove all sources of ignition. Evacuate persons not wearing protective equipment from area of spill or leak until clean up is complete. Remove all ignition sources. If appropriate, moisten to prevent dust. Collect powdered material in the most convenient and safe manner and deposit in sealed containers. Ventilate area after clean up is complete. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable.

Fire Extinguishing: Cyanazine decomposes in heat, producing very toxic fumes and gases of hydrogen cyanide, hydrogen chloride, ethyl chloride, ammonia, acetone, and ethylene. Cyanazine may burn, but does not readily ignite. *On a small fire:* use dry chemical, CO_2 or water spray. *On a large fire:* use water spray, fog or regular foam. Move containers from fire area if you can do it without risk. Dike fire-control water for later disposal; do not scatter the material. Use water spray or fog; do not use straight streams. *Fire involving storage or vehicular tanks:* isolate for 800 meters/0.5 mile in all directions; also, consider initial evacuation for 800 meters/0.5 mile in all directions. Fight fire from maximum distance or use unmanned hose holders or monitor nozzles. Do not get water inside containers. Cool containers with flooding quantities of water until well after fire is out. Withdraw immediately in the case of rising sound from venting safety devices or discoloration of tank. ALWAYS stay away from tanks engulfed in fire. For massive fire, use unmanned hose holders or monitor nozzles; if this is impossible, withdraw from area and let fire burn. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode.

Disposal Method Suggested: Generators of waste containing this contaminant (≥100 kg/mo) must conform with EPA regulations governing storage, transportation, treatment, and waste disposal. Dissolve or mix the material with a combustible solvent and burn in a chemical incinerator equipped with an afterburner and scrubber. All federal, state, and local environmental regulations must be observed. In accordance with 40CFR165, follow recommendations for the disposal of pesticides and pesticide containers. Containers must be disposed of properly by following package label directions or by contacting your local or federal environmental control agency, or by contacting your regional EPA office.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- EXTOXNET, Extension Toxicology Network, "Pesticide Information Profile, Cyanazine," Oregon State University, Corvallis, OR. June 1996. ace.orst.edu/info/extoxnet/pips/cyanazin.htm
- Sax, N. I., Ed., "Dangerous Properties of Industrial Materials Report," 3, No. 1, 47-50, New York, Van Nostrand Reinhold Co. (1983)
- USEPA, "Chemical Profile: Cyanazine," Washington DC, Office of Drinking Water (August 1987)
- New Jersey Department of Health and Senior Services and Senior Services, "Hazardous Substance Fact Sheet: Bladex," Trenton, NJ (November, 1986, Rev. October, 2000). http://www.state.nj.us/health/eoh/rtkweb/0240.pdf
- Environment Working Group, "Background Information on Cyanazine," Washington DC, August 2, 1995. http://www.ewg.org/pub/home/reports/Cyanazine/Cyanazine.html

Cycloate C:1668

Use Type: Herbicide
CAS Number: 1134-23-2
Formula: $C_{11}H_{21}NOS$
Synonyms: Cyclohexylethylcarbamothioic acid-*S*-ethyl ester; Cyclohexylethylthiocarbamic acid-*S*-ethyl ester; *S*-Ethyl cyclohexylethylthiocarbamate; *S*-Ethyl-*N*-ethyl-*N*-cyclohexylthiolcarbamate; Hexylthiocarbam
Trade Names: ETSAN®; EUREX®; R-2063®; RO-NEET®; RO-NEET®-6E; RO-NEET® 10G; RONIT®; SABET®
Chemical class: Thiocarbamate
EPA/OPP PC Code: 041301
California DPR Chemical Code: 516
HSDB Number: 1712
UN/NA & ERG Number: UN3082 (environmentally hazardous substances, liquid, n. o. s.)/171
RTECS® Number: GU7200000
EC Number: 214-482-7
Uses: Used to control broadleaf weeds, annual and perennial grasses and nutgrass in spinach, beets, and sugar beets. Not approved for use in EU countries[115]. Actively registered in the U.S.
U.S. Maximum Allowable Residue Levels for Cycloate (40 CFR 180.212): [40 CFR 180.212(a)] (USEPA);beet, garden, root 0.05 ppm (negligible residue); beet, garden, tops 0.05 ppm (negligible residue); beet, sugar, roots 0.05 ppm (negligible residue); beet, sugar, tops 0.05 ppm (negligible residue); spinach 0.05 ppm (negligible residue).
Human toxicity (long-term)[101]: Intermediate–35.00 ppb, Health Advisory
Fish toxicity (threshold)[101]: Very low–658.46663 ppb, MATC (Maximum Acceptable Toxicant Concentration)
Regulatory Authority and Advisory Information:
California Proposition 65 Chemical: Developmental/Reproductive toxin (3/19/1999)
Health Advisory: Mutagen
Acute Oral Category: 3, CAUTION
Potential Ground Water Pollutant [California FAC Section 13145(d)/12811, active]
RCRA Universal Treatment Standards: Wastewater (mg/L), 0.003; Nonwastewater (mg/kg), 1.4
EPCRA Section 313 Form R *de minimis* concentration reporting level: 1.0%
European/International Regulations: Hazard Symbol: Xn; risk phrases: R22 (see Appendix 1)
Description: An oily, clear or amber to yellow liquid. Aromatic odor; Molecular weight 215.36; Specific gravity (H_2O:1) = 1.0 @ 20 °C; Boiling point = 145–146 °C @10 mmHg; Freezing/Melting point = 12 °C; Vapor pressure = 1.6 × 10^{-3} mmHg @ 20 °C. Flash

point = 100 °C; 139C (oc); Moderately soluble in water; solubility = 75–100 mg/L.

Incompatibilities: Reacts violently with powerful oxidizers such as calcium hypochlorite. Flammable gases are generated by the combination of thiocarbamates with aldehydes, nitrides, and hydrides. Thiocarbamates are incompatible with acids, peroxides, and acid halides.

Determination in Water: Log K_{ow} = 3.9–4.1. Values above 3.0 are likely to bioaccumulate in aquatic organisms.

References:

Short Term Exposure: Some thiocarbamates may react with recently ingested alcohol or alcohol-containing products including wine, medications, and cold remedies such as cough-syrups. Low toxicity. Concentrated solutions are slightly corrosive to eyes and mucous membranes. Dust inhalation can cause irritation of the respiratory system with sneezing. Eye contact can cause irritation, watering, pain, and inflammation of the eyelids. Dermal contact can cause irritation and minor ulceration. Ingestion can cause nausea, vomiting, fever, muscle twitching, seizure, rapid respiration, slow heart beat. Severe exposure may result in death. LD_{50} (oral, rat) = 1700 mg/kg; LD_{50} (dermal, rat) = >2500 mg/kg.

Long Term Exposure: A nerve toxin; high or repeated exposures may cause nerve damage.

Points of Attack: Respiratory system, central nervous system, cardiovascular system, skin, eyes.

Medical Surveillance: Preliminary medical exam to detect chronic diseases of central nervous system, liver, heart, kidneys, lung and skin, as well as endocrinological or immunological disturbances, should protect susceptible individuals. Periodical medical exams of internal organs, skin and eyes are important to avoid chronic occupational intoxications. They should include lab and patch tests when necessary[83]. Medical observation is recommended for 24 to 48 hours after breathing overexposure, as pulmonary edema may be delayed. As first aid for pulmonary edema, consider administering a corticosteroid spray. Cigarette smoking may exacerbate pulmonary injury and should be discouraged for at least 72 hours following exposure. Before employment and at regular times after that, the following are recommended: If symptoms develop or overexposure occurs, repeat the above tests as soon as possible and get an exam of the nervous system. Also consider complete blood count and chest x-ray following acute overexposure. Examination of the nervous system. In addition to comprehensive initial medical and work histories emphasizing reproductive experience and menstrual history, patient should have physical examination and testing of genito-urinary tract, sperm count, motility and morphology. If required, other tests, such as serum testosterone, serum follicle stimulating hormone (FSH), and serum lutenizing hormone (LH), may be indicated.

First Aid: Eyes: If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least 15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately. If this chemical contacts the skin, remove contaminated clothing and wash immediately with soap and water. Seek medical attention immediately. If this chemical has been inhaled, remove from exposure, begin rescue breathing (using universal precautions) if breathing has stopped, and CPR if heart action has stopped. Transfer promptly to a medical facility. When this chemical has been swallowed, get medical attention. If victim is conscious and able to swallow, have victim drink 4 to 8 ounces of water. Do not induce vomiting. *Note to physician or authorized medical personnel*: Medical observation is recommended for 24 to 48 hours after breathing overexposure, as pulmonary edema may be delayed. As first aid for pulmonary edema, consider administering a corticosteroid spray. Cigarette smoking may exacerbate pulmonary injury and should be discouraged for at least 72 hours following exposure.

Personal Protective Methods: Reacts with the following absorbent materials: Cellulose-Based; Mineral- and Clay-Based; Dirt/Earth[88]. Applicators and other handlers must wear: Coveralls worn over long-sleeved shirt and long pants; Chemical-resistant gloves such as DuPont™ Tychem® suit fabrics, barrier laminate, or Viton®; Chemical-resistant footwear plus socks; Protective eye wear; Chemical-resistant headgear for overhead exposure; Chemical-resistant apron when cleaning equipment, mixing, or loading[83]. Agricultural Use/Engineering Controls: When handlers use closed systems, enclosed cabs, or aircraft in a manner that meets the requirements listed in the Worker Protection Standard (WPS) for agricultural pesticides, ***40 CFR 170.240(d)(4-6)***, the handler PPE requirements may be reduced or modified as specified in the Worker Protection Standard. Firefighters should wear NIOSH-approved self-contained breathing apparatus and full protective clothing.

Respirator Selection: *At any detectable concentration:* SCBAF: Pd,Pp (APF = 10,000) (any MSHA/NIOSH/MSHA- or European Standard EN 149-approved self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode); or SaF: Pd,Pp: ASCBA (APF = 10,000) (any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary, self-contained breathing apparatus operated in a pressure-demand or other positive-pressure mode). *Escape:* 100F (APF = 50) (any air-purifying, full facepiece respirator with an N100, R100, or P100 filter) or SCBAE (any appropriate escape-type, self-contained breathing apparatus). All respirators selected must be approved by NIOSH under the provisions of 42 CFR 84. The current listing of NIOSH-certified respirators can be found in theNIOSH/NPPTL Certified Equipment List, which is available on the NIOSH Web site.

Storage: Color Code-Green: General storage may be used. Prior to working with this chemical you should be trained on its proper handling and storage. Store in tightly closed containers in a cool, dry place away from ignition sources.

Shipping: Environmentally hazardous substances, solid or liquid, usually fall in Hazard Class 9.

Spill Handling: Evacuate and restrict persons not wearing protective equipment from area of spill or leak until clean up is complete. Remove all ignition sources. Collect powdered material in the most convenient and safe manner and deposit in sealed containers. Ventilate area of spill or leak after clean up is complete. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable. Soil Adsorption Index (K_{oc}) = 400.

Fire Extinguishing: A combustible liquid. Use dry chemical, carbon dioxide; water spray; or alcohol-resistant foam extinguishers. Poisonous gases and oxides of sulfur and nitrogen are produced in fire. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies. From a secure, explosion-proof location, use water spray to cool exposed containers. If cooling streams are ineffective (venting sound increases in volume and pitch, tank discolors, or shows any signs of deforming), withdraw immediately to a secure position. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode.

Disposal Method Suggested: Do not discharge into drains or sewers. Dispose of waste material as hazardous waste using a licensed disposal contractor to an approved landfill. Consult with environmental regulatory agencies for guidance on acceptable disposal practices. Incineration with effluent gas scrubbing is recommended. Containers must be disposed of properly by following package label directions or by contacting your local or federal environmental control agency, or by contacting your regional EPA office.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- U. S. Environmental. Protection Agency, Office of Pesticide Programs, Pesticide Residue Limits, "Cycloate," 40 CFR 180.212. http://www.epa.gov/pesticides/food/viewtols.htm

Cycloheximide C:1730

Use Type: Fungicide; plant growth regulator
CAS Number: 66-81-9
Formula: $C_{15}H_{23}NO_4$
Synonyms: 3[2-(3,5-Dimethyl-2-oxocyclohexyl)-2-hydroxyethyl]glutarimide; NSC-185; 2,6-Piperidinedione, 4-(2-3,5-dimethyl-2-oxocyclohexyl)-2-hydroxyethyl-, (*IS*)-[1*α*(S*),3α,5β]-
Trade Names: ACTI-AID®[C]; ACTIDIONE®[C]; ACTIDIONE® TGF[C]; ACTIDONE®; ACTIDONE® PM; ACTIDONE® TGF; ACTISPRAY; HIZAROCIN®; KAKEN®; NARAMYCIN®; NARAMYCIN A®; NEOCYCLOHEXIMIDE®; U-4527
Chemical Class: Unclassified
California DPR Chemical Code: 5
HSDB Number: 1552
UN/NA & ERG Number: UN2588 (Pesticide, solid, poisonous, n.o.s.)/151; UN2902 (Pesticide, liquid, poisonous, n.o.s.)/151
RTECS® Number: MA4375000
EC Number: 200-636-0 [*Annex I Index No.:* 631-140-00-8]

Uses: A U.S. EPA restricted Use Pesticide (RUP). Used as an antibiotic, plant growth regulator, and protein synthesis inhibitor. Inhibits growth of many plant pathogenic fungi. Effective for control of powdery mildew on roses and many other ornamentals, rusts and leaf spots on lawn grasses, and azalea petal blight. Also used as a repellent for rodents and other animal pests and in cancer therapy. Not listed for use in EU countries[115].

Human toxicity (long-term): Very low–140.00 ppb, Health Advisory

Fish toxicity (threshold): Very low–1308.29960 ppb, MATC (Maximum Acceptable Toxicant Concentration)

Regulatory Authority and Advisory Information:
Reportable Quantity (RQ): 100 lb (45.4 kg)
Acute Oral Category: 1, DANGER–POISON
Superfund/EPCRA 302, Extremely Hazardous Substances: TPQ = 100/10,000 lb (45.4/4540 kg)
California Proposition 65 Chemical: Developmental/Reproductive toxin (1/1/1989)
European/International Regulations *(66-81-9)*: Hazard Symbol: T+, N; risk phrases: R61; R28; R51/53; R68; safety phrases: S53; S45; S61 (see Appendix 1).
WGK (German Aquatic Hazard Class): 3-Highly water polluting (CAS 66-81-9)

Description: Cycloheximide is a colorless crystalline substance. Molecular weight = 281.34[83]; Boiling point = 490 °C; Freezing/Melting point = 119.5–121.1 °C; Vapor pressure = 6×10^{-3} mmHg @ 25 °C; Flashpoint = 250 °C. Soluble in water; solubility = 10 to 50 mg/mL @20 °C[88].

Incompatibilities: Incompatible with oxidizers, acid anhydrides, strong bases. Imides react with azo and diazo compounds to generate toxic gases. Flammable gases are formed by the reaction of organic imides with strong reducing agents. Imides are extremely weak bases (weaker than water). React with strong bases to form salts. That is, they can react as acids.

Permissible Exposure Limits in Air:
Protective Action Criteria (PAC) Ver. 27[89]
PAC-1: 0.18 mg/m^3
PAC-2: 2 mg/m^3
PAC-3: 2 mg/m3

Permissible Concentration in Water: Runoff from spills or fire control may cause water pollution.

Determination in Water: Log K_{ow} = <0.75. Unlikely to bioaccumulate in marine organisms.

Routes of Entry: Inhalation, ingestion and skin

Harmful Effects and Symptoms

Short Term Exposure: Contact can cause eye and skin irritation. Exposure can cause excessive salivation, nausea, vomiting, diarrhea, and elevated blood urea nitrogen (BUN). High exposures can also cause imbalance, tremors, seizures and coma. Extremely toxic. The probable oral lethal dose in humans is 5–50 mg/kg, or 7 drops to 1 teaspoonful for a 150-lb person. Signs of skin irritation may appear as much as 6 to 24 hours after exposure. LD_{50} (oral, rat) = 2–3.7 mg/kg.

Long Term Exposure: May cause mutations and damage the developing fetus. May cause liver and kidney damage.

Points of Attack: Reproductive system. Liver and kidneys

Medical Surveillance: Comprehensive physical examination with emphasis on the genito-urinary tract analysis to include sperm count, motility and morphology. Other tests, such as serum testosterone, serum follicle stimulating hormone (FSH), and serum lutenizing hormone (LH), may be carried out if, in the opinion of a physician, they are indicated. Liver and kidney function tests.

First Aid: If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least 15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately. If this chemical contacts the skin, remove contaminated clothing and wash immediately with soap and water. Seek medical attention immediately. If this chemical has been inhaled, remove from exposure, begin rescue breathing (using universal precautions) if breathing has stopped, and CPR if heart action has stopped. Transfer promptly to a medical facility. When this chemical has been swallowed, get medical attention. Give large quantities of water and induce vomiting. Do not make an unconscious person vomit. Medical observation is recommended for 24 to 48 hours following dermal contact

Personal Protective Methods: Wear protective gloves and clothing to prevent any reasonable probability of dermal contact. Safety equipment suppliers/manufacturers can provide recommendations on the most protective glove/clothing material for your operation. All protective clothing (suits, gloves, footwear, headgear) should be clean, available each day, and put on before work. Contact lenses should not be worn when working with this chemical. Wear dust-proof chemical goggles and face shield unless full facepiece respiratory protection is worn. Employees should wash immediately with soap when skin is wet or contaminated. Provide emergency showers and eyewash.

Respirator Selection: SCBA > 0.18 mg/m^3. *Where there is a potential for overexposure:* SCBAF: Pd,Pp (APF = 10,000) (any NIOSH/MSHA- or European Standard EN 149-approved self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode); or SaF: Pd,Pp: ASCBA (APF = 10,000) (any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary, self-contained breathing apparatus operated in a pressure-demand or other positive-pressure mode).

Storage: Color Code-Blue: Health Hazard/Poison. Store in a secure poison location. Prior to working with this chemical you should be trained on its proper handling and storage. Store in tightly closed containers in a cool, well-ventilated area away from oxidizing agents; acid hydrides, and strong bases.

Shipping: Pesticides, solid, toxic/poisonous, n.o.s. require a shipping label of "poisonous materials" and fall in Hazard Class 6.1. Technical name required.

Spill Handling: Avoid breathing dusts. Keep upwind. Wear self-contained breathing apparatus. Material is rapidly inactivated at room temperature by dilute alkali. First remove all sources of ignition. Evacuate persons not wearing protective equipment from area of spill or leak until clean up is complete. Remove all ignition sources. Collect powdered material in the most convenient and safe manner and deposit in sealed containers. Ventilate area after clean up is complete. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable.

Fire Extinguishing: Hazardous decomposition includes oxides of carbon and nitrogen. *On a small fire:* use dry chemical, CO_2 or water spray. *On a large fire:* use water spray, fog or regular foam. Move containers from fire area if you can do it without risk. Dike fire-control water for later disposal; do not scatter the material. Use water spray or fog; do not use straight streams. *Fire involving storage or vehicular tanks:* isolate for 800 meters/0.5 mile in all directions; also, consider initial evacuation for 800 meters/0.5 mile in all directions. Fight fire from maximum distance or use unmanned hose holders or monitor nozzles. Do not get water inside containers. Cool containers with flooding quantities of water until well after fire is out. Withdraw immediately in the case of rising sound from venting safety devices or discoloration of tank. ALWAYS stay away from tanks engulfed in fire. For massive fire, use unmanned hose holders or monitor nozzles; if this is impossible, withdraw from area and let fire burn. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies.

Disposal Method Suggested: High-temperature incinerator with flue gas scrubbing equipment.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- Sax, N. I., Ed., "Dangerous Properties of Industrial Materials Report," 2, No. 5, 41-43 (1982) and 9, No. 1, 55-64 (1989)
- USEPA, "Chemical Profile: Cycloheximide," Washington DC, Chemical Emergency Preparedness Program (November 30, 1987)
- New Jersey Department of Health and Senior Services, Hazardous Substance Fact Sheet, "Cycloheximide," Trenton NJ (January 1999). http://www.state.nj.us/health/eoh/rtkweb/0574.pdf
- Pesticide Management Education Program (PMEP), Cornell University, "Cycloheximide (Acti-dione) Chemical Profile 2/85," Ithaca, NY. http://pmep.cce.cornell.edu/profiles/fung-nemat/aceticacid-etridiazole/cycloheximide/fung-prof-cycloheximide.html

Cyfluthrin C:1806

Use Type: Insecticide

CAS Number: 68359-37-5

Formula: $C_{22}H_{18}Cl_2FNO_3$

Synonyms: Cyano(4-fluoro-3-phenoxyphenyl)methyl 3-(2,2-dichloroethenyl)-2,2-dimethylcyclopropanecarboxylate; Cyclopropanecarboxylic acid, 3-(2,2-dichloroethenyl)-2,2-dimethyl-, cyano(4-fluoro-3-phenoxyphenyl)methyl ester; Cyclopropanecarboxylic acid, 2-(2,2-dichlorovinyl)-3,3-dimethyl-, ester with (4-fluoro-3-phenoxyphenyl)hydroxyacetonitrile; Cyfluthin; Cyfluthrine; Cyfoxylate

Trade Names: AZTEC®; ATTATOX®; BAY FCR 1272®; BAYTHROID®; BAYTHROID® H; BAYTHROID® TECHNICAL; BUG-B-GON®; CONTUR®; CYLATHRIN®; EULAN SP®; FCR 1272®; INTUDER®; INTUDER HPX®; LASER®; RENOUNCE®; RESPONSAR®; SOLFAC®; TEMPO®; TEMPO® H; TEMPO® 20WP

Chemical class: Pyrethroid

EPA/OPP PC Code: 128831

California DPR Chemical Code: 2223

HSDB Number: 6599

UN/NA & ERG Number: UN3352 (liquid)/151

RTECS® Number: GZ1253000

EC Number: 269-855-7 [*Annex I Index No.:*607-254-00-7]

Uses: Cyfluthrin is a non-systemic insecticide used to control a variety of chewing and sucking insects on cotton, hops, cereals, corn, peanuts, fruit, potatoes and other crops and vegetables. It is also used o control structural pests such as termites.

U.S. Maximum Allowable Residue Levels for Cyfluthrin [40 CFR 180.436(a)(1)]: alfalfa 5.0 ppm; alfalfa, hay 10.0 ppm; almonds, hulls 0.5 ppm; barley, bran 5.0 ppm; brassica, head and stem, subgroup 5A, 2.5 ppm; brassica, leafy greens, subgroup 5B, 7.0 ppm; carrots, roots 0.20 ppm; cattle, fat 10.0 ppm; cattle, meat 0.40 ppm; cattle, meat byproducts 0.40 ppm; citrus, dried pulp 0.3 ppm; citrus, oil 0.3 ppm; corn, field, forage 3.0 ppm; corn, field, milled byproducts 7.0 ppm; corn, field, refined oil 30.0 ppm; corn, field, stover 6.0 ppm; corn, pop, stover 6.0 ppm; corn, sweet, forage 15.0 ppm; corn, sweet, kernel plus cob with husks removed 0.05 ppm; corn, sweet, stover 30.00 ppm; cotton, hulls 2.0 ppm; cotton, refined oil 2.0 ppm; cotton, undelinted seed 1.0 ppm; egg 0.01 ppm; fruit, citrus, group 10, 0.2 ppm; fruit, pome, group 11, 0.5 ppm; fruit, stone, group 12, 0.3 ppm; goat, fat 10.0 ppm; goat, meat 0.40 ppm; goat, meat byproducts 0.40 ppm; grain, aspirated fractions 600 ppm; grain, cereal, group 15 ppm; 4.0 ppm; grape 1.0 ppm; grape, raisin 3.5 ppm; hog, fat 10.0 ppm; hog, meat 0.40 ppm; hog, meat byproducts 0.40 ppm; hop, dried cones 20.0 ppm; hop, vines 4.0 ppm; horse, fat 10.0 ppm; horse, meat 0.40 ppm; horse, meat byproducts 0.40 ppm; lettuce, head 2.0 ppm; lettuce, leaf 3.0 ppm; milk 1.0 ppm; milk, fat 30.0 ppm; mustard greens 7.0 ppm; nut, tree, group 14, 0.01 ppm; oat, bran 5.0 ppm; pea and bean, dried shelled, except soybean, subgroup 6C, 0.15 ppm; pea, dry, seed 0.15 ppm; pea, southern, succulent 0.25 ppm; peanut 0.0 ppm; peanut, hay 6.0 ppm; pepper 0.50 ppm; pistachio 0.0 ppm; poultry, fat 0.0 ppm; poultry, meat 0.01 ppm; poultry, meat byproducts 0.01 ppm; radish, roots 1.0 ppm; rice, bran 6.0 ppm; rice, hulls 18.0 ppm; rye, bran 5.0 ppm; sheep, fat 10.0 ppm; sheep, meat 0.40 ppm; sheep, meat byproducts 0.40 ppm; sorghum, grain, forage 2.0 ppm; sorghum, grain, stover 5.0 ppm; soybean, forage 8.0 ppm; soybean, hay 4.0 ppm; soybean, seed 0.03 ppm; sugarcane, cane 0.05 ppm; sugarcane, molasses 0.20 ppm; sunflower, forage 5.0 ppm; sunflower, seed 0.02 ppm; tomato 0.20 ppm; tomato, paste 0.5 ppm; tomato, pomace 5.0 ppm; turnips, greens 7.0 ppm; vegetable, cucurbit, group 9, 0.1 ppm; vegetable, fruiting, group 8, 0.5 ppm; vegetable, leafy greens, except brassica, group 4, 6.0 ppm; vegetable, tuberous and corn, subgroup 1C, 0.01 ppm; wheat, bran 6.5 ppm; wheat, forage 5.0 ppm; wheat, hay 6.0 ppm; wheat, shorts 11.0 ppm; wheat, straw 6.0.

Regional registration, as defined in section 180.1(n) [40 CFR 180.436(c)]: in or on the following raw agricultural commodities: grass, forage 6.0 ppm; grass, hay 8.0 ppm. A tolerance of 0.05 ppm in food commodities exposed to the insecticide during treatment of food-handling establishments where food and food products are held, processed, prepared, or served. Treatments may be made by general surface, spot, and/or crack and crevice applications. (9/24/2007).

Human toxicity (long-term)[101]: Very low–175.00 ppb, Health Advisory

Fish toxicity (threshold)[101]: Extra high–0.01330 ppb, MATC (Maximum Acceptable Toxicant Concentration)

Regulatory Authority and Advisory Information:

Carcinogenicity: EPA, Not likely to be a human carcinogen

Acute Oral Category: 1, DANGER–POISON

Health Advisory: Endocrine disruptor (S!)

EPCRA Section 313 Form R *de minimis* concentration reporting level: 1.0%

European/International Regulations: Hazard Symbol: T+, N; risk phrases: R26/28; R50/53; safety phrases: S1/2; S28; S36/37/39; S45; S60; S61 (see Appendix 1)

WGK (German Aquatic Hazard Class): 3-Highly water polluting

Description: In pure form may be colorless crystalline solid or powder. Commercial is a yellowish paste or viscous, yellowish-brown oil. Aromatic odor. Molecular weight = 434.29; Specific gravity (H_2O:1) = 1.28; Boiling point = 210 °C (decomposes); Freezing/Melting point = 59 °C; 79 °C; Vapor pressure = 1.6×10^{-8} mmHg @ 20 °C; 3×10^{-4} mmHg @ 25 °C. Hazard Identification (based on NFPA-704 M Rating System): Health 1, Flammability 1, Reactivity 0. Low solubility in water.

Incompatibilities: May react violently with strong oxidizers, bromine, 90% hydrogen peroxide, phosphorus trichloride, silver powders or dust. Incompatible with silver compounds. Mixture with some silver compounds forms explosive salts of silver oxalate.

Permissible Exposure Limits in Air: ACGIH TLV®[1]: (all pyrethrins) 5 mg/m^3 TWA

Determination in Air: Collection by impinger or fritted bubbler, analysis by gas liquid chromatography/ultraviolet. See NIOSH IV, Method #5008[18], as pyrethroid.

Determination in Water: Log K_{ow} = >5. Values above 3.0 are likely to bioaccumulate in aquatic organisms.

Harmful Effects and Symptoms

Short Term Exposure: Contact with eyes or skin may cause irritation or injury. Inhalation should be avoided; use NIOSH- or CEN (UK)-approved air-purifying respirators for pesticides. May be harmful if swallowed. LD_{50} (oral, rat) = >400 mg/kg; LD_{50} (dermal, rat) = 5 g/kg.

Long Term Exposure: Fluorides may cause bone disease (pain and tenderness of the bones); mottled teeth in children. May be an endorine disruptor.

Points of Attack: Endocrine system, bones.

Medical Surveillance: Before beginning employment and at regular times after that, the following are recommended: Employees should be screened for history of certain medical conditions which might place the employee at increased risk from pyrethroid exposure. Chronic respiratory disease: In persons with chronic respiratory disease, especially asthma, the inhalation of pyrethroids might cause exacerbation of symptoms due to its sensitizing properties. Lung function tests. These may be normal if the person is not having an attack at the time of the test. Consider chest x-ray if lung symptoms are present. Skin disease: Pyrethroids can cause dermatitis which may be allergic in nature. Persons with preexisting skin disorders may be more susceptible to the effects of this agent. Evaluation by a qualified allergist, including exposure history and testing, may help diagnose allergy. Any employee developing the above-listed conditions should be referred for further medical examination[9].

First Aid: If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least 15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately. If this chemical contacts the skin, remove contaminated clothing and wash immediately with soap and water. Seek medical attention immediately. If this chemical has been inhaled, remove from exposure, begin rescue breathing (using universal precautions) if breathing has stopped, and CPR if heart action has stopped. Transfer promptly to a medical facility. When this chemical has been swallowed, get medical attention. Give large quantities of water and induce vomiting. Do not make an unconscious person vomit.

Personal Protective Methods: Applicators and other handlers must wear: Coveralls worn over long-sleeved shirt and long pants; Chemical-resistant gloves such as DuPont™ Tychem® suit fabrics, barrier laminate, or Viton®; Chemical-resistant footwear plus socks; Protective eye wear; Chemical-resistant headgear for overhead exposure; Chemical-resistant apron when cleaning equipment, mixing, or loading[83]. Agricultural Use/Engineering Controls: When handlers use closed systems, enclosed cabs, or aircraft in a manner that meets the requirements listed in the Worker Protection Standard (WPS) for agricultural pesticides, 40 CFR 170.240(d)(4-6), the handler PPE requirements may be reduced or modified as specified in the Worker Protection Standard. Firefighters should wear NIOSH approved self-contained breathing apparatus and full protective clothing.

Respirator Selection: NIOSH/OSHA *for pyrethrum*: *50 mg/m^3:* CcrOv95 (APF = 10) [any air-purifying half-mask respirator equipped with an organic vapor cartridge(s) in combination with an N95, R95, or P95 filter. The following filters may also be used: N99, R99, P99, N100, R100, P100]; or Sa (APF = 10) (any supplied-air respirator). *125 mg/m^3:* Sa:Cf (APF = 25) (any supplied-air respirator operated in a continuous-flow mode); or PaprOvHie (APF = 25) (any air-purifying full facepiece respirator equipped with an organic vapor cartridge in combination with a high-efficiency particulate filter). *250 mg/m^3:* CcrFOv100 (APF = 50) [any air-purifying full facepiece respirator equipped with organic vapor cartridge(s) in combination with an N100, R100, or P100 filter]; or PaprTOvHie (APF = 50) [any powered, air-purifying respirator with a tight-fitting face-piece and organic vapor cartridge(s) in combination with a high-efficiency particulate filter]; or SCBAF (APF = 50) (any self-contained breathing apparatus with full facepiece); or SaF (APF = 50) (any supplied-air respirator with a full facepiece). *5000 mg/m^3:* SaF:Pd,Pp (APF = 2000) (any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode). *Emergency or planned entry into unknown concentrations or IDLH conditions:* SCBAF:Pd,Pp (APF = 10,000) (any self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode); or SaF:Pd,Pp:ASCBA (APF = 10,000) (any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary self-contained breathing apparatus operated in a pressure-demand or other positive-pressure mode). *Escape:* GmFOv100 (APF = 50) [any air-purifying, full facepiece respirator (gas mask) with a chin-style, front- or back-mounted organic vapor canister having an N100, R100, or P100 filter]; or SCBAE (any appropriate escape-type, self-contained breathing apparatus).

Note: Substance reported to cause eye irritation or damage; may require eye protection.

Storage: Color Code-Blue: Health Hazard/Poison. Store in a secure poison location at temperature <35 °C and away from alkaline materials. Prior to working with this chemical you should be trained on its proper handling and storage. Store in tightly closed containers in a cool, well-ventilated area.

Shipping: This material is a toxic pesticide and should be labeled "poisonous materials." It falls into Hazard Class 6.1. PG III.

Spill Handling: First remove all sources of ignition. Evacuate persons not wearing protective equipment from area of spill or leak until clean up is complete. Remove all ignition sources. Ventilate area of spill or leak. Use water spray to reduce vapor. Absorb liquids in vermiculite, dry sand, earth, or a similar material and deposit in sealed containers. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable.

Fire Extinguishing: Hazardous decomposition includes oxides of nitrogen and carbon and hydrogen fluoride and hydrogen chloride gases. *On a small fire:* use dry chemical, CO_2 or water spray. *On a a large fire:* use water spray, fog or regular foam. Move containers from fire area if you can do it without risk. Dike fire-control water for later disposal; do not scatter the material. Use water spray or fog; do not use straight streams. *Fire involving storage or vehicular tanks:* isolate for 800 meters/0.5 mile in all directions; also, consider initial evacuation for 800 meters/0.5 mile in all directions. Fight fire from maximum distance or use unmanned hose holders or monitor nozzles. Do not get water inside containers. Cool containers with flooding quantities of water until well after fire is out. Withdraw immediately in the case of rising sound from venting safety devices or discoloration of tank. ALWAYS stay away from tanks engulfed in fire. For massive fire, use unmanned hose holders or monitor nozzles; if this is impossible, withdraw from area and let fire burn. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies.

Disposal Method Suggested: Incineration would be an effective disposal procedure where permitted. If an efficient incinerator is not available, the product should be mixed with large amounts of combustible material and contact with the smoke should be avoided. In accordance with 40CFR165, follow recommendations for the disposal of pesticides and pesticide containers.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- EXTOXNET, Extension Toxicology Network, "Pesticide Information Profile, Cyfluthrin," Oregon State University, Corvallis, OR (March 2001). http://pmep.cce.cornell.edu/profiles/extoxnet/carbaryl-dicrotophos/cyfluthrin-ext.html
- USEPA, Office of Pesticide Programs, Pesticide Residue Limits, "Cyfluthrin," 40 CFR 180.436. http://www.epa.gov/pesticides/food/viewtols.htm

lambda-Cyhalothrin C:1808

Use Type: Insecticide; acaridide

CAS Number: 91465-08-6

Formula: $C_{23}H_{19}ClF_3NO_3$

Synonyms: (*R*+*S*)-*α*-Cyano-3-phenoxybenzyl(1*S*+1*R*)-*cis*-3-(*Z*-2-Chloro-3,3,3-trifluoroprop-1-enyl)-2,2-dimethylcyclopropanecarboxylate; (*RS*)-*α*-Cyano-3-phenoxybenzyl*(Z)*-(1*RS*,3*RS*)-(2-chloro-3,3,3-trifluoropropenyl)-2,2-dimethylcyclopropanecarboxylate; Cyclopropanecarboxylic acid, 3-(2-chloro-3,3,3-trifluoro-1-propenyl)-2,2-dimethyl-, cyano(3-phenoxyphenyl)methyl ester, [1*α(S*)*,3*α(Z)*]-(+)-; λ-Cyhalothrin; Cyhalothrin-K

Trade Names: CHARGE®; COMMODORE®; DEMAND®; DEMAND CS®; DOUBLE BARREL®; EXCALIBER®; GRENADE®; HALLMARK®; ICON®; IMPASSE®; KARATE®; MATADOR®; NINJA®; PP-321®; RATE®; SABER®; SAMURAI®; SCIMITAR®; SENTINEL®; WARRIOR®

Chemical class: Pyrethroid

EPA/OPP PC Code: 128897

California DPR Chemical Code: 2297

HSDB Number: 6791as cyhalothrin

UN/NA & ERG Number: UN3077 (solid)/171; UN3082 (liquid)/171

RTECS® Number: GZ1227780

EC Number: 415-130-7 [*Annex I Index No.:* 607-252-006]

Uses: A U.S. EPA restricted Use Pesticide (RUP). Only cyhalothrin is banned for use in EU; not *lamda*-isomer; CAS 68085-85-8). Used to control a variety of pests in many crops. Also used in structural pest situations..

U.S. Maximum Allowable Residue Levels for lambda-Cyhalothrin [40 CFR 180.438(a)(2)]: Alfalfa, hay 6.0 ppm; almonds, hulls 1.5 ppm; apple, wet pomace 2.50 ppm; avocado, imported 0.20 ppm; brassica, head and stem, subgroup 5A, 0.4 ppm; canola, seed 0.15 ppm; cattle, fat 3.0 ppm; cattle, meat 0.2 ppm; cattle, meat byproducts 0.2 ppm; Corn, field, flour 0.15 ppm; corn, field, forage 6.0 ppm; corn, field, grain 0.05 ppm; corn, field, stover 1.0 ppm; corn, pop, grain 0.05 ppm; corn, pop, stover 1.0 ppm; corn, sweet, forage 6.0 ppm; corn, sweet, stover 1.0 ppm; corn, sweet, kernel plus cob with husks removed 0.05 ppm; cotton, undelinted seed 0.05 ppm; egg 0.01 ppm; fruit, pome, group 11 0.30 ppm; fruit, stone, group 12 0.50 ppm; garlic 0.10 ppm; goat, fat 3.0 ppm; goat, meat 0.2 ppm; goat, meat byproducts 0.2 ppm; grain, aspirated fractions 2.0 ppm; hog, fat 3.0 ppm; hog, meat 0.2 ppm; hog, meat byproducts 0.2 ppm; horse, fat 3.0 ppm; horse, meat 0.2 ppm; horse, meat byproducts 0.2 ppm; lettuce, head 2.0 ppm; lettuce, leaf 2.0 ppm; milk, fat (reflecting 0.20 ppm; ppm in whole milk) 5.0 ppm; nut, tree, group 14, 0.05 ppm; okra 0.20 ppm; onion, bulb 0.1 ppm; pea and bean, dried shelled, except soybean, subgroup 6C, 0.10 ppm; pea and bean, succulent shelled, subgroup 6B, 0.01 ppm; peanut 0.05 ppm; peanut, hay 3.0 ppm; pistachio 0.05 ppm; poultry, fat 0.03 ppm; poultry, meat 0.01 ppm; poultry, meat byproducts 0.01 ppm; rice, grain 1.0 ppm; rice, hulls 5.0 ppm; rice, straw 1.8 ppm; sheep, fat 3.0 ppm; sheep, meat 0.2 ppm; sheep, meat byproducts 0.2 ppm; sorghum, grain, forage 0.30 ppm; sorghum, grain, grain 0.20 ppm; sorghum, grain, stover 0.50 ppm; soybean 0.01 ppm; sugarcane, cane 0.05 ppm; sunflower, forage 0.20 ppm; sunflower, refined oil 0.30 ppm; sunflower, seed 0.20 ppm; sunflower, seed, hulls 0.50 ppm; tomato 0.10 ppm; tomato, dry pomace 6.0 ppm; tomato, wet pomace 6.0 ppm; vegetable, fruiting, group 8, 0.20 ppm; vegetable, legume, edible podded, subgroup 6A, 0.20 ppm; wheat, bran 2.0 ppm; wheat, forage 2.0 ppm; wheat, grain 0.05 ppm; wheat, hay 2.0 ppm; wheat, straw 2.0 ppm. ***[40 CFR 180.438(b)]***: The tolerances will expire and are revoked on the dates specified in the following table: barley, bran 0.2 ppm; 12/31/08 barley, grain 0.05 ppm; 12/31/08 barley, hay 2.0 ppm; 12/31/08 barley, straw 2.0 ppm; 12/31/08 clover, forage 5.0 ppm; 12/31/08 clover, hay 6.0 ppm; 12/31/08 grass, forage 5.0 ppm; 12/31/08 grass, hay 6.0 ppm; 12/31/08 rice, wild, grain 1.0 ppm. ***[40 CFR 483 (a)(3)]*** A tolerance of 0.01 ppm is established for residues in or on all food commodities (other than those already covered by a higher tolerance as a result of use on growing crops) in food-handling establishments where food products are held, processed, or prepared.

Fish toxicity (threshold)[101]***:*** Extra high–0.04384 ppb, MATC (Maximum Acceptable Toxicant Concentration)

Regulatory Authority and Advisory Information:

Acute Oral Category: 2, WARNING

Health Advisory: Endocrine disruptor (S!)

European/International Regulations: Hazard Symbol: T+, N; risk phrases: R21; R25; R26; R50/53; safety phrases: S1/2; S28; S36/37/39; S38; S45; S60; S61 (see Appendix 1)

Description: Colorless to beige powder; or viscous yellowish-brown liquid. Mild odor. Liquid formulations containing organic solvents may be flammable. Molecular weight = 449.85; Specific gravity (H_2O:1) = 1.25 @ 25 °C; Boiling point = (decomposes); Freezing/Melting point = 50 °C; Vapor pressure = (est.) 1.1×10^{-6} mmHg @ 20 °C; Flash point = 75 °C. Slight solubility in water; solubility = <1 ppm. Hydrolyzed by water (slowly @ pH = 7–9, rapidly @ pH = >9). Physical and toxicological properties may be affected by the carrier solvents used in commercial formulations.

Incompatibilities: May react violently with strong oxidizers, bromine, 90% hydrogen peroxide, phosphorus trichloride, silver powders or dust. Incompatible with silver compounds. Mixture with some silver compounds forms explosive salts of silver oxalate. Hydrolyzed by water (slowly @ pH = 7–9, rapidly @ pH = >9).

Permissible Exposure Limits in Air:

ACGIH TLV®[1]: (all pyrethrins) 5 mg/m^3 TWA

Determination in Air: Collection by impinger or fritted bubbler, analysis by gas-liquid chromatography/ultraviolet. See NIOSH IV, Method #5008[18], as pyrethroid.

Determination in Water: Log K_{ow} = 6.8–7.0. Values above 3.0 are likely to bioaccumulate in aquatic organisms.

Routes of Entry: Inhalation, ingestion, dermal or eye contact.

References:

Short Term Exposure: High toxicity. Contact with eyes or skin may cause irritation or injury. Ingestion is harmful. Inhalation should be avoided. *Inhalation:* Convulsions, cough, trouble breathing, sore throat. *Skin:* Pain and redness. *Eyes:* Pain and redness. *Ingestion:* Abdominal pain and coughing. LD_{50} (oral, rat) = 50–166 mg/kg; LD_{50} (dermal, rat) = >500 mg/kg.

Long Term Exposure: May cause respiratory disease, asthma, skin sensitization, skin allergy, dermatitis.

Points of Attack: Lungs, skin.

Medical Surveillance: Before beginning employment and at regular times after that, the following are recommended: Employees should be screened for history of certain medical conditions which might place the employee at increased risk from pyrethroid exposure. Chronic respiratory disease: In persons with chronic respiratory disease, especially asthma, the inhalation of pyrethroids might cause exacerbation of symptoms due to its sensitizing properties. Lung function tests. These may be normal if the person is not having an attack at the time of the test. Consider chest x-ray if lung symptoms are present. Skin disease: Pyrethroids can cause dermatitis which may be allergic in nature. Persons with preexisting skin disorders may be more susceptible to the effects of this agent. Evaluation by a qualified allergist, including exposure history and testing, may help diagnose allergy. Any employee developing the above-listed conditions should be referred for further medical examination[9]. Evaluation by a qualified allergist, including exposure history and testing, may help diagnose allergy.

First Aid: If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least 15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately. If this chemical contacts the skin, remove contaminated clothing and wash immediately with soap and water. Seek medical attention immediately. If this chemical has been inhaled, remove from exposure, begin rescue breathing (using universal precautions) if breathing has stopped, and CPR if heart action has stopped. Transfer promptly to a medical facility. When this chemical has been swallowed, get medical attention. Give large quantities of water and induce vomiting. Do not make an unconscious person vomit.

Personal Protective Methods: Applicators and other handlers must wear: Coveralls worn over long-sleeved shirt and long pants; Chemical-resistant gloves such as DuPont™ Tychem® suit fabrics, barrier laminate, or Viton®; Chemical-resistant footwear plus socks; Protective eye wear; Chemical-resistant headgear for overhead exposure; Chemical-resistant apron when cleaning equipment, mixing, or loading[83]. Agricultural Use/Engineering Controls: When handlers use closed systems, enclosed cabs, or aircraft in a manner that meets the requirements listed in the Worker Protection Standard (WPS) for agricultural pesticides, 40 CFR 170.240(d)(4-6), the handler PPE requirements may be reduced or modified as specified in the Worker Protection Standard. Firefighters should wear NIOSH approved self-contained breathing apparatus and full protective clothing.

Respirator Selection: NIOSH/OSHA *for pyrethrum*: *50 mg/m^3:* CcrOv95 (APF = 10) [any air-purifying half-mask respirator equipped with an organic vapor cartridge(s) in combination with an N95, R95, or P95 filter. The following filters may also be used: N99, R99, P99, N100, R100, P100]; or Sa (APF = 10) (any supplied-air respirator). *125 mg/m^3:* Sa:Cf (APF = 25) (any supplied-air respirator operated in a continuous-flow mode); or PaprOvHie (APF = 25) (any air-purifying full facepiece respirator equipped with an organic vapor cartridge in combination with a high-efficiency particulate filter). *250 mg/m^3:* CcrFOv100 (APF = 50) [any air-purifying full facepiece respirator equipped with organic vapor cartridge(s) in combination with an N100, R100, or P100 filter]; or PaprTOvHie (APF = 50) [any powered, air-purifying respirator with a tight-fitting face-piece and organic vapor cartridge(s) in combination with a high-efficiency particulate filter]; or SCBAF (APF = 50) (any self-contained breathing apparatus with full facepiece); or SaF (APF = 50) (any supplied-air respirator with a full facepiece). *5000 mg/m^3:* SaF:Pd,Pp (APF = 2000) (any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode). *Emergency or planned entry into unknown concentrations or IDLH conditions:* SCBAF:Pd,Pp (APF = 10,000) (any self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode); or SaF:Pd,Pp:ASCBA (APF = 10,000) (any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary self-contained breathing apparatus operated in a pressure-demand or other positive-pressure mode). *Escape:* GmFOv100 (APF = 50) [any air-purifying, full facepiece respirator (gas mask) with a chin-style, front- or back-mounted organic vapor canister having an N100, R100, or P100 filter]; or SCBAE (any appropriate escape-type, self-contained breathing apparatus). *Note:* Substance reported to cause eye irritation or damage; may require eye protection.

Storage: Color Code-Blue: Health Hazard/Poison. Store in a secure poison location at temperature <35 °C and away from alkaline materials. Prior to working with this chemical you should be trained on its proper handling and storage. Store in tightly closed containers in a cool, well-ventilated area.

Shipping: This material is a toxic pesticide and should be labeled "poisonous materials." It falls into Hazard Class 6.1. PG III.

Spill Handling: First remove all sources of ignition. Evacuate persons not wearing protective equipment from area of spill or leak until clean up is complete. Remove all ignition sources. Ventilate area of spill or leak. Use water spray to reduce vapor. Absorb liquids in vermiculite, dry sand, earth, or a similar material and deposit in sealed containers. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable.

Fire Extinguishing: Irritating gases are produced in fire. Use dry chemical, carbon dioxide; or alcohol-resistant foam extinguishers. Vapors are heavier than air and will collect in low areas. Vapors may travel long distances to ignition sources and flashback. Vapors in confined areas may explode when exposed to fire. Storage containers and parts of containers may rocket great distances, in many directions. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies. From a secure, explosion-proof location, use water spray to cool exposed containers. If cooling streams are ineffective (venting sound increases in volume and pitch, tank discolors, or shows any signs of deforming), withdraw immediately to a secure position. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode.

Disposal Method Suggested: Incineration would be an effective disposal procedure where permitted. If an efficient incinerator is not available, the product should be mixed with large amounts of combustible material and contact with the smoke should be avoided. In accordance with 40CFR165, follow recommendations for the disposal of pesticides and pesticide containers.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- National Pesticide Telecommunications Network (Now NPIC), "*lambda*-Cyhalothrin General Fact Sheet," Corvallis, OR (January 2001). http://www.npic.orst.edu/factsheets/l_cyhalogen.pdf
- EXTOXNET, Extension Toxicology Network, "Pesticide Information Profile, *lambda* Cyhalothrin," Oregon State

University, Corvallis, OR. http://extoxnet.orst.edu/pips/lambdacy.htm

- USEPA, Office of Pesticide Programs, Pesticide Residue Limits, "*lambda*-Cyhalothrin," 40 CFR 180.438. http://www.epa.gov/pesticides/food/viewtols.htm

Cymoxanil C:1820

Use Type: Fungicide
CAS Number: 57966-95-7
Formula: $C_7H_{10}N_4O_3$
Synonyms: Acetamide, 2-cyano-*N*-[(ethylamino)carbonyl]-2-(methoxyimino)-; 2-Cyano-*N*-[(ethylamino)carbonyl]-2-(methoxyimino)acetamide; Acetamide, 2-cyano-*N*-[(ethylamino)carbonyl]-2-(methoxyimino)-; 2-Cyano-*N*-ethylcarbamoyl-2-methoxyiminoacetamide
Trade Names: CURZATE®; DPX 3217®; DPX 3217 M®; DPX-T3217®; EVOLVE®; MZ-CURZATE®; TANOS® Cymoxanil
Chemical class: Cyanoacetamide oxime
EPA/OPP PC Code: 129106
California DPR Chemical Code: 4002
HSDB Number: 6914
UN/NA & ERG Number: UN3077 (solid)/171
RTECS® Number: AB5957000
EC Number: 261-043-0 [*Annex I Index No.:* 616-035-00-5]
Uses: Cymoxanil is applied as a seed treatment to cut potato seed pieces or as a foliar to control late blight.
U.S. Maximum Allowable Residue Levels for Cymoxanil [40 CFR 180.503(a)]: potatoes 0.05 ppm; ***[40 CFR 180.503(e)]***
grapes, imported 0.1 ppm; tomatoes, imported 0.1 ppm. (7/1/98).
Human toxicity (long-term)[101]: Low–91.00 ppb, Health Advisory
Fish toxicity (threshold)[101]: High–1.53362 ppb, MATC (Maximum Acceptable Toxicant Concentration)
Regulatory Authority and Advisory Information:
Carcinogenicity: EPA: Not likely to be carcinogenic to humans.
Acute Oral Category: 3, CAUTION
Clean Air Act: Hazardous Air Pollutants (Title I, Part A, Section 112)
Clean water act: Section 307 Priority Pollutants as cyanide, total; Toxic Pollutant (Section 401.15)
RCRA Universal Treatment Standards: Wastewater (mg/L), 1.2 (total); 0.86 (amenable); Nonwastewater (mg/kg), 590 (total); 30 (amenable)
RCRA Ground Water Monitoring List. Suggested test method(s) (PQL *ug*/L): 9010(40)
Safe Drinking Water Act: MCL, 0.2 mg/L; MCLG, 0.2 mg/L; Regulated chemical (47 FR 9352)
EPCRA Section 304 RQ: CERCLA, 10 lb (4.54 kg)
EPCRA Section 313 Form R *de minimis* concentration reporting level: 1.0%
Marine pollutant (49CFR, Subchapter 172.101, Appendix B) as cyanides, mixtures or solutions.
European/International Regulations: Hazard Symbol: Xn, N; risk phrases: R22; R43; R51/R53; safety phrases: S2; S36/37; S60; S61 (see Appendix 1)
Description: A white to peach (pale pink) crystalline solid. Molecular weight = 198.20; Specific gravity (H_2O:1) = 1.31 @ 25 °C; Melting point = 159–160 °C; Vapor pressure = 12×10^{-8} mmHg @ 25 °C. Low solubility in water; solubility increases with temperature.
Incompatibilities: Slowly hydrolyzes in water, releasing ammonia and forming acetate salts. Light sensitive.
Determination in Water: Log K_{ow} = <1.0. Unlikely to bioaccumulate in marine organisms.
References:
Short Term Exposure: Contact with eyes or skin may cause irritation or injury. Inhalation should be avoided; use NIOSH- or CEN (UK)-approved air-purifying respirators for pesticides. May be harmful if swallowed. LD_{50} (oral, rat) = >1 g/kg; LD_{50} (dermal, rat) = >3 g/kg.
Long Term Exposure: May cause skin sensitization.
Points of Attack: Skin.
Medical Surveillance:
First Aid: If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least 15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately. If this chemical contacts the skin, remove contaminated clothing and wash immediately with soap and water. Seek medical attention immediately. If this chemical has been inhaled, remove from exposure, begin rescue breathing (using universal precautions) if breathing has stopped, and CPR if heart action has stopped. Transfer promptly to a medical facility. When this chemical has been swallowed, get medical attention. Give large quantities of water and induce vomiting. Do not make an unconscious person vomit. Evaluation by a qualified allergist, including exposure history and testing, may help diagnose allergy.
Personal Protective Methods: Applicators and other handlers must wear: Coveralls worn over long-sleeved shirt and long pants; Chemical-resistant gloves such as DuPont™ Tychem® suit fabrics, barrier laminate, or Viton®; Chemical-resistant footwear plus socks; Protective eye wear; Chemical-resistant headgear for overhead exposure; Chemical-resistant apron when cleaning equipment, mixing, or loading[83]. Agricultural Use/Engineering Controls: When handlers use closed systems, enclosed cabs, or aircraft in a manner that meets the requirements listed in the Worker Protection Standard (WPS) for agricultural pesticides, 40 CFR 170.240(d)(4-6), the handler PPE requirements may be reduced or modified as specified in the Worker Protection Standard. Firefighters should wear NIOSH approved self-contained breathing apparatus and full protective clothing.
Respirator Selection: Wherever and whenever workplace conditions warrant respirator use, a respiratory protection program must be followed that meets one or more of the following requirements: OSHA's 29 CFR 1910.134, ANSI Z88.2, or European Standard EN 149.
Storage: Color Code-Blue: Health Hazard/Poison. Store in a secure poison location. Prior to working with this

chemical you should be trained on its proper handling and storage. Store in tightly closed containers in a cool, well-ventilated area.

Shipping: Environmentally hazardous substances, solid or liquid, usually fall in Hazard Class 9.

Spill Handling: First remove all sources of ignition. Evacuate persons not wearing protective equipment from area of spill or leak until clean up is complete. Remove all ignition sources. Ventilate area of spill or leak. Use water spray to reduce vapor. Absorb liquids in vermiculite, dry sand, earth, or a similar material and deposit in sealed containers. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable.

Fire Extinguishing: Hazardous decomposition includes oxides of nitrogen and carbon. As an immediate precautionary measure, isolate spill or leak area in all directions for at least 50 meters/150 feet for liquids and at least 25 meters/75 feet for solids. *Fire involving storage or vehicular tanks:* isolate for 800 meters/0.5 mile in all directions; also, consider initial evacuation for 800 meters /0.5 mile in all directions. *On a small fire:* use dry chemical, CO_2, water spray or regular foam. *On a large fire:* use water spray, fog or regular foam. Do not scatter spilled material with high-pressure streams of water. Move containers from fire area if you can do it without risk. Dike fire-control water for later disposal. *Fire involving tanks:* from a secure, explosion-proof location, use water spray to cool exposed containers. If cooling streams are ineffective (venting sound increases in volume and pitch, tank discolors, or shows any signs of deforming), withdraw immediately to a secure position. Always stay away from tanks engulfed in fire. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode.

Disposal Method Suggested: Do not discharge into drains or sewers. Burn in incinerator specifically designed for pesticide disposal or dispose as a hazardous waste in a landfill approved and licensed for the disposal of pesticides. Consult with environmental regulatory agencies for guidance on acceptable disposal practices. Ultimate disposal of the chemical must consider: the material's impact on air quality; potential migration in soil or water; effects on animal, aquatic, and plant life; and conformance with environmental and public health regulations.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- U.S. Environmental Protection Agency, Office of Pesticide Programs, “Pesticide Fact Sheet, Cymoxanil,” Washington DC (April 21, 1998). http://www.epa.gov/opprd001/factsheets/cymozanil.pdf
- USEPA, Office of Pesticide Programs, Pesticide Residue Limits, “Cymoxanil” 40 CFR 180.503. http://www.epa.gov/pesticides/food/viewtols.htm

Cypermethrin C:1830

Use Type: Insecticide

CAS Number: 52315-07-8; (former numbers: 69865-47-0; 86752-99-0; 86753-92-6; 88161-75-5; 97955-44-7)

Formula: $C_{22}H_{19}Cl_2NO_3$

Synonyms: (RS)-*α*-Cyano-3-phenoxybenzyl (1RS)-*cis, trans*-3-(2,2-dichlorovinyl)-2,2-dimethylcyclopropanecarboxylate; Cyano(3-phenoxyphenyl)methyl 3-(2,2-dichloroethenyl)-2, 2-dimethylcyclopropanecarboxylate; Cyano(3-phenoxyphenyl]methyl3-(2,2-dichlorovinyl-2,2-dimethylcyclopropanecarboxylate; Cyclopropanecarboxylic acid, 3-(2,2-dichloroethenyl)-2,2-dimethyl-, cyano(3-phenoxyphenyl)methyl ester; (±)-α-Cyano-3-phenoxybenzyl 2,2-dimethyl-3-(2,2-dichlorovinyl)cyclopropanecarboxylate; Cyano(3-phenoxyphenyl)methyl 3-(2,2-dichloroethenyl)-2,2-dimethylcyclopropanecarboxylate; F 56701

Trade Names: AMMO®; AGROTHRIN®; ARDAP®; ARRIVO®; AVICADE®; BARRICADE®; CCN52®; CNN 52®; CYMBUSH® 2E; CYMBUSH® 3E; CYMPERATOR®; CYNOFF®; CYPERCARE®; CYPERSECT®; CYPERKILL®; CYRUX®; DEMON®; DORSAN-C® (+cypermethrin); DYSECT®; FASTAC®; FLECTRON®; FMC® 30980; FMC 45497; FMC® 45806; FOLCORD®; IMPERATOR®; JF 5705 F®; KAFIL® SUPER; KENCIS®; NAGATA®; NRDC 149®; NRDC 160®; NRDC 166®; NURELLE; POLYTRIN®; PERMASECT C®; PP383®; PREVAIL®; RALO 10®; RIPCORD®; ROCYPER®; RYCOPEL®; SHERPA®; SIPERIN®; STOCKADE®; SUPERSECT®; TOPCLIP-PARASOL®; USTAAD®; WL 43467®; WRDC149®

Chemical class: Pyrethroid

EPA/OPP PC Code: 109702

California DPR Chemical Code: 2171

HSDB Number: 6600

UN/NA & ERG Number: UN3352 (liquid)/151; UN3349 (solid)/151

RTECS® Number: GZ1250000

EC Number: 257-842-7 [*Annex I Index No.:* 607-422-00-x]

Uses: A U.S. EPA restricted Use Pesticide (RUP) used to control a variety of insects on cotton, fruit and vegetable crops. Also used in commercial and residential settings, ships, laboratories and food processing plants.

Human toxicity (long-term)[101]: High–7.00 ppb, Health Advisory

Fish toxicity (threshold)[101]: Extra high–0.21494 ppb, MATC (Maximum Acceptable Toxicant Concentration)

U.S. Maximum Allowable Residue Levels for Cypermethrin [(40 CFR 180.418 (a) (2)]: alfalfa, hay 15.00 ppm; alfalfa, forage 5.00 ppm; alfalfa, seed 0.50 ppm; almond, hulls 6 ppm; animal feed, nongrass, group 18, forage 8 ppm; animal feed, nongrass, group 18, hay 40 ppm; beet, sugar, roots 0.05 ppm; beet, sugar, tops 0.20 ppm; berry group 13 0.8 ppm; borage, seed 0.2 ppm; brassica, head and stem, subgroup 5A, 2.00 ppm; brassica, leafy greens, subgroup 5B, 14.00 ppm; cabbage 2.00 ppm; castor oil plant, refined oil 0.4 ppm; castor oil plant, seed 0.2 ppm; cattle, fat 1.00 ppm; cattle, meat 0.2 ppm; cattle, meat byproducts 0.05 ppm; Chinese tallowtree, refined oil 0.4 ppm; Chinese tallowtree, seed 0.2 ppm; cilantro, leaves 10 ppm; citrus, dried pulp 1.8 ppm; citrus, oil 4.0 ppm; corn, field, forage 0.20 ppm; corn, field, grain 0.05 ppm; corn, field, stover 3.00 ppm; corn, pop, grain 0.05 ppm; corn, pop, stover 3.00 ppm; corn, sweet, forage 15.00 ppm; corn, sweet, kernel plus cob with husks removed 0.05 ppm; corn, sweet, stover 15.00 ppm; cotton, undelinted seed 0.5 ppm; crambe, seed 0.2 ppm; cuphea, seed 0.2 ppm; echium, seed 0.2 ppm; egg 0.05 ppm; euphorbia, refined oil 0.4 ppm; euphorbia, seed 0.2 ppm; evening primrose, refined oil 0.4 ppm; evening primrose, seed 0.2 ppm; flax, seed 0.2 ppm; food commodities/feed commodities (other than those covered by a higher tolerance as a result of use on growing crops) in food/feed handling establishments 0.05 ppm; fruit, citrus, group 10 ppm; 0.35 ppm; fruit, pome, group 11 2 ppm; fruit, stone, group 12 ppm; 1 ppm; goat, fat 1.00 ppm; goat, meat 0.2 ppm; goat, meat byproducts 0.05 ppm; gold of pleasure, seed 0.2 ppm; grain, aspirated fractions 10.0 ppm; grape 2 ppm; grass, forage, fodder, and hay, group 17, forage 10 ppm; grass, forage, fodder and hay, group 17, hay 35 ppm; hare's-ear mustard, seed 0.2 ppm; hog, fat 0.1 ppm; hog, meat 0.05 ppm; horse, fat 1.00 ppm; horse, meat 0.2 ppm; horse, meat byproducts 0.05 ppm; jojoba, refined oil 0.4 ppm; jojoba, seed 0.2 ppm; lesquerella, seed 0.2 ppm; lunaria, seed 0.2 ppm; meadowfoam, seed 0.2 ppm; milk, fat (reflecting 0.10 ppm; in whole milk) 2.50 ppm; milkweed, seed 0.2 ppm; mustard, seed 0.2 ppm; niger seed, refined oil 0.4 ppm; niger seed, seed 0.2 ppm; nut, tree, group 14 ppm; 0.05 ppm; oil radish, seed 0.2 ppm; okra 0.2 ppm; onion, bulb 0.10 ppm; onion, green 3.00 ppm; pea and bean, dried shelled, except soybean, subgroup 6C, 0.05 ppm; pea and bean, succulent shelled, subgroup 6B, 0.1 ppm; peanut 0.05 ppm; pecan 0.05 ppm; poppy, seed 0.2 ppm; poultry, fat 0.05 ppm; poultry, meat 0.05 ppm; rapeseed 0.2 ppm; rice, grain rice, wild, grain 1.5 ppm; rose hip, refined oil 0.4 ppm; rose hip, seed 0.2 ppm; safflower, seed 0.2 ppm; sesame, seed 0.2 ppm; sheep, fat 1.00 ppm; sheep, meat 0.2 ppm; sheep, meat byproducts 0.05 ppm; sorghum, grain, forage 0.1 ppm; sorghum, grain, grain 0.5 ppm; sorghum, grain, stover 5.0 ppm; soybean, seed 0.05 ppm; stokes aster, refined oil 0.4 ppm; stokes aster, seed 0.2 ppm; sugarcane, cane 0.60 ppm; sunflower, refined oil 0.5 ppm; sunflower, seed 0.2 ppm; sweet rocket, seed 0.2 ppm; tallowwood, refined oil 0.4 ppm; tallowwood, seed 0.2 ppm; tea oil plant, refined oil 0.4 ppm; tea oil plant, seed 0.2 ppm; turnip, greens 14 ppm; vegetable, cucurbit, group 9, 0.2 ppm; vegetable, fruiting, group 8, 0.2 ppm; vegetable, leafy, except brassica, group 4, 10.00 ppm; vegetable, legume, edible podded, subgroup 6A, 0.5 ppm; vegetable, root and tuber, group 1, except sugar beet 0.1 ppm; vernonia, refined oil 0.4 ppm; vernonia, seed 0.2 ppm; wheat, forage 3.0 ppm; wheat, grain 0.2 ppm; wheat, hay 6.0 ppm; wheat, straw 7.0 ppm

Regulatory Authority and Advisory Information:

Carcinogenicity: EPA Group C, Possible human carcinogen.

Health Advisory: Endocrine disruptor (S!), Mutagen, Developmental/Reproductive Toxin

Acute Oral Category: 2, WARNING

European/International Regulations: Hazard Symbol: T, N; risk phrases: R25; R37; R48/22; R50/53; safety phrases: S1/2; S36/37/39; S45; S60; S61 (see Appendix 1)

WGK (German Aquatic Hazard Class): 3-Severe hazard to waters

Description: Thick, yellow-brown liquid or semisolid mass (technical product). Molecular weight = 416.30; Specific gravity (H_2O:1) = 1.25 @ 20 °C; Freezing/Melting point = 41.2 °C; 70 °C; Vapor pressure = 5.1×10^{-8} mmHg @ 70 °C; 1.7×10^{-9} mmHg @ 20 °C[83]. Very sparingly soluble in water; solubility = 0.041 ppm @ room temp; about 0.01 ppm @ 20 °C.

Incompatibilities: May react violently with strong oxidizers, bromine, 90% hydrogen peroxide, phosphorus trichloride, silver powders or dust. Incompatible with silver compounds. Mixture with some silver compounds forms explosive salts of silver oxalate.

Permissible Exposure Limits in Air:

ACGIH TLV®[1]: (all pyrethrins) 5 mg/m^3 TWA

Determination in Air: Collection by impinger or fritted bubbler, analysis by gas-liquid chromatography/ultraviolet. See NIOSH IV, Method #5008[18]. (pyrethrum)

Determination in Water: Collection by impinger or fritted bubbler, analysis by gas-liquid chromatography/ultraviolet. See NIOSH IV, Method #5008[18]. Log K_{ow} = >4.5. Values above 3.0 are likely to bioaccumulate in aquatic organisms. Log K_{ow} = >5. Values above 3.0 are likely to bioaccumulate in aquatic organisms

Harmful Effects and Symptoms

Short Term Exposure: Pyrethrins can affect you when breathed in and by passing through your skin. Irritates the eyes and respiratory tract. High exposure can affect the nervous system causing headache, nausea, vomiting, fatigue, and restlessness, rhinorrhea (discharge of thin nasal mucous). LD_{50} (oral, rat) = 57,500 μg/kg.; LD_{50} (dermal, rat) = <2 g/kg.

Long Term Exposure: High or repeated exposure can cause lung allergy (with cough, wheezing and/or shortness of breath) or hay fever symptoms (sneezing, runny or stuffy nose). Allergic “pneumonia” can also occur with cough, chest pain, breathing difficulty and abnormal chest x-ray. Repeated attacks may lead to permanent scarring. Skin allergy may also develop with rash and itching, even with lower exposures. Dermal contact can cause rash with redness, blisters and intense itching. A severe generalized allergy can occur with weakness and collapse

Points of Attack: Respiratory system, skin, central nervous system

Medical Surveillance: This chemical is a suspected or known human carcinogen. Exposed persons should contact a physician for advice regarding the possible long term health effects and advice for medical monitoring. Before beginning employment and at regular times after that, the following are recommended: Employees should be screened for history of certain medical conditions which might place the employee at increased risk from pyrethroid exposure. Chronic respiratory disease: In persons with chronic respiratory disease, especially asthma, the inhalation of pyrethroids might cause exacerbation of symptoms due to its sensitizing properties. Lung function tests. These may be normal if the person is not having an attack at the time of the test. Consider chest x-ray if lung symptoms are present. Skin disease: Pyrethroids can cause dermatitis which may be allergic in nature. Persons with preexisting skin disorders may be more susceptible to the effects of this agent. Evaluation by a qualified allergist, including exposure history and testing, may help diagnose allergy. Any employee developing the above-listed conditions should be referred for further medical examination[9]. Examination of the nervous system.

First Aid: If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least 15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately. If this chemical contacts the skin, remove contaminated clothing and wash immediately with soap and water. Seek medical attention immediately. If this chemical has been inhaled, remove from exposure, begin rescue breathing (using universal precautions) if breathing has stopped, and CPR if heart action has stopped. Transfer promptly to a medical facility. When this chemical has been swallowed, get medical attention. *Do not induce vomiting when formulations containing petroleum solvents are ingested*. Otherwise, give large quantities of water and induce vomiting. Do not make an unconscious person vomit.

Personal Protective Methods: Applicators and other handlers must wear: Coveralls worn over long-sleeved shirt and long pants; Chemical-resistant gloves such as DuPont™ Tychem® suit fabrics, barrier laminate, or Viton®; Chemical-resistant footwear plus socks; Protective eye wear; Chemical-resistant headgear for overhead exposure; Chemical-resistant apron when cleaning equipment, mixing, or loading[83]. Agricultural Use/Engineering Controls: When handlers use closed systems, enclosed cabs, or aircraft in a manner that meets the requirements listed in the Worker Protection Standard (WPS) for agricultural pesticides, 40 CFR 170.240(d)(4-6), the handler PPE requirements may be reduced or modified as specified in the Worker Protection Standard. Firefighters should wear NIOSH approved self-contained breathing apparatus and full protective clothing.

Respirator Selection: NIOSH/OSHA *for pyrethrum*: *50 mg/m^3:* CcrOv95 (APF = 10) [any air-purifying half-mask respirator equipped with an organic vapor cartridge(s) in combination with an N95, R95, or P95 filter. The following filters may also be used: N99, R99, P99, N100, R100, P100]; or Sa (APF = 10) (any supplied-air respirator). *125 mg/m^3:* Sa:Cf (APF = 25) (any supplied-air respirator operated in a continuous-flow mode); or PaprOvHie (APF = 25) (any air-purifying full facepiece respirator equipped with an organic vapor cartridge in combination with a high-efficiency particulate filter). *250 mg/m^3:* CcrFOv100 (APF = 50) [any air-purifying full facepiece respirator equipped with organic vapor cartridge(s) in combination with an N100, R100, or P100 filter]; or PaprTOvHie (APF = 50) [any powered, air-purifying respirator with a tight-fitting face-piece and organic vapor cartridge(s) in combination with a high-efficiency particulate filter]; or SCBAF (APF = 50) (any self-contained breathing apparatus with full facepiece); or SaF (APF = 50) (any supplied-air respirator with a full facepiece). *5000 mg/m^3:* SaF:Pd,Pp (APF = 2000) (any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode). *Emergency or planned entry into unknown concentrations or IDLH conditions:* SCBAF:Pd,Pp (APF = 10,000) (any self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode); or SaF:Pd,Pp:ASCBA (APF = 10,000) (any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary self-contained breathing apparatus operated in a pressure-demand or other positive-pressure mode). *Escape:* GmFOv100 (APF = 50) [any air-purifying, full facepiece respirator (gas mask) with a chin-style, front- or back-mounted organic vapor canister having an N100, R100, or P100 filter]; or SCBAE (any appropriate escape-type, self-contained breathing apparatus).

Note: Substance reported to cause eye irritation or damage; may require eye protection.

Storage: Color Code-Blue: Health Hazard/Poison. Store in a secure poison location at temperature <35 °C and away from alkaline materials. Prior to working with this chemical you should be trained on its proper handling and storage. Store in tightly closed containers in a cool, well-ventilated area.

Shipping: This material is a toxic pesticide and should be labeled "poisonous materials." It falls into Hazard Class 6.1. PG III.

Spill Handling: First remove all sources of ignition. Evacuate persons not wearing protective equipment from area of spill or leak until clean up is complete. Remove all ignition sources. Ventilate area of spill or leak. Use water spray to reduce vapor. Absorb liquids in vermiculite, dry sand, earth, or a similar material and deposit in sealed containers. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable.

Fire Extinguishing: Hazardous decomposition includes oxides of nitrogen and oxygen and hydrogen chloride gas. *On a small fire:* use dry chemical, CO_2 or water spray. *On a a large fire:* use water spray, fog or regular foam. Move containers from fire area if you can do it without risk. Dike fire-control water for later disposal; do not scatter the material. Use water spray or fog; do not use straight streams. *Fire involving storage or vehicular tanks:* isolate for 800 meters/0.5 mile in all directions; also, consider initial evacuation for 800 meters/0.5 mile in all directions. Fight fire from maximum distance or use unmanned hose holders or monitor nozzles. Do not get water inside containers. Cool containers with flooding quantities of water until well after fire is out. Withdraw immediately in the case of rising sound from venting safety devices or discoloration of tank. ALWAYS stay away from tanks engulfed in fire. For massive fire, use unmanned hose holders or monitor nozzles; if this is impossible, withdraw from area and let fire burn. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies.

Disposal Method Suggested: Incineration would be an effective disposal procedure where permitted. If an efficient incinerator is not available, the product should be mixed with large amounts of combustible material and contact with the smoke should be avoided. In accordance with 40CFR165, follow recommendations for the disposal of pesticides and pesticide containers.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda,MD. http://toxnet.nlm.nih.gov
- EXTOXNET, Extension Toxicology Network, "Pesticide Information Profile, Cypermethrin," Oregon State University, Corvallis, OR (September 1993). http://pmep.cce.cornell.edu/profiles/extoxnet/carbaryl-dicrotophos/cypermet-ext.html

alpha-Cypermethrin C:1831

Use Type: Insecticide

CAS Number: 67375-30-8; 66841-24-5 (d-trans-β-Cypermethrin); 97955-44-7 (*zeta*-)

Formula: $C_{22}H_{19}Cl_2NO_3$

Synonyms: Alphacypermethrin; (+)-Alphamethrin; *α*-Cyano-3-phenoxybenzyl 3-(2,2-dichlorovinyl)-2,2-dimethylcyclopropanecarboxylate, (±)-*cis* isomer; Cyano(3-phenoxyphenyl)methyl 3-(2,2-dichlorovinyl)-2,2-dimethylcyclopropanecarboxylate, (±)-*cis* isomer; Cyclopropanecarboxylic acid, 3-(2,2-dichloroethenyl)-2,2-dimethyl-, cyano(3-phenoxyphenyl)methyl ester, [1α(S*), 3*α*]-(+)-

Cypermethrin-s: *s*-Cyano(3-phenoxyphenyl)methyl (±)-*cis/trans*-3-(2,2-dichloethenyl)-2,2-dimethylcyclopropane arboxylate; Cyclopropanecarboxylic acid, 3-(2,2-dichloroethenyl)-2,2-dimethyl-, cyano(3-phenoxyphenyl)methyl ester, (*S*)-; Cypermethrin-minus; *zeta*-Cypermethrin

Trade Names: BESTOX®; CONCORD®; DOMINEX®; FASTAC®; FENDONA®; FMC 45497®[C]; NRDC 160®; RENEGADE®; WL-85871®

Cypermethrin-s: FURY® (*s*-isomer); FMC 56701® (*s*-isomer)

Chemical class: Pyrethroid

EPA/OPP PC Code: 209600; 129064; (109702 use code 129064) cypermethrin-*S*

California DPR Chemical Code: 3866

HSDB Number: 6554

UN/NA & ERG Number: UN3352 (liquid)/151; UN3349 (solid)/151

RTECS® Number: GZ1250000

EC Number: Not assigned [*Annex I Index No.:* 607-422-00-x]

Uses: A U.S. EPA restricted Use Pesticide (RUP) (*zeta*-Cypermethrin only). Used for the control of a wide range of chewing and sucking insects (particularly Lepidotera, Coleoptera, and Hemiptera) in fruit (including citrus), vegetables, vines, cereals, maize, beet, oilseed rape, potatoes, cotton, rice, soya beans, forestry, and other crops. Control of cockroaches, mosquitoes, flies, and other insect pests in public health; and flies in animal houses. Also used as an animal ectoparasiticide.

Regulatory Authority and Advisory Information:

Toxicity (oral) Category (*alpha*-): 2, WARNING; Category (*zeta*-): 1, DANGER–POISON

Health Advisory: Endocring Disruptor (S!), Mutagen

U.S. DOT Regulated Marine Pollutant (49 CFR, Subchapter 172.101, Appendix B), severe pollutant

European/International Regulations: Hazard Symbol: T, N; risk phrases: R25; R37; R48/22; R50/53; safety phrases: S1/2; S36/37/39; S45; S60; S61 (see Appendix 1)

WGK (German Aquatic Hazard Class): 3-Severe hazard to waters.

Description: Colorless crystalline solid or viscous yellowish-brown semisolid mass. Mild aromatic odor. Molecular weight = 416.30; Specific gravity (H_2O:1) = 1.36 @ 20 °C; Boiling point = 200 °C @ 0.07 mmHg; Freezing/Melting point = 80.5 °C; Vapor pressure = 170 mmHg @ 20 °C. Very low solubility in water; solubility = 0.2 ppm @ 20 °C.

Incompatibilities: May react violently with strong oxidizers, bromine, 90% hydrogen peroxide, phosphorus trichloride, silver powders or dust. Incompatible with silver compounds. Mixture with some silver compounds forms explosive salts of silver oxalate. When heated to decomposition this chemical emits toxic nitrogen oxides and chlorine gas.

Determination in Water: Collection by impinger or fritted bubbler, analysis by gas-liquid chromatography/ultraviolet. See NIOSH IV, Method #5008[18]. Log K_{ow} = 6.29. Values at or above 3.0 are likely to bioaccumulate in marine organisms.

Harmful Effects and Symptoms

Short Term Exposure: Pyrethrins can affect you when breathed in and by passing through your skin. Irritates the eyes and respiratory tract. High exposure can affect the nervous system causing headache, nausea, vomiting, fatigue, and restlessness, rhinorrhea (discharge of thin nasal mucous). LD_{50} (oral, rat) = <100 mg/kg.; LD_{50} (dermal, rat) = <2 g/kg.

Long Term Exposure: High or repeated exposure can cause lung allergy (with cough, wheezing and/or shortness of breath) or hay fever symptoms (sneezing, runny or stuffy nose). Allergic "pneumonia" can also occur with cough, chest pain, breathing difficulty and abnormal chest x-ray. Repeated attacks may lead to permanent scarring. Skin allergy may also develop with rash, redness, blisters, and itching, even with lower exposures. A severe generalized allergy can occur with weakness and collapse. Fluorides may cause bone disease (pain and tenderness of the bones); mottled teeth in children.

Points of Attack: Respiratory system, bones, skin, central nervous system

Medical Surveillance: Before beginning employment and at regular times after that, the following are recommended: Lung function tests. These may be normal if the person is not having an attack at the time of the test. Consider chest x-ray if lung symptoms are present. Evaluation by a qualified allergist, including exposure history and testing, may help diagnose allergy. Examination of the nervous system.

First Aid: If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least 15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately. If this chemical contacts the skin, remove contaminated clothing and wash immediately with soap and water. Seek medical attention immediately. If this chemical has been inhaled, remove from exposure, begin rescue breathing (using universal precautions) if breathing has stopped, and CPR if heart action has stopped. Transfer promptly to a medical facility. When this chemical has been swallowed, get medical attention. *Do not induce vomiting when formulations containing petroleum solvents are ingested*. Otherwise, give large quantities of water and induce vomiting. Do not make an unconscious person vomit.

Personal Protective Methods: Applicators and other handlers must wear: Coveralls worn over long-sleeved shirt and long pants; Chemical-resistant gloves such as DuPont™ Tychem® suit fabrics, barrier laminate, or Viton®; Chemical-resistant footwear plus socks; Protective eye wear; Chemical-resistant headgear for overhead exposure; Chemical-resistant apron when cleaning equipment, mixing, or loading[83]. Agricultural Use/Engineering Controls: When handlers use closed systems, enclosed cabs, or aircraft in a manner that meets the requirements listed in the Worker Protection Standard (WPS) for agricultural pesticides, 40 CFR 170.240(d)(4-6), the handler PPE requirements may be reduced or modified as specified in the Worker Protection Standard. Firefighters should wear NIOSH approved self-contained breathing apparatus and full protective clothing.

Respirator Selection: Wherever and whenever workplace conditions warrant respirator use, a respiratory protection program must be followed that meets one or more of the following requirements: OSHA's 29 CFR 1910.134, ANSI Z88.2, or European Standard EN 149.

Storage: Color Code-Blue: Health Hazard/Poison. Store in a secure poison location. Prior to working with this chemical you should be trained on its proper handling and storage. Store in tightly closed containers in a cool, well-ventilated area.

Shipping: This chemical should be labeled "poisonous materials." It falls into Hazard Class 6.1(b).

Spill Handling: First remove all sources of ignition. Evacuate persons not wearing protective equipment from area of spill or leak until clean up is complete. Remove all ignition sources. Ventilate area of spill or leak. Use water spray to reduce vapor. Absorb liquids in vermiculite, dry sand, earth, or a similar material and deposit in sealed containers. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable.

Fire Extinguishing: When heated to decomposition it emits toxic fumes of formaldehyde, acrolein, hydrogen cyanide, hydrogen chloride and hydrogen fluoride. *On a small fire:* use dry chemical, CO_2 or water spray. *On a large fire:* use water spray, fog or regular foam. Move containers from fire area if you can do it without risk. Dike fire-control water for later disposal; do not scatter the material. Use water spray or fog; do not use straight streams. *Fire involving storage or vehicular tanks:* isolate for 800 meters/0.5 mile in all directions; also, consider initial evacuation for 800 meters/0.5 mile in all directions. Fight fire from maximum distance or use unmanned hose holders or monitor nozzles. Do not get water inside containers. Cool containers with flooding quantities of water until well after fire is out. Withdraw immediately in the case of rising sound from venting safety devices or discoloration of tank. ALWAYS stay away from tanks engulfed in fire. For massive fire, use unmanned hose holders or monitor nozzles; if this is impossible, withdraw from area and let fire burn. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies.

Disposal Method Suggested: Do not discharge into drains or sewers. Burn in incinerator specifically designed for pesticide disposal or dispose as a hazardous waste in a landfill approved and licensed for the disposal of pesticides. Consult with environmental regulatory agencies for guidance on acceptable disposal practices. Ultimate disposal of the chemical must consider: the material's impact on air quality; potential migration in soil or water; effects on animal, aquatic, and plant life; and conformance with environmental and public health regulations.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- International Programme on Chemical Safety (IPCS), "*Environmental Health Criteria, alpha-Cypermethrin*," Geneva, Switzerland (1992). http://www.inchem.org/documents/ehc/ehc/ehc142.htm

Cyproconazole C:1850

Use Type: Fungicide

CAS Number: 94361-06-5

Formula: $C_{15}H_{18}ClN_3O$

Synonyms: *α*-(4-Chlorophenyl)-*α*-(1-cyclopropylethyl)-1*H*-1,2,4-triazole-1-ethanol; (2*RS*, 3*RS*)-2-(4-Chlorophenyl)-3-cyclopropyl-1-(1*H*-1,2,4-triazol-1-yl)butan-2-ol; 1*H*-1,2,4-Triazole-1-ethanol, *α*-(4-chlorophenyl)-*α*-(1-cyclopropylethyl)-

Trade Names: ALTO®; ALTO®˒ ELITE; ATEMI®; ATEMI-50-SL®;EVIPOL®; FLINT®; NOAH GOLD®; SAN-619 F®; SENTINEL®; SN 108266®

Chemical class: Azole; Triazole

EPA/OPP PC Code: 128993

California DPR Chemical Code: 5105

HSDB Number: 7706

UN/NA & ERG Number: UN3082 (environmentally hazardous substances, liquid, n. o. s.)/171

EC Number: [*Annex I Index No.*: 650-032-00-x]]

Uses: Used to control fungus on cereals, coffee beans; anthracnose and other diseases on turfgrass; used against rust and leaf spot disease.

U.S. Maximum Allowable Residue Levels for Cyproconazole: ***[40 CFR 180.485(a)(1)]*** aspirated grain fractions 2.5 ppm; cattle, fat 0.01 ppm; cattle, meat byproducts (except liver) 0.01 ppm; coffee bean, green (imported) (there are no U.S. registrations as of February 15, 2008 for use on coffee bean.) 0.1 ppm; corn, field, forage 0.60 ppm; corn, field, grain 0.01 ppm; corn, field, stover 1.2 ppm; goat, fat 0.01 ppm; goat, meat byproducts (except liver) 0.01 ppm; horse, fat 0.01 ppm; horse, meat byproducts (except liver) 0.01 ppm; sheep, fat 0.01 ppm; sheep, meat byproducts (except liver) 0.01 ppm; soybean, forage 1.0 ppm; soybean, hay 3.0 ppm; soybean, oil 0.10 ppm; soybean, seed 0.05 ppm; wheat, forage 0.80 ppm; wheat, grain 0.05 ppm; wheat, grain, milled byproducts 0.10 ppm; wheat, hay 1.3 ppm; wheat, straw 0.90 ppm; ***40 CFR 180.485(a)(2)*** milk 0.02 ppm; ***40 CFR 180.485(a)(3)*** cattle, liver 0.50 ppm; goat, liver 0.50 ppm; hog, liver 0.01 ppm; horse, liver 0.50 ppm; sheep, liver 0.50 ppm.

Human toxicity (long-term)[101]: High–1.15894 ppb, CHCL (Chronic Human Carcinogen Level)

Fish toxicity (threshold)[101]: Very low–3210.91612 ppb, MATC (Maximum Acceptable Toxicant Concentration)

Regulatory Authority and Advisory Information:

Carcinogenicity: EPA Group 2b, probable carcinogen

Acute Oral Category: 3, CAUTION

European/International Regulations: Hazard Symbol: Xn, N; risk phrases: R22; R50/53; R63; safety phrases: S2; S36/37; S60; S61 (see Appendix 1)

Description: Colorless, crystalline solid. Odorless. Molecular weight = 291.78; Specific gravity (H_2O:1) = 1.26; Boiling point = decomposes @ 295–300 °C; Freezing/Melting point = 104–106.5 °C; Vapor pressure = 2.5×10^{-7} mmHg @ 20 °C. Moderately soluble in water.

Incompatibilities: The triazoles are sensitive to heat, friction, and impact. Sensitivity varies with the type substitution to the triazole ring. Metal chelated and halogen substitution of the triazol ring make for a particularly heat sensitive material. Azido and nitro derivatives have been employed as high explosives. No matter the derivative these materials should be treated as explosives[88].

Determination in Water: Log K_{ow} = 2.9–3.1. Values above 3.0 are likely to bioaccumulate in aquatic organisms.

Routes of Entry: Ingestion, dermal contact

Harmful Effects and Symptoms

Short Term Exposure: Contact may irritate skin and cause eye irritation and possible severe injury. Inhalation should be avoided; use NIOSH- or CEN (UK)-approved air-purifying respirators for pesticides. Poisonous if swallowed. LD_{50} (oral, rat) = (male) 1020 mg/kg; (female) 1330 mg/kg[14].

Medical Surveillance: Contact physician if poisoning is suspected or if redness, itching, burning of the skin or eyes develop.

First Aid: If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least 15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately. If this chemical contacts the skin, remove contaminated clothing and wash immediately with soap and water. If this chemical has been inhaled, remove from exposure, begin rescue breathing (using universal precautions) if breathing has stopped, and CPR if heart action has stopped. Transfer promptly to a medical facility. When this chemical has been swallowed, get medical attention. Give large quantities of water and induce vomiting. Do not make an unconscious person vomit.

Personal Protective Methods: Wear positive-pressure self-contained breathing apparatus (SCBA). Wear chemical protective clothing that is specifically recommended by the manufacturer. DuPont™ Tychem® Suit Fabrics is recommended by one government source[88]. It may provide little or no thermal protection. Structural firefighters' protective clothing provides limited protection in fire situations

ONLY; it is not effective in spill situations where direct contact with the substance is possible.

Respirator Selection: Where the neat (undiluted) test chemical is weighed and diluted, wear a NIOSH-approved half face respirator equipped with a combination filter cartridge, i.e. organic vapor/acid gas/HEPA (specific for organic vapors, HCl, acid gas, SO_2 and a high efficiency particulate filter)[88] Wherever and whenever workplace conditions warrant respirator use, a respiratory protection program must be followed that meets one or more of the following requirements: OSHA's 29 CFR 1910.134, ANSI Z88.2, or European Standard EN 149.

Storage: Color Code-Blue: Health Hazard/Poison. Store in a secure poison location. Refrigerate. Prior to working with this chemical you should be trained on its proper handling and storage. Store in tightly closed containers in a cool, well-ventilated area. Sources of ignition, such as smoking and open flames, are prohibited where this chemical is used, handled, or stored in a manner that could create a potential fire or explosion hazard.

Shipping: Environmentally hazardous substances, solid or liquid, usually fall in Hazard Class 9.

Spill Handling: For solids, isolate spill or leak area in all directions for at least 25 meters/75 feet. Increase, in the downwind direction, as necessary. First remove all sources of ignition. Evacuate persons not wearing protective equipment from area of spill or leak until clean up is complete. Remove all ignition sources. Do not touch damaged containers or spilled material unless wearing appropriate protective clothing. Stop leak if you can do it without risk. Prevent entry into waterways, sewers, basements or confined areas. Cover with plastic sheet to prevent spreading. Absorb or cover with dry earth, sand or other non-combustible material and transfer to containers. If you spill this chemical, you should dampen the solid spill material with water, then transfer the dampened material to a suitable container. Use absorbent paper dampened with water to pick up any remaining material. Seal your contaminated clothing and the absorbent paper in a vapor-tight plastic bag for eventual disposal. Wash all contaminated surfaces with a soap and water solution. Do not re-enter the contaminated area until the Safety Officer (or other responsible person) has verified that the area has been properly cleaned. Do not allow water to get inside containers. Ventilate area after clean up is complete. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable.

Fire Extinguishing: See "Incompatibilities" section. Use dry chemical, carbon dioxide; or halon extinguishers. Hazardous decomposition includes toxic oxides of nitrogen and hydrogen chloride gas. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies. From a secure, explosion-proof location, use water spray to cool exposed containers. If cooling streams are ineffective (venting sound increases in volume and pitch, tank discolors, or shows any signs of deforming), withdraw immediately to a secure position. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode

Disposal Method Suggested: Consult with environmental regulatory agencies for guidance on acceptable disposal practices. Contact a licensed disposal facility about surplus and non-recyclable solutions. Burn in a chemical incinerator equipped with an afterburner and scrubber. Extra care must be exercised as the material in an organic solvent is highly flammable. In accordance with 40CFR165, follow recommendations for the disposal of pesticides and pesticide containers. Containers must be disposed of properly by following package label directions or by contacting your local or federal environmental control agency, or by contacting your regional EPA office. Incineration or permanganate oxidation.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- United States National Library of Medicine, ChemIDplus Advanced, Bethesda, MD. http://chem.sis.nlm.nih.gov/chemidplus/rn/94361-06-5

Cyprodinil C:1860

Use Type: Fungicide

CAS Number: 121552-61-2

Formula: $C_{14}H_{15}N_3$

Synonyms: *N*-(4-Cyclopropyl-6-methyl-pyrimidin-2-yl)-; 4-Cyclopropyl-6-methyl-*N*-phenyl-2-pyrimidinamine; 2-Pyrimidinamine, 4-cyclopropyl-6-methyl-*N*-phenyl-

Trade Names: CGA 219417® technical; CHORUS®; SWITCH®; UNIX®; VANGUARD®

Chemical class: Anilinopyrimidine

EPA/OPP PC Code: 288202

California DPR Chemical Code: 4000

HSDB Number: 7019

UN/NA & ERG Number: UN3077 (solid)/171 or UN3082/171, depending on formulation.

EC Number: Not assigned [*Annex I Index No.:* 612-242-00-x]

Uses: Cyprodinil is applied to the foliage of almonds, grapes, stone fruit crops, and pome fruit crops to control plant diseases. Target fungi for cyprodinil include scab and brown rot blossom

U.S. Maximum Allowable Residue Levels for ciprodinil [(40 CFR 180.532(a)(1)]: almond hulls 0.05 ppm; almond nutmeats 0.02 ppm; apple pomace, wet 0.15 ppm; grapes 2.0 ppm; pome fruit 0.1 ppm; raisins 3.0 ppm; and stone fruit 2.0 ppm. (7/1/2001)

Human toxicity (long-term)[101]: Very low–262.50 ppb, Health Advisory

Fish toxicity (threshold)[101]: Low–160.91666 ppb, MATC (Maximum Acceptable Toxicant Concentration)

Regulatory Authority and Advisory Information:

Carcinogenicity: EPA: Not likely to be a human carcinogen

European/International Regulations: Hazard Symbol: Xi, N; risk phrases: R43; R50/53; safety phrases: S2, S24; S37, S46; S60; S61 (see Appendix 1)

Description: White crystalline solid or beige powder. Molecular weight = 225.30; Freezing/Melting point = 70–75 °C; Vapor pressure = 5.0×10^{-4} mmHg. Low solubility in water; solubility = 12 mg/L @ 20 °C.

Determination in Water: Log K_{ow} = 3.9–4.0. Values of more than 3.0 are likely to bioaccumulate in marine organisms.

Harmful Effects and Symptoms

Short Term Exposure: Skin, eye, and respiratory tract irritant. Inhalation should be avoided; use NIOSH- or CEN (UK)-approved air-purifying respirators for pesticides. May be harmful if swallowed.

Long Term Exposure:

Points of Attack: Ski

Medical Surveillance: Evaluation by a qualified allergist, including exposure history and testing, may help diagnose allergy.

First Aid: If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least 15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately. If this chemical contacts the skin, remove contaminated clothing and wash immediately with soap and water. Seek medical attention immediately. If this chemical has been inhaled, remove from exposure, begin rescue breathing (using universal precautions) if breathing has stopped, and CPR if heart action has stopped. Transfer promptly to a medical facility. When this chemical has been swallowed, get medical attention. Give large quantities of water and induce vomiting. Do not make an unconscious person vomit. Do not induce vomiting when formulations containing petroleum solvents are ingested.

Personal Protective Methods: Wear protective gloves and clothing to prevent any reasonable probability of dermal contact. Safety equipment suppliers/manufacturers can provide recommendations on the most protective glove/clothing material for your operation. DuPont™ Tychem® suit fabrics[88]. All protective clothing (suits, gloves, footwear, headgear) should be clean, available each day, and put on before work. Contact lenses should not be worn when working with this chemical. Wear splash chemical goggles and face shield unless full facepiece respiratory protection is worn. Employees should wash immediately with soap when skin is wet or contaminated. Provide emergency showers and eyewash.

Respirator Selection: Wherever and whenever workplace conditions warrant respirator use, a respiratory protection program must be followed that meets one or more of the following requirements: OSHA's 29 CFR 1910.134, ANSI Z88.2, or European Standard EN 149.

Shipping: Environmentally hazardous substances, solid or liquid, usually fall in Hazard Class 9.

Spill Handling: Do not touch damaged containers or spilled material unless wearing appropriate protective clothing. Stop leak if you can do it without risk. Prevent entry into waterways, sewers, basements or confined areas. Cover with plastic sheet to prevent spreading. Absorb or cover with dry earth, sand or other non-combustible material and transfer to containers. Do not allow water to get inside containers.

Fire Extinguishing: Decomposition products include toxic nitrogen oxides and oxides of carbon. *On a small fire:* use dry chemical, carbon dioxide or water spray. *On a large fire:* use water spray, fog or regular foam. Move containers from fire area if you can do it without risk. Dike fire-control water for later disposal. Use water spray or fog; do not scatter material using straight water jet streams. Do not allow water to get inside containers. Cool containers with flooding quantities of water until well after fire is out. Withdraw immediately in the case of rising sound from venting safety devices or discoloration of tank. For massive fire, use unmanned hose holders or monitor nozzles; if this is impossible, withdraw from area and let fire burn.

Disposal Method Suggested: Recycle any unused portion of the material for its approved use or return it to the manufacturer or supplier. Ultimate disposal of the chemical must consider: the material's impact on air quality; potential migration in soil or water; effects on animal, aquatic, and plant life; and conformance with environmental and public health regulations.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- U.S. Environmental Protection Agency, Office of Pesticide Programs, "Pesticide Fact Sheet, Cyprodinil," Washington, DC (April 6, 1998). http://www.epa.gov/opprd001/factsheets/cyprodinil.pdf

Cyromazine C:1870

Use Type: Insecticide (insect growth regulator)

CAS Number: 66215-27-8

Formula: $C_6H_{10}N_6$

Synonyms: *N*-Cyclopropyl-1,3,5-triazine-2,4,6-triamine; 2-Cyclopropylamino-4,6-diamino-*s*-triazine; Cyclopropylmelamine; 2,4-Diamino-6-(cyclopropylamino)-*s*-triazine; 1,3,5-Triazine-2,4,6-triamine, *N*-cyclopropyl-

Trade Names: ARMOR®; CITATION; CGA-72662®; LARVADEX®; PATRON®; TRIGARD®; VETRAZIN®

Chemical class: Triazine

EPA/OPP PC Code: 121301

California DPR Chemical Code: 2286
HSDB Number: 6602
UN/NA & ERG Number: UN3077 (solid)/171
RTECS® Number: ZX1056500
EC Number: 266-257-8

Uses: As an insect growth regulator, cyromazine is fed to caged poultry and is passed through the chicken, leaving a residue in the manure. The chemical controls the growth of the fly larvae developing in the manure. Used as a foliar spray to control leaf miners in vegetables, mushrooms, potatoes and ornamentals and to control flies on animals.

U.S. Maximum Allowable Residue Levels for Cyromazine 40 CFR 180.414(a)(1): bean, dry, except cowpea 3.0 ppm; bean, lima 1.0 ppm; broccoli 1.0 ppm; cabbage, abyssinian 10.0 ppm; cabbage, seakale 10.0 ppm; cattle, fat 0.05 ppm; cattle, kidney 0.2 ppm; cattle, meat 0.05 ppm; cattle, meat byproducts, except kidney 0.05 ppm; egg 0.25 ppm; garlic, bulb 0.2 ppm; garlic, great-headed, bulb 0.2 ppm; goat, fat 0.05 ppm; goat, kidney 0.2 ppm; goat, meat 0.05 ppm; goat, meat byproducts, except kidney 0.05 ppm; hanover salad, leaves 10.0 ppm; hog, fat 0.05 ppm; hog, kidney 0.2 ppm; hog, meat 0.05 ppm; hog, meat byproducts, except kidney 0.05 ppm; horse, fat 0.05 ppm; horse, kidney 0.2 ppm; horse, meat 0.05 ppm; horse, meat byproducts, except kidney 0.05 ppm; leek 3.0 ppm; mango (there are no U.S. registrations on mango as of May 4, 2000) 0.3 ppm; milk 0.05 ppm; mushroom 1.0 ppm; onion, dry bulb 0.2 ppm; onion, green 3.0 ppm; onion, potato 3.0 ppm; onion, tree 3.0 ppm; onion, welsh 3.0 ppm; pepper 1.0 ppm; potato 0.8 ppm; poultry, fat (from chicken layer hens and chicken breeder hens only) 0.05 ppm; poultry, meat (from chicken layer hens and chicken breeder hens only) 0.05 ppm; poultry, meat byproducts (from chicken layer hens and chicken breeder hens only) 0.05 ppm; rakkyo, bulb 0.2 ppm; shallot, bulb 0.2 ppm; shallot, fresh leaves 3.0 ppm; sheep, fat 0.05 ppm; sheep, kidney 0.2 ppm; sheep, meat 0.05 ppm; sheep, meat byproducts, except kidney 0.05 ppm; tomato 0.5 ppm; turnip, greens 10.0 ppm; vegetable, brassica, leafy, group 5, except broccoli 10.0 ppm; vegetable, leafy, except brassica, group 4, 7.0 ppm; vegetable, cucurbit, group 9, 1.0 ppm; ***[40 CFR 180.414(a)(2)]***; cyromazine may be safely used in accordance with the following conditions: (i) It is used as a feed additive only in feed for chicken layer hens and chicken breeder hens at the rate of not more than 0.01 pound of cyromazine per ton of poultry feed. (ii) It is used for control of flies in manure of treated chicken layer hens and chicken breeder hens. (iii) Feeding of-treated feed must stop at least 3 days (72 hours) before slaughter. If the feed is formulated by any person other than the end user, the formulator must inform the end user, in writing, of the 3-day (72 hours) preslaughter interval. (iv) To ensure safe use of the additive, the labeling of the pesticide formulation containing the feed additive shall conform to the labeling which is registered by the U.S. Environmental Protection Agency, and the additive shall be used in accordance with this registered labeling. (v) Residues of cyromazine are not to exceed 5.0 ppm in poultry feed. ***[40 CFR 180.414(d)]***: Cotton, undelinted seed 0.1 ppm; corn, sweet, kernel plus cob with husks removed 0.5 ppm; corn, sweet, forage 0.5 ppm; corn, sweet, stover 0.5 ppm; radish, root 0.5 ppm; radish, tops (leaves) 0.5 ppm

Human toxicity (long-term)[101]: Low–52.50 ppb, Health Advisory

Fish toxicity (threshold)[101]: Very low–22450.18892 ppb, MATC (Maximum Acceptable Toxicant Concentration)

Regulatory Authority and Advisory Information:
Carcinogenicity: EPA Group E, evidence of non-carcinogenicity for humans.
Acute Oral Category: 4, Caution
European/International Regulations: Hazard Symbol: N; risk phrases: R51/53; safety phrases: S61 (see Appendix 1)
WGK (German Aquatic Hazard Class): 2-Hazard to waters

Description: White crystalline solid. Odorless. Molecular weight = 166.18; Specific gravity (H_2O:1) = 1.35; Freezing/Melting point = 225 °C; Vapor pressure = 3.36×10^{-9} mmHg @ 20 °C. Soluble in water; solubility = 1%.

Incompatibilities: Incompatible with oxidizers, acids, acid chlorides, acid halides, isocyanates, halogenated organics, peroxides, phenols (acidic), epoxides, anhydrides. Contact with strong reducing agents such as halides may generate explosive a flammable gas.

Routes of Entry: Inhalation, passing through the skin, ingestion

Harmful Effects and Symptoms

Short Term Exposure: May cause skin and severe eye irritation. Moderately poisonous if ingested or inhaled. LD_{50} (oral, rat) = >3 g/kg; LD_{50} (dermal, rat) = >3 g/kg.

Long Term Exposure: May cause lung irritation and damage. May cause skin allergy. Contact with some triazine compounds (such as atrazine) may increase risks of tumors known to be associated with hormonal factors. These have been observed in both animals and human beings, and are consistent with the known effects on the hypothalamic pituitary gonadal axis. Repeated exposure may cause weight loss and reduced red blood cell count. May be mutagenic

Points of Attack: Liver, lungs and skin. May cause reproductive and fetal effects.

Medical Surveillance: Before beginning employment and at regular times after that, for those with frequent or potentially high exposures, the following is recommended: Lung function tests. Consider chest x-ray following acute overexposure. Evaluation by a qualified allergist. Examination of the nervous system.

First Aid: If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least 15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately. If this chemical contacts the skin, remove contaminated clothing and wash immediately with soap and water. Seek medical attention immediately. If this chemical has been inhaled, remove from exposure, begin rescue breathing (using universal precautions) if breathing has stopped, and CPR if heart action has stopped. Transfer promptly to a medical facility. When this chemical has been swallowed, get medical attention. Give large quantities of water or milk and induce vomiting. Do not make an unconscious person vomit.

Personal Protective Methods: Applicators and other handlers must wear: Coveralls worn over long-sleeved shirt and long pants; Chemical-resistant gloves such as DuPont™ Tychem® suit fabrics, barrier laminate, or Viton®; Chemical-resistant footwear plus socks; Protective eye wear; Chemical-resistant headgear for overhead exposure; Chemical-resistant apron when cleaning equipment, mixing, or loading[83]. Agricultural Use/Engineering Controls: When handlers use closed systems, enclosed cabs, or aircraft in a manner that meets the requirements listed in the Worker Protection Standard (WPS) for agricultural pesticides, ***40 CFR 170.240(d)(4-6)***, the handler PPE requirements may be reduced or modified as specified in the Worker Protection Standard. Firefighters should wear NIOSH approved self-contained breathing apparatus and full protective clothing.

Respirator Selection: Wherever and whenever workplace conditions warrant respirator use, a respiratory protection program must be followed that meets one or more of the following requirements: OSHA's 29 CFR 1910.134, ANSI Z88.2, or European Standard EN 149.

Shipping: Environmentally hazardous substances, solid or liquid, usually fall in Hazard Class 9.

Spill Handling: Do not touch damaged containers or spilled material unless wearing appropriate protective clothing. Stop leak if you can do it without risk. Prevent entry into waterways, sewers, basements or confined areas. Cover with plastic sheet to prevent spreading. Absorb or cover with dry earth, sand or other non-combustible material and transfer to containers. Do not allow water to get inside containers.

Fire Extinguishing: Decomposition products include toxic nitrogen oxides and oxides of carbon. *On a small fire:* use dry chemical, carbon dioxide or foam. *On a large fire:* use water spray, fog or regular foam. Move containers from fire area if you can do it without risk. Dike fire-control water for later disposal. Use water spray or fog; do not scatter material using straight water jet streams. Do not allow water to get inside containers. Cool containers with flooding quantities of water until well after fire is out. Withdraw immediately in the case of rising sound from venting safety devices or discoloration of tank For massive fire, use unmanned hose holders or monitor nozzles; if this is impossible, withdraw from area and let fire burn.

Disposal Method Suggested: Recycle any unused portion of the material for its approved use or return it to the manufacturer or supplier. Incineration with effluent gas scrubbing is recommended. Containers must be disposed of properly by following package label directions or by contacting your local or federal environmental control agency, or by contacting your regional EPA office. Ultimate disposal of the chemical must consider: the material's impact on air quality; potential migration in soil or water; effects on animal, aquatic, and plant life; and conformance with environmental and public health regulations.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- Pesticide Management Education Program, "Cyromazine (Larvadex, Trigard) Chemical Fact Sheet 12/86," Cornell University, Ithaca, NY (December 1986). http://pmep.cce.cornell.edu/profiles/insect-mite/cadusafos-cyromazine/cyromazine/insect-prof-cyromazine.html
- USEPA, Office of Pesticide Programs, Pesticide Residue Limits, "Cyromazine," 40 CFR 180.414. http://www.epa.gov/pesticides/food/viewtols.htm

D

2,4-D acid, salts & esters D:0100

Use Type: Herbicide, Plant growth regulator
CAS Number: 94-75-7 (acid); 5742-19-8 [2,4-D-diethanolamine salt (DEA)]; 1928-43-4 [2,4-D 2-ethylhexyl ester (EHE)]
Formula: $C_8H_6Cl_2O_3$; $Cl_2C_6H_3OCH_2COOH$; C16H22Cl3O3
Synonyms: Acido 2,4-diclorofenoxiacetico (Spanish); Dichlorophenoxyacetic acid; 2,4-Dichlorphenoxyacetic acid; 2,4-Dichlorophenoxyacetic acid, salts and esters; 2,4-D, salts and esters; ENT 8,538;NSC 423; 2,4-PA (in Japan)
Trade Names: ACME® 2,4-D; AGROCER COMPLEX®; AGROTECT®; AMIDOX®; AMINOL 806®; AMINOZ®; AMOXONE®; AQUA-KLEEN®; BARRAGE®; BH 2,4-D®; BRUSH-RHAP®, active;[C]; BUSH KILLER®; B-SELEKTONON®; CAMPAIGN®; CHIPCO TURF HERBICIDE "D"®; CHLOROXONE®; CITRUS FIX; CROP RIDER®[C]; CROTILIN®; CURTAIL®; D 50®; 2,4-D PHENOXY PESTICIDE®; DACAMID®; DACAMINE®[C]; DECAMINE®; DEBROUSSAILLANT 600®; DED-WEED®; DEHERBAN®; DESORMONE® 2,4-D; DICOPUR®; DICOTOX®; DIKAMIN®; DIKONIRT®; DMA-4®; DORMONE®; DYMEC®; EMULSAMINE BK®[C]; EMULSAMINE E-3®[C]; ENVERT®[C]; ESTERON®; ESTERON BRUSH KILLER®; ESTERON 99 CONCENTRATE®; ESTERONE FOUR®, ESTERON 44 WEED KILLER®; ESTONE®; FARMCO®[C]; FERNESTA®; FERNIMINE®; FERNOXONE®; FERXONE®; FOREDEX 75®; FORMULA 40®; HEDONAL®; HERBANIL®; HERBI D-480®; HERBIDAL®; HERBOXONE®; HI-DEP®; HORMOTOX®; IPANER®; KROTILINE®; LAND MASTER®; LAWN-KEEP®; MACRONDRAY®; MALERBANE®; MATON®; MIRACLE®[C]; MONOSAN®; MOTA MASKROS®; MOXONE®; NETAGRONE®; PENNAMINE®[C]; PHENOX®; PIELIK®; PLANOTOX®; PLANTGARD®; RHODIA®; SALVO®[C]; SAVAGE®; SPRITZ-HORMIN/2,4-D®; SPRITZ-HORMIT/2,4-D®; SUPER D WEEDONE®; SUPERORMONE CONCENTRE®; TRANSAMINE®[C]; TRIBUTON®; TRINOXOL®[C]; U 46® 2,4-D; U-5043®; VERGEMASTER®; VERTON®[C]; VIDON 638®; VISKO®[C]; VISKO-RHAP®[C]; WEED-AG-BAR®; WEEDAR®; WEED-B-GON®; WEEDEZ WONDER BAR®; WEEDONE®; WEED-RHAP®[C]; WEED TOX®; WEEDTROL®
Chemical Class: Phenoxyacetic acid; Chlorophenoxy; Alkylchlorophenoxy
EPA/OPP PC Code: 030001
California DPR Chemical Code: 636
HSDB Number: 202; 7309 (EHE); None (DEA)
UN/NA & ERG Number: UN3345 (solid)/153; UN3348 (liquid)/153; UN2765/152[86]
RTECS® Number: AG6825000
EC Number: 202-361-1 [*Annex I Index No.:* 607-039-00-8]
Uses: 2,4-Dichlorophenoxyacetic acid was introduced as a plant growth-regulator in 1942. 2, 4-D is the most widely used herbicide in the United States and its used in more than 100 countries. It is registered in the United States as a herbicide for control of broadleaf plants and as a plant growth-regulator. There are many forms or derivatives of 2,4-D including esters, amines, and salts. It is used in cultivated agriculture, in pasture and rangeland applications, forest management, home, garden, and to control aquatic vegetation. It may be found in emulsion form, in aqueous solutions (salts), and as a dry compound. The product *Agent Orange*, made by Monsanto Chemical and used extensively throughout Vietnam, was about 50% 2,4-D. However, the controversies associated with the use of *Agent Orange* involved a contaminant (dioxin) in the 2,4,5-T component of the defoliant. In 1964 *Agent Orange* replaced *Agent Purple* a mixture of the *n*-butyl esters of 2,4-D and 2,4,5-T plus the isobutyl ester of 2,4,5-T.
U.S. Maximum Allowable Residue Levels for 2,4-D [40 CFR 180.142(a)(1)]: See also Hazardous Substance Data Bank, Number: 202 @ http://toxnet.nlm.nih.gov/cgi-bin/sis/search/f?./temp/~geopv R:1: in or on raw agricultural commodities as follows: apples 5 ppm; apricots 5 ppm; citrus fruits 5 ppm; pears 5 ppm; potatoes 0.2 ppm; and quinces 5 ppm; preharvest application 2,4-D dimethylamine salt apricots 5 ppm; 2,4-D from the preharvest application of 2,4-D isopropyl ester and 2,4-D butoxyethyl ester and from the postharvest application of 2,4-D alkanolamine salts and 2,4-D isopropyl ester citrus fruits 5 ppm; ***[40 CFR 180.142(a)(2)]*** barley, grain 0.5 ppm; blueberries 0.1 ppm; corn, fodder 20 ppm; corn, forage 20 ppm; corn, fresh, sweet (kernel plus cob with husk removed) 0.5 ppm; corn, grain 0.5 ppm; cranberries 0.5 ppm; grapes 0.5 ppm; grass hay 300 ppm; grasses, pasture 1,000 ppm; grasses, rangeland 1,000 ppm; millet, forage 20 ppm; millet, grain 0.5 ppm; millet, straw 20 ppm; nuts 0.2 ppm; oats, forage 20 ppm; oats, grain 0.5 ppm; pistachios 0.2 ppm; rice 0.1 ppm; rice, straw 20 ppm; rye, forage 20 ppm; rye, grain 0.5 ppm: sorghum, fodder 20 ppm; sorghum, forage 20 ppm; sorghum, grain 0.5 ppm; stone fruits 0.2 ppm; sugarcane 2 ppm; sugarcane, forage 20 ppm; wheat, forage 20 ppm; and wheat, grain 0.5 ppm. ***[40 CFR 180.142(a)(2)(i)]*** the inorganic salts: ammonium, lithium, potassium, and sodium; (B) the amine salt: alkanolamines of the ethanol and isopropanol series (C-12), alkyl (C-13), alkyl (C-14), alkylamines derived from tall oil, amylamine, diethanolamine, diethylamine, diisopropanolamine, dimethylamine, N,N-dimethyllinoleylamine, N,N-dimethyloleyamine, ethanolamine, ethylamine, heptylamine, isopropanolamine, isopropylamine, linoleylamine, methylamine, morpholine, octylamine,

oleylamine, N-oleyl-1,3-propylenediamine, propylamine, triethanolamine, triethylamine triisopropanolamine, and trimethylamine. ***[40 CFR 180.142(a)(2)(ii)]*** Residues on /the commodities listed at ***[40 CFR 180.142(a)(2)]*** may result from application of 2,4-D in acid form, or in the form of one or more of the following esters: amyl(pentyl), butoxyethoxypropyl, butoxyethyl, butoxypolyethylene glycol butyl ether, butoxypropyl, butyl, dipropylene glycol isobutyl ether, ethoxyethoxyethyl, ethoxyethoxypropyl, ethyl, ethoxypropyl, isobutyl, isooctyl (including, but not limited to, 2-ethylhexyl, 2-ethyl-4-methylpentyl, and 2-octyl), isopropyl, methyl, polyethylene glycol 200, polypropoxybutyl, polypropylene glycol, propylene glycol, propylene glycol butyl ether, propylene glycol isobutyl ether, tetrahydrofurfuryl, and tripropylene glycol isobutyl ether. **Tolerances are established for negligible residues of 2,4-D from application of its dimethylamine salt to irrigation ditch banks in the Western United States in programs of the Bureau of Reclamation, U.S. Department of Interior; cooperating water user organizations; the Bureau of Sport Fisheries, U.S. Department of Interior; Agricultural Research Services, U.S. Department of Agriculture; and the Corps of Engineers, U.S. Department of Defense. Where tolerances are established at higher levels from other uses of 2,4-D on the following crops, the higher tolerance applies also to residues from the irrigation ditch bank use cited in this paragraph.** ***[40 CFR 180.142(a)(3)]:*** The established tolerances follow: avocados, 0.1(N); citrus fruits, 0.1(N); cottonseed, 0.1(N); cucurbits, 0.1(N); forage grasses, 0.1(N); forage legumes, 0.1(N); fruiting vegetables, 0.1(N); grain crops, 0.1(N); hops, 0.1(N); leafy vegetables, 0.1(N); nuts, 0.1(N); pome fruits, 0.1(N); root crop vegetables, 0.1(N); seed and pod vegetables, 0.1(N); small fruits, 0.1(N); and stone fruits, 0.1(N). ***[40 CFR 180.142(a)(4)]*** 2,4-D sodium salt and alkanolamine salts (of the ethanol and isopropanol series), calculated as 2,4-D (2,4-dichlorophenoxyacetic acid) as follows: asparagus, 5 ppm. ***[40 CFR 180.142(a)(5)]*** A tolerance is established for residues of 2,4-D from application of its alkanolamine salts (of the ethanol and isopropanol series) as follows: strawberries, 0.5 ppm. ***[40 CFR 180.142(a)(6)]*** A tolerance is established for residues for 2,4-D from application of its dimethylamine salt for water hyacinth control in ponds, lakes, reservoirs, marshes, bayous, drainage ditches, canals, rivers, and streams that are quiescent or slow moving in programs conducted by the Corps of Engineers or other Federal, State, or local public agencies. Where tolerances are established at higher levels from other uses of the dimethylamine salt of 2,4-D on crops included within these commodity groups, the higher tolerances also apply to residues from the aquatic uses cited in this paragraph. The established tolerances follow: crops in paragraph (c) of this section, 1.0 ppm; crop groupings in paragraph (c) of this section, 1.0 ppm; fish, 1.0 ppm; and shellfish, 1.0 ppm. ***Tolerances are established for residues of 2,4dichlorophenoxyacetic acid (2,4-D) and/or its metabolite, 2,4-dichlorophenol (2,4-DCP) in food products of animal origin as follows [40 CFR 180.142(a)(8)]:*** cattle, fat: 0.2 ppm; cattle, kidney 2 ppm; cattle, meat 0.2 ppm; cattle, meat byproducts (except kidney) 0.2 ppm; eggs 0.05 ppm; goats, fat 0.2 ppm; goats, kidney 2 ppm; goats, meat 0.2 ppm; goats, meat byproducts (except kidney) 0.2 ppm; hogs, fat 0.2 ppm; hogs, kidney 2 ppm; hogs, meat 0.2 ppm; hogs, meat byproducts (except kidney) 0.2 ppm; horses, fat 0.2 ppm; horses, kidney 2 ppm; horses, meat 0.2 ppm; horses, meat byproducts (except kidney) 0.2 ppm; milk 0.1 ppm; poultry 0.05 ppm; sheep, fat 0.2 ppm; sheep, kidney 2 ppm; sheep, meat 0.2 ppm; and sheep, meat byproducts (except kidney) 0.2 ppm. ***A tolerance is established for residues of 2,4-D from application of its dimethylamine salt or its butoxyethanol ester for Eurasian Watermilfoil control in programs conducted by the Tennessee Valley Authority in dams and reservoirs of the TVA system as follows [40 CFR 180.142(a)(9)]:*** fish 1.0 ppm. ***Tolerances are established for residues of 2,4-D at [40 CFR 180.142(a)(2)]:*** barley, grain 0.5 ppm; blueberry 0.1 ppm; corn, forage 20 ppm; corn, fresh, sweet, kernel plus cob with husk removed 0.5 ppm; corn, grain 0.5 ppm; corn, stover 20 ppm; cranberry 0.5 ppm; fruit, stone 0.2 ppm; grapes 0.5 ppm; grass hay 300 ppm; grasses, pasture 1,000 ppm; grasses, rangeland 1,000 ppm; millet, forage 20 ppm; millet, grain 0.5 ppm; millet, straw 20 ppm; nut 0.2 ppm; oat, forage 20 ppm; oat, grain 0.5 ppm; pistachio 0.2 ppm; rice, grain 0.1 ppm; rice, straw 20 ppm; rye, forage 20 ppm; rye, grain 0.5 ppm; sorghum, forage 20 ppm; sorghum, grain 0.5 ppm; sorghum, grain, stover 20 ppm; sugarcane, cane 2 ppm; sugarcane, forage 20 ppm; wheat, forage 20 ppm; and wheat, grain 0.5 ppm. (Residues on all the above may result from application of 2,4-D in acid form, or in the form of one or more of the following esters: amyl (pentyl), butoxyethoxypropyl, butoxyethyl, butoxypolythylene glycol butyl ether, butoxypropyl, butyl, dipropylene glycol isobutyl ether, ethoxyethoxyethyl, ethoxyethoxypropyl, ethyl, ethoxypropyl, isobutyl, isooctyl (including, but not limited to, 2-ethylhexyl, 2-ethyl-4-methylpentyl, and 2-octyl), isopropyl, methyl, polyethylene glycol 200, polypropoxybutyl, polypropylene glycol, propylene glycol, propylene glycol butyl ether, propylene glycol isobutyl ether, tetrahydrofurfuryl, and tripropylene glycol isobutyl ether.) ***Regional registration, as defined in section 180.1(n) [40 CFR 180.142(a)(10)]:*** on the following raw agricultural commodity: raspberries, 1.0 ppm. ***The following tolerances are established for residues of 2,4-D (2,4-dichloro-phenoxyacetic acid) in the following processed feeds. Such residues may be present therein only as a result of application to the growing crop of the herbicides identified in this section: [40 CFR 180.142(a)(12)]:*** (i) in sugarcane bagasse 5 ppm; sugarcane molasses 5 ppm. (ii) in the milled fractions derived from barley, oats, rye and wheat to be ingested as animal feed or converted into animal feed, 2 ppm. ***[40 CFR 180.142(a)(13)]:*** in sugarcane molasses, resulting from application of the herbicide to sugarcane fields 5 ppm; ***[40 CFR 180.142(a)(13) (ii)]*** in the milled fractions (except flour) derived from barley, oats, rye, and wheat to be ingested as food or to be converted to food. Such residues may be present therein only as a result of application to the growing crop of the herbicides identified in ***40 CFR 180.142***. ***[40 CFR 180.142(a)(13) (iii)]:*** 0.1 ppm (negligible residue) in potable water. Such residues may be present therein only: (A) As a result of the application of the dimethylamine salt of 2,4-D to irrigation ditch banks in the Western United States to programs of the Bureau of Reclamation; cooperating water user organizations; the Bureau of Sport Fisheries, U.S. Department of the Interior; Agricultural Research Services, U.S. Department of Agriculture; and the Corps of Engineers, U.S. Department of Defense. (B) As a result of the application of the dimethylamine salt of 2,4-D for water hyacinth control in ponds, lakes, reservoirs, marshes, bayous, drainage ditches, canals, rivers and streams that are quiescent or slow moving in programs of the Corps of Engineers or other Federal, State, or local public agencies. (C) As a result of application of its dimethylamine salt or its butoxyethanol ester for Eurasian watermilfoil control in programs conducted by the Tennessee Valley Authority in dams and reservoirs of the TVA system. (7/1/2001).

Human toxicity (long-term)[101]: Low–70.00 ppb, MCL (Maximum Contaminant Level)

Fish toxicity (threshold)[101]: Very low–4247.00420 ppb, MATC (Maximum Acceptable Toxicant Concentration)

Regulatory Authority and Advisory Information:

Carcinogenicity: EPA Group D, Not classifiable as to human carcinogenicity. ACGIH A4, not classified as a human carcinogen.

Acute Oral Category: 2, WARNING; Category: 3, CAUTION[86] (based on formulation)

Health Advisory: Mutagen, Endocrine disruptor (S!)

Potential Ground Water Pollutant [California FAC Section 13145(d)/12811, active], includes salts: 2,4-D, 2-ethylhexyl ester; 2,4-D, diethanolamine salt; 2,4-D, dimethylamine salt; 2,4-D, isooctyl ester

Clean Air Act: Hazardous Air Pollutants (Title I, Part A, Section 112)

Clean Water Act: Section 311 Hazardous Substances/RQ 40CFR117.3 (same as CERCLA, see below); Section 313 Water Priority Chemicals (57FR41331, 9/9/92)

Reportable Quantity (RQ): 100 lb (45.5 kg)

U.S. EPA Hazardous Waste Number (RCRA No.): D016 & U240

RCRA Toxicity Characteristic (Section 261.24), Maximum Concentration of Contaminants, regulatory level, 10.0 mg/L

RCRA 40CFR268.48; 61FR15654, Universal Treatment Standards: Wastewater (mg/L), 0.72; Nonwastewater (mg/kg), 10

RCRA 40CFR264, appendix 9; TSD Facilities Ground Water Monitoring List. Suggested test method(s) (PQL μg/L): 8150 (10)

Safe Drinking Water Act: MCL, 0.1 mg/L; MCGL, 0.07 mg/L; Regulated chemical (47 FR 9352) as 2,4-D

CERCLA/SARA 313: Form R *de minimis* concentration reporting level: 1.0%

US DOT Regulated Marine Pollutant (49CFR172.101, appendix B)

European/International Regulations: Hazard Symbol: Xn; risk phrases: R22; R37; R41; R43; safety phrases: S2; S24; S25; S26; S36/37/39; S46; S61 (see Appendix 1)

WGK (German Aquatic Hazard Class): 2-Hazard to waters

Description: 2,4-Dichlorophenoxyacetic acid is a white to yellow crystalline powder with a slight phenolic odor. Molecular weight = 221.04; Specific gravity (H_2O:1) = 1.563 @ 20°C; Boiling point = (decomposes) below BP @ 158°C; Freezing/Melting point = 140.5°C; Vapor pressure = 8×10^{-6} mmHg[83]; 0.4 mmHg @ 160°C[9]. Heat of Combustion = (est.) –7,700 Btu/lb = –4,300 cal/g = -180×105 J/kg. Slightly soluble in water; solubility = 0.05%. 2,4D-DEA (diethanolamine salt, CAS: 5742-19-8) is a cream-colored powder. Molecular weight = 326.18; Vapor pressure = 9.98×10^{-8} mmHg. Solubility in water = 8.1×10^{5} mg/L

2,4-D-EHE (ethylhexyl ester, CAS: 1928-43-4) is a yellow to dark amber liquid. Sweet odor. Molecular weight = 333.28; Boiling point = (decomposes); Vapor pressure = 3.6×10^{-6} mmHg. Solubility in water = 8.7×10^{-2} mg/L.

Incompatibilities: A weak acid, incompatible with bases. Decomposes in sunlight or heat, forming hydrogen chloride and phosgene. Contact with strong oxidizers may cause fire and explosions. Attacks metals and painted surfaces. Vapors of the EHE ester may form an explosive mixture with air.

Permissible Exposure Limits in Air: OSHA PEL: 10 mg/m^3 TWA

NIOSH REL: 10 mg/m^3 TWA

ACGIH TLV®[1]: 10 mg/m^3 TWA; not classifiable as a human carcinogen

Protective Action Criteria (PAC) Ver. 27[89]

PAC-1: 14 mg/m^3
PAC-2: 140 mg/m^3
PAC-3: 500 mg/m^3

2,4-D, including salts and esters

DFG MAK: 1 mg/m^3, inhalable fraction TWA; Peak limitation Category II(8) [skin]; Pregnancy Risk Group C

Determination in Air: Collection on a glass fiber filter and analysis by HPLC with ultraviolet detection. See NIOSH Method #5001[18]

Permissible Concentration in Water: Federal Drinking Water Guidelines: 70 ppb[93]

Determination in Water: Filter; Methanol; high-pressure liquid chromatography/Ultraviolet detection; NIOSH IV Method #5001[18]. The taste and odor threshold in water is 3.13 mg/L. Log K_{ow} = ranges from 2.8 for the acid to 5.8 for (EHE). Values at or above 3.0 are likely to bioaccumulate in marine organisms.

Routes of Entry: Inhalation, skin absorption, ingestion, skin and eye contact

Harmful Effects and Symptoms

Short Term Exposure: *Inhalation:* May cause irritation of the mouth, nose and throat, headache, nausea, vomiting, and diarrhea at levels above 10 mg/m^3. Nerve damage, which may be delayed, may include swelling of legs and feet, muscle twitch and stupor. Severe exposures may result in death. *Skin:* Dust or liquid left in contact with the skin for several hours may be absorbed. This may result in severe delayed symptoms as listed above. These symptoms may last for months or years. *Eyes:* Irritation may occur. *Ingestion:* The oral dose (human) required to produce symptoms is about 1/12 ounce (1/2 teaspoon). Increasing amounts may result in increasingly severe symptoms as listed above. Death has resulted from as little as 1/5 ounce. Survival for more than 48 hours is usually followed by complete recovery although symptoms may last for several months. LD_{50} (oral, human) = 80 mg/kg[86]; LD_{50} (oral, rat) = 375[86] – >1600 mg/kg.

Long Term Exposure: Workers exposed to 2,4-D in the manufacturing process over a 5 to 10 year period at levels above 10 mg/m^3 complained of weakness, rapid fatigue, headache and vertigo. May cause tumors. Liver damage, low blood pressure and slowed heartbeat were also found. Based on animal tests, 2,4-D may affect human reproduction. May cause skin sensitization. May be neurotoxic.

Points of Attack: Skin, central nervous system, liver, kidneys, skin. Reproductive cells.

Medical Surveillance: Preliminary medical exam to detect chronic diseases of central nervous system, liver, heart, kidneys, lung and skin, as well as endocrinological or immunological disturbances, should protect susceptible individuals. Periodical medical exams of internal organs, skin and eyes are important to avoid chronic occupational intoxications. They should include lab and patch tests when necessary[83]. If symptoms develop or overexposure is suspected, the following may be useful: Liver and kidney function tests. Exam of the nervous system. In addition to comprehensive initial medical and work histories emphasizing reproductive experience and menstrual history, patient should have physical examination and testing of genito-urinary tract, sperm count, motility and morphology. If required, other tests, such as serum testosterone, serum follicle stimulating hormone (FSH), and serum lutenizing hormone (LH), may be indicated. Evaluation by a qualified allergist, including exposure history and testing, may help diagnose allergy.

First Aid: If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least 15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately. If this chemical contacts the skin, remove contaminated clothing and wash immediately with soap and water. Seek medical attention immediately. If this chemical has been inhaled, remove from exposure, begin rescue breathing (using universal precautions) if breathing has stopped, and CPR if heart action has stopped. Transfer promptly to a medical facility. When this chemical has been swallowed, get medical attention. Give large quantities of water and induce vomiting. Do not make an unconscious person vomit.

Personal Protective Methods: Wear protective gloves and clothing to prevent any reasonable probability of dermal contact. **8 hr** (more than 8 hours of resistance to breakthrough >0.1 μg/cm²/min): natural rubber gloves, Neoprene™ rubber gloves, suits, boots; nitrile rubber gloves, suits, boots; polyvinyl alcohol gloves. Safety equipment suppliers/manufacturers can provide recommendations on the most protective glove/clothing material for your operation. All protective clothing (suits, gloves, footwear, headgear) should be clean, available each day, and put on before work. Contact lenses should not be worn when working with this chemical. Wear dust-proof chemical goggles and face shield unless full facepiece respiratory protection is worn. Employees should wash immediately with soap when skin is wet or contaminated. Provide emergency showers and eyewash.

Respirator Selection: SCBA > 14 mg/m^3. NIOSH: *100 mg/m³:* Any air-purifying half-mask respirator with organic vapor cartridge(s) in combination with an N95, R95, or P95 filter [the following filters may also be used: N99, R99, P99, N100, R100, P100]; or GmFOv100 (APF = 50) [any air-purifying, full facepiece respirator (gas mask) with a chin-style, front- or back-mounted organic vapor canister having an N100, R100, or P100 filter]; or PaprOvHie (APF = 25) (any air-purifying full facepiece respirator equipped with an organic vapor cartridge in combination with a high-efficiency particulate filter); or Sa (APF = 10) (any supplied-air respirator); or SCBAF (APF = 50) (any self-contained breathing apparatus with a full facepiece); or SaF (APF = 50) (any supplied-air respirator with a full facepiece); or SaT: Cf (APF = 50) (any supplied-air respirator that has a tight-fitting face-piece and is operated in a continuous-flow mode). *Emergency or planned entry into unknown concentrations or IDLH conditions:* SCBAF: Pd,Pp (APF = 10,000) (any self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode); or SaF: Pd,Pp: ASCBA (APF = 10,000) (any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary self-contained breathing apparatus operated in a pressure-demand or other positive-pressure mode). *Escape*: GmFOv100 (APF = 50) [any air-purifying, full facepiece respirator (gas mask) with a chin-style, front- or back-mounted organic vapor canister having an N100, R100, or P100 filter]; or SCBAE (any appropriate escape-type, self-contained breathing apparatus).

Storage: Color Code-Blue: Health Hazard/Poison. Store in a secure poison location. Prior to working with this chemical, you should be trained on its proper handling and storage. Store in tightly closed containers in a dark, cool, well-ventilated area. Keep away from oxidizers, heat, and sunlight. A regulated, marked area should be established where this chemical is stored in compliance with OSHA Standard 1910.1045.

Shipping: Phenoxyacetic acid derivative pesticides require a shipping label of "poisonous materials" and fall in Hazard Class 6.1, Packing Group III.

Spill Handling: First remove all sources of ignition. Evacuate persons not wearing protective equipment from area of spill or leak until clean up is complete. Remove all ignition sources. Collect powdered material in the most convenient and safe manner and deposit in sealed containers. Ventilate area after clean up is complete. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable.

Fire Extinguishing: 2,4-Dichlorophenoxyacetic acid ester may burn, but does not readily ignite. Hazardous decomposition includes oxides of carbon, hydrogen chloride and phosgene. As an immediate precautionary measure, isolate spill or leak area in all directions for at least 50 meters/150 feet for liquids and at least 25 meters/75 feet for solids. *Fire involving storage or vehicular tanks:* isolate for 800 meters/0.5 mile in all directions; also, consider initial evacuation for 800 meters/0.5 mile in all directions. *On a small fire:* use dry chemical, CO_2, water spray or regular foam. *On a large fire:* use water spray, fog or regular foam. Do not scatter spilled material with high-pressure streams of water. Move containers from fire area if you can do it without risk. Dike fire-control water for later disposal. *Fire involving tanks:* from a secure, explosion-proof location, use water spray to cool exposed containers. If cooling streams are ineffective (venting sound increases in volume and pitch, tank discolors, or shows any signs of deforming), withdraw immediately to a secure position. Always stay away from tanks engulfed in fire. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode.

Disposal Method Suggested: Generators of waste containing this contaminant (≥100 kg/mo) must conform with EPA regulations governing storage, transportation, treatment, and waste disposal. Incineration of phenoxys is effective in 1 second @ 982°C, using a straight combustion process, or @ 482°C using catalytic combustion. Over 99% decomposition was reported when small amounts of 2,4-D were burned in a polyethylene bag. See "References" for additional detail. In accordance with 40CFR165, follow recommendations for the disposal of pesticides and pesticide containers. Containers must be disposed of properly by following package label directions or by contacting your local or federal environmental control agency, or by contacting your regional EPA office. Consult with environmental regulatory agencies for guidance on acceptable disposal practices.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- EXTOXNET, Extension Toxicology Network, "Pesticide Information Profile, 2,4-D," Oregon State University, Corvallis, OR. (June, 1996). http://ace.ace.orst.edu/info/extoxnet/pips/24-D.htm
- USEPA, Office of Pesticide Programs, Pesticide Residue Limits, "2,4-D", 40 CFR 180. http://www.epa.gov/cgi-bin/oppsrch
- USEPA, 2,4-Dichlorophenoxy Acetic Acid, Health and Environmental Effects Profile No. 77, Washington DC, Office of Solid Waste (April 30, 1980)
- New Jersey Department of Health, "Hazardous Substance Fact Sheet: 2,4-Dichlorophenoxyacetic Acid Ester," Trenton, NJ (March 1989, rev. January 1999). http://www.state.nj.us/health/eoh/rtkweb/0593.pdf
- New York State Department of Health, "Chemical Fact Sheet: 2,4-D," Albany, NY, Bureau of Toxic Substance Assessment (March 1986 and Version 2)
- Sax, N. I., Ed., "Dangerous Properties of Industrial Materials Report," 1, No. 6, 49-52 (1981) and 7, No. 6, 11-46 (1987)
- Jervais, G.; Luukinen, B., Buhl, K.; Stone, D., *2,4-D Technical Fact Sheet*; National Pesticide Information Center, Oregon State University Extension Services, Corvallis, OR (2008)

Daminozide D:0120

Use Type: Plant growth regulator
CAS Number: 1596-84-5
Formula: $C_6H_{12}N_2O_3$
Synonyms: Butanedioic acid mono(2,2-dimethylhydrazide); DIMAS; *N*-Dimethyl amino-β-carbamyl propionic acid; *N*-(Dimethylamino)succinamic acid; DMSA; NCI-C03827; Succinic acid, 2,2-dimethylhydrazide; Succinic-1,1-dimethyl hydrazide
Trade Names: ALAR®; ALAR-85®; AMINOZID®; AMINOZIDE®; B-9®; B-995®; B-NINE®; DAZIDE®; DAZIDE®; ENHANCE®; DIMAS®; KYLAR®; SADH®
Chemical Class: Azo, Diazo, Azido compounds
EPA/OPP PC Code: 035101
California DPR Chemical Code: 7
HSDB Number: 1769
UN/NA&ERG Number: UN2811 (toxic solid, organic, n.o.s.)/154
RTECS® Number: WM9625000
EC Number: 216-485-9

Uses: Daminozide is a systemic growth regulator registered for use on ornamentals, including potted chrysanthemums and poinsettias, and bedding plants in enclosed structures. U.S. sales for food and feed crops were halted in 1989 because of health considerations, i. e., the Alar scare on apples.

Human toxicity (long-term) ***[101]:*** Intermediate–40.22989 ppb, CHCL (Chronic Human Carcinogen Level)

Fish toxicity (threshold) ***[101]:*** Very low–31007.43129 ppb, MATC (Maximum Acceptable Toxicant Concentration)

Regulatory Authority and Advisory Information:
Carcinogenicity: EPA Group B2, Probable human carcinogen.
California Proposition 65 Chemical: Carcinogen (January 1, 1990)
Health Advisory: Mutagen
Acute Oral Category: 4, Caution

Description: White crystalline solid or water soluble powder. Molecular weight = 160.20; Boiling point = decomposes @ 142°C;. Freezing/Melting point =154°C; Vapor pressure = 1×10^{-8} mmHg @ 20°C; <7.50×10^{-5} mmHg @

20°C[88]. Soluble in water; solubility = 100 g/kg @ 25°C; 1–10 mg/mL @ 23.9°C[88].

Incompatibilities: Keep material away from oxidizers, sulfuric acid, caustics, ammonia, aliphatic amines, alkanolamines, isocyanates, alkylene oxides, epichlorohydrin, as it may generate toxic gases. Contact with alkali metals may generate flammable gases. May corrode metals, especially in the presence of moisture.

Determination in Air: Filter; none; Gravimetric; NIOSH IV [Particulates NOR; #0500 (total), #0600 (respirable)].[18].

Determination in Water: Log K_{ow} = very low. Unlikely to bioaccumulate in marine organisms.

Harmful Effects and Symptoms

Short Term Exposure: However, daminozide metabolizes to diamethylhydrazine, which is a proven carcinogen in animal tests. In has a low dermal irritation potential and it is neither teratogenic nor mutagenic[55]. It is not an acute toxin to fish or wildlife. LD_{50} (oral, rat) = >5 g/kg; LD_{50} (dermal, rat) = >5 g/kg.

Long Term Exposure: May cause reproductive and fetal effects. May cause tumors.

Points of Attack: Reproductive cells. Reproductive system.

Medical Surveillance: This chemical is a suspected or known human carcinogen. Exposed persons should contact a physician for advice regarding the possible long term health effects and advice for medical monitoring. In addition to comprehensive initial medical and work histories emphasizing reproductive experience and menstrual history, patient should have physical examination and testing of genito-urinary tract, sperm count, motility and morphology. If required, other tests, such as serum testosterone, serum follicle stimulating hormone (FSH), and serum lutenizing hormone (LH), may be indicated.

First Aid: **Skin:** Flood all areas of body that have contacted the substance with water. Don't wait to remove contaminated clothing; do it under the water stream. Use soap to help ensure removal. Isolate contaminated clothing when removed to prevent contact by others. *Eyes*: Remove any contact lenses at once. Flush eyes well with copious quantities of water or normal saline for at least 20–30 minutes. Seek medical attention. *Inhalation:* Leave contaminated area immediately; breathe fresh air. Proper respiratory protection must be supplied to any rescuers. If coughing, difficult breathing or any other symptoms develop, seek medical attention at once, even if symptoms develop many hours after exposure. *Ingestion:* If convulsions are not present, give a glass or two of water or milk to dilute the substance. Ensure that the person's airway is unobstructed and contact a hospital or poison center immediately for advice on whether or not to induce vomiting

Respirator Selection: *At any detectable concentration:* SCBAF: Pd,Pp (APF = 10,000) (any NIOSH/MSHA- or European Standard EN 149-approved self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode); or SaF: Pd,Pp: ASCBA (APF = 10,000) (any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary, self-contained breathing apparatus operated in a pressure-demand or other positive-pressure mode). *Escape:* 100 F (APF = 50) (any air-purifying, full facepiece respirator with an N100, R100, or P100 filter k-mounted organic vapor canister having a high-efficiency particulate filter); or SCBAE (any appropriate escape-type, self-contained breathing apparatus).

Storage: Color Code-Blue: Health Hazard/Poison. Store in a secure poison location. Prior to working with daminozide you should be trained on its proper handling and storage. Store in a cool, dry place or in a refrigerator. A regulated, marked area should be established where this chemical is handled, used, or stored in compliance with OSHA Standard 1910.1045.

Shipping: Toxic, solids, organic, n.o.s. require a label of "poisonous materials." This material falls in Hazard Class 6.1 and Packing Group III.

Spill Handling: First remove all sources of ignition. Evacuate persons not wearing protective equipment from area of spill or leak until clean up is complete. Remove all ignition sources. Collect powdered material in the most convenient and safe manner and deposit in sealed containers. Ventilate area after clean up is complete. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable.

Fire Extinguishing: Hazardous decomposition includes oxides of nitrogen and carbon. *Fire involving storage or vehicular tanks:* isolate for 800 meters/0.5 mile in all directions; also, consider initial evacuation for 800 meters/0.5 mile in all directions. *Small fire:* dry chemical, carbon dioxide or water spray. *Large fire:* dry chemical, carbon dioxide, alcohol-resistant foam or water spray. Move containers from fire area if you can do it without risk. Dike fire-control water for later disposal; do not scatter the material. *Fire involving tanks or car/trailer loads:* fight fire from maximum distance or use unmanned hose holders or monitor nozzles. Do not get water inside containers. Cool containers with flooding quantities of water until well after fire is out. Withdraw immediately in the case of rising sound from venting safety devices or discoloration of tank. Always stay away from tanks engulfed in fire. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode.

Disposal Method Suggested: Incineration in a unit with efficient gas scrubbing. Containers must be disposed of properly by following package label directions or by contacting your local or federal environmental control agency, or by contacting your regional EPA office.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- EXTOXNET, Extension Toxicology Network, "Pesticide Information Profile, Daminozide," Oregon State University, Corvallis, OR (September 1996). http://ace.orst.edu/cgi-bin/mfs/01/pips/daminozi.htm?8
- USEPA, "Reregistration Eligibility Decision (RED), Daminozide," Office of Prevention, Pesticides and Toxic Substances, Washington DC (September 1993). http://www.epa.gov/REDs/factsheets/0032fact.pdf

Dazomet D:0132

Use Type: Insecticide, Herbicide, Fumigant, Fungicide, Nematicide

CAS Number: 533-74-4

Formula: $C_5H_{10}N_2S_2$

Synonyms: Caswell No. 840; Dimethylformocarbothialdine; 3,5-Dimethylperhydro- 1,3,5-thiadiazin-2-thion (Czech, German); 3,5-Dimethyl- 1,2,3,5- tetrahydro-1,3,5-thiadiazinethione-2; 3,5-Dimethyltetrahydro -1,3,5-2*H*-thiadiazine-2-thione; 3,5-Dimethyltetrahydro-1,3,5-thiadiazine-2-thione; 3,5-Dimethyl-1,3,5-thiadiazinane-2-thione; 3,5-Dimethyl-2-thionotetrahydro-1,3,5-thiadiazine; DMTT; Tetrahydro-2*H*-3,5-dimethyl-1,3,5-thiadiazine-2-thione; Tetrahydro-3,5-dimethyl-1,3,5-thiadiazine-2-thione; Tetrahydro-3,5-dimethyl-2*H*-1,3,5-thiadiazine-2-thione; 2*H*-1,3,5-Thiadiazine-2-thione, tetrahydro-3,5-dimethyl-; 2-Thio-3,5-dimethyltetrahydro-1,3,5-thiadiazine

Trade Names: AMA-20®, Kemira Chemicals (Finland); BASAMID®; BASAMID® G; BASAMID®-GRANULAR; BASAMID® P; BASAMID-PUDER®; CARBOTHIALDIN®; CARBOTHIALDINE®; CRAG®; CRAG® FUNGICIDE 974; CRAG® NEMACIDE; DAZOMET®-POWDER BASF; FENNOSAN® B 100; MICO-FUME®; MYLON®; MYLONE®; MYLONE® 85; N 521®; NALCON 243®; PREZERVIT®; STAUFFER N® 521; THIADIAZIN® (PESTICIDE); TIAZON®; TROYSAN® 142; UCC 974®

Chemical Class: Dithiocarbamate

EPA/OPP PC Code: 035602

California DPR Chemical Code: 233

HSDB Number: 1642

UN/NA & ERG Number: UN3077 (solid)/171

RTECS® Number: XI2800000

EC Number: 208-576-7 [*Annex I Index No.*613-008-00-X]

Uses: Dazomet is a soil fumigant used against germinating weed seeds, soil insects, nematodes, and soil-borne diseases in forest nursery seed beds, tobacco crops, greenhouse crops, and substrates for potted plants, turf, and ornamentals. It is also used as an antimicrobial agent for slimicide preparations and for adhesives, paper-mill slimicide, paint, and cooling water slimicides.

Human toxicity (long-term)[101]: Intermediate–24.500 ppb, Health Advisory

Fish toxicity (threshold)[101]: Intermediate–16.769960 ppb, MATC (Maximum Acceptable Toxicant Concentration)

Regulatory Authority and Advisory Information:

Carcinogenicity: EPA Group D, Not classifiable as a human carcinogen

Health Advisory: Skin irritant/sensitizer

Acute Oral Category: 2, WARNING

Potential Ground Water Pollutant [California FAC Section 13145(d)/12811, active]

EPA Hazardous Waste Number (RCRA No.): U366

EPCRA Section 313 Form R *de minimis* concentration reporting level: 1.0%

European/International Regulations: Hazard Symbol: Xi, Xn, N; risk phrases: R22; R36; R50/53; safety phrases: S2, S15; S22, S24; S60; S61 (see Appendix 1)

WGK (German Aquatic Hazard Class): 3-Severe hazard to waters

Description: White crystalline solid. Nearly odorless. Molecular weight = 162.27; Freezing/Melting point = 102–105°C (decomposes prior to boiling); Vapor pressure = 3.2×10^{-6}mm @ 20°C. Flash point = 93°C. Combustible in dust form. Highly soluble in water; solubility = 1300 mg/L @ 25°C.

Incompatibilities: Sensitive to moisture and heat. Decomposes on heating above 102°C, producing toxic fumes including nitrogen oxides and sulfur oxides. Decomposes on contact with acids, producing carbon disulfide. Decomposes on contact with water or moisture, producing toxic gases. Flammable gases are generated by the combination of dithiocarbamates with aldehydes, nitrides, and hydrides. Dithiocarbamates are incompatible with acids, peroxides, and acid halides.

Determination in Water: EPA EMSLC Method 630. The Determination of Dithiocarbamate Pesticides in Municipal and Industrial Wastewater by UV-VIS Spectrophotometry. Log K_{ow} = 1.38. Unlikely to bioaccumulate in marine organisms.

Routes of Entry: Absorbed through the skin, inhalation, ingestion

Harmful Effects and Symptoms

Short Term Exposure: Corrosive. Irritates skin and a severe eye irritant. Poisonous if swallowed. Unlike carbamates the dithiocarbamates are not cholinesterase inhibitors, but some of them may react with recently ingested alcohol or alcohol-containing products including wine, medications, and cold remedies such as cough-syrups. LD_{50} (oral, rat) = 300–350 mg/kg; LD_{50} (dermal, rat) = >2 g/kg.

Long Term Exposure: Skin sensitizer. May cause liver damage.

Points of Attack: Skin, liver (possible toxin).

Medical Surveillance: Evaluation by a qualified allergist, including exposure history and testing, may help diagnose allergy.

First Aid: If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least 15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately. If this chemical contacts the skin, remove contaminated clothing and wash immediately with soap and water. Seek medical attention immediately. If this chemical has been inhaled, remove from exposure, begin rescue breathing (using universal precautions) if breathing has stopped, and CPR if heart action has stopped. Transfer promptly to a medical facility. When this chemical has been swallowed, get medical attention. Give large quantities of water and induce vomiting. Do not make an unconscious person vomit. Do not induce vomiting when formulations containing petroleum solvents are ingested.

Personal Protective Methods: Reacts with the following absorbent materials: Cellulose-Based; Mineral- and Clay-Based; Dirt/Earth[88]. Applicators and other handlers must wear: Coveralls worn over long-sleeved shirt and long pants; Chemical-resistant gloves such as DuPont™ Tychem® suit fabrics, barrier laminate, or Viton®; Chemical-resistant footwear plus socks; Protective eye wear; Chemical-resistant headgear for overhead exposure; Chemical-resistant apron when cleaning equipment, mixing, or loading[83]. Agricultural Use/Engineering Controls: When handlers use closed systems, enclosed cabs, or aircraft in a manner that meets the requirements listed in the Worker Protection Standard (WPS) for agricultural pesticides, ***40 CFR 170.240(d)(4-6),*** the handler PPE requirements may be reduced or modified as specified in the Worker Protection Standard. Firefighters should wear NIOSH approved self-contained breathing apparatus and full protective clothing.

Respirator Selection: Where potential exists for exposures over 2 mg/m^3, use an NIOSH/MSHA- or European Standard EN 149-approved full facepiece respirator with a pesticide cartridge. Increased protection is obtained from full facepiece air-purifying respirators. If while wearing a filter, cartridge or canister respirator, you can smell, taste, or otherwise detect disulfiram, or in the case of a full facepiece respirator you experience eye irritation, leave the area immediately. Check to make sure the respirator-to-face seal is still good. If it is, replace the filter, cartridge, or canister. If the seal is no longer good, you may need a new respirator. *Where potential for high exposures exists*, use an NIOSH/MSHA- or European Standard EN 149-approved supplied-air respirator with a full facepiece operated in the positive-pressure mode, or with a full facepiece, hood, or helmet in the continuous flow mode; or use an NIOSH/MSHA- or European Standard EN 149-approved self-contained breathing apparatus with a full facepiece operated in the pressure-demand or other positive-pressure mode.

Storage: Color Code-White: Corrosive or Contact Hazard; Store separately in a corrosion resistant location. Prior to working with this chemical you should be trained on its proper handling and storage. Store in tightly closed containers in a cool, well-ventilated area. Color Code-Blue: Health Hazard/Poison. Store in a secure poison location. Prior to working with this chemical you should be trained on its proper handling and storage. Store in tightly closed containers in a cool, well-ventilated area away from oxidizers.

Shipping: Environmentally hazardous substances, solid or liquid, usually fall in Hazard Class 9.

Spill Handling: First remove all sources of ignition. Evacuate persons not wearing protective equipment from area of spill or leak until clean up is complete. Remove all ignition sources. Collect powdered material in the most convenient and safe manner and deposit in sealed containers. Ventilate area after clean up is complete. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable.

Fire Extinguishing: Extinguish fire using an agent suitable for type of surrounding fire. Disulfiram itself does not burn readily. Poisonous gases are produced in fire. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies. From a secure, explosion-proof location, use water spray to cool exposed containers. If cooling streams are ineffective (venting sound increases in volume and pitch, tank discolors, or shows any signs of deforming), withdraw immediately to a secure position. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode.

Disposal Method Suggested: Do not discharge into drains or sewers. Dispose of waste material as hazardous waste using a licensed disposal contractor to an approved landfill. Consult with environmental regulatory agencies for guidance on acceptable disposal practices. Generators of waste containing this contaminant (≥100 kg/mo) must conform with EPA regulations governing storage, transportation, treatment, and waste disposal. A potential candidate for liquid injection incineration at a temperature range of 650 to 1,600 °C and a residence time 0.1 to 2 seconds. Also, a potential candidate for rotary kiln incineration at a temperature range of 820 to 1,600°C and residence times of seconds for liquids and gases, and hours for solids[83]. In accordance with 40CFR165, follow recommendations for the disposal of pesticides and pesticide containers. Containers must be disposed of properly by following package label directions or by contacting your local or federal environmental control agency, or by contacting your regional EPA office.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- United States National Library of Medicine, ChemIDplus Advanced, Bethesda, MD. http://chem.sis.nlm.nih.gov/chemidplus/rn/533-74-4

2,4-DB D:0133

Use Type: Herbicide
CAS Number: 94-82-6
Formula: $C_{10}H_{10}Cl_2O_3$
Synonyms: Acido 2,4-diclorofenoxibutirico (Spanish); 2,4-D butyric; Butanoic acid, 4-(2,4-dichlorophenoxy)-; Butyric acid, 4-(2,4-dichlorophenoxy)-; Caswell No. 316; 4-(2,4-DB); 4-(2,4-Dichlorophenoxy)butyric acid; γ-(2,4-Dichlorophenoxy)butyric acid; 2,4-DM
Trade Names: BUTIREX®; BUTORMONE®; BUTOXON®; BUTOXONE®; BUTOXONE® ESTER; BUTOXONE® AMINE; BUTYRAC®; BUTYRAC® 118; BUTYRAC® 200; BUTYRAC® ESTER; CAMPBELL'S® DB STRAIGHT; CAMPBELL'S® REDLEGOR; DESORMONE® 2,4, DB; EMBUTOX KLEAN-UP®; EMBUTONE®; EMBUTOX®; LEGUMEX® D
Chemical Class: Chlorophenoxy; Aryloxyalkanoic acid
EPA/OPP PC Code: 030801
California DPR Chemical Code: 5020
HSDB Number: 6603
UN/NA & ERG Number: UN3077 (solid)/171
RTECS® Number: ES9100000
EC Number: 202-366-9 [Annex I Index No.: 607-083-00-8]
Uses: 2,4-DB is a selective systemic herbicide used to control annual and perennial broadleaf weeds in many field crops such as alfalfa, peanuts, cereals and soybeans; used as a defoliant. In the plant, the compound changes to 2,4-D and inhibits growth at the tips of stems and roots.
Human toxicity (long-term)[101]: Low–70.00 ppb, Health Advisory
Fish toxicity (threshold)[101]: Low–269.85657 ppb, MATC (Maximum Acceptable Toxicant Concentration)
Regulatory Authority and Advisory Information:
Carcinogenicity: EPA, Not likely to be carcinogenic to humans; IARC, Group 2b, Possibly carcinogenic to humans.
California Proposition 65 Chemical: Developmental toxin, male; delisted (1/1/2005)
Health Advisory: Mutagen, Developmental/ Reproductive Toxin (?), Endocrine disruptor (S!)
Acute Oral Category: 2, WARNING
EPCRA Section 313 Form R *de minimis* concentration reporting level: 1.0%
AB 2588-Air Toxics "Hot Spots" Chemicals (CAL) as chlorophenoxy pesticides.
The "Director's List" (CAL/OSHA) as chlorophenoxy pesticides.
European/International Regulations: Hazard Symbol: Xn, N; risk phrases: R22; R51/53; safety phrases: S2; S25; S29; S46; S61 (see Appendix 1)
Description: White to light-brown crystalline solid. May be shipped as a concentrate to be mixed with water and used as a spray. Slight phenolic odor. Molecular weight = 249.09; Boiling point = 324°C; Freezing/Melting point =115–119°C; Vapor pressure = 3.5×10^{-6} mmHg @ 25°C (est); 9.44×10^{-3} mmHg @ 25°C. Highly soluble in water.
Incompatibilities: 2,4-DB is a weak organic acid. Keep away from oxidizers, sulfuric acid, caustics, ammonia, aliphatic amines, alkanolamines, isocyanates, alkylene oxides, epichlorohydrin. Corrosive to iron, aluminum, zinc, and possibly other metals, especially in the presence of moisture.
Determination in Air: Filter; none; Gravimetric; NIOSH IV [Particulates NOR; #0500 (total), #0600 (respirable)].[18].
Determination in Water: Log K_{ow} = >3.0. Values above 3.0 are likely to bioaccumulate in aquatic organisms.
Routes of Entry: Inhalation, ingestion, absorbed through the skin.
Harmful Effects and Symptoms
Short Term Exposure: Poisonous; may be fatal if inhaled, swallowed, or absorbed through skin. Severely irritates eyes, skin and respiratory tract, with burning sensation, pain, redness and swelling. Metabolic stimulant. If inhaled, causes coughing, dilated pupils, headache, profuse perspiration, intense thirst, extreme fatigue, rapid pulse, high fever, clammy, flushed skin, rapid breathing, nausea, vomiting, cyanosis (bluish tint to skin and lips), anxiety and confusion, convulsions, risk of lung edema. If swallowed, face and lips turn bluish. Liver injury with associated jaundice, kidney failure, and cardiac arrhythmias are commonly noted. Nerve damage, which may be delayed, may include swelling of legs and feet, muscle twitch and stupor. Severe exposure can cause death from heart failure. Dust or liquid left in contact with the skin for several hours may be absorbed. This may result in severe delayed symptoms as listed above. These symptoms may last for months or years. LD_{50} (oral, rat) = 700–800 mg/kg; LD_{50} (dermal, rat) = >5 g/kg.
Long Term Exposure: Workers exposed to chlorophenoxy compounds over a 5 to 10 year period at levels above 10 mg/m^3 complained of weakness, rapid fatigue, headache and vertigo. Liver damage, low blood pressure and slowed heartbeat were also found. Based on animal tests, may affect human reproduction
Points of Attack: Eyes, skin, respiratory system, central nervous system, cardiovascular system, liver, kidney
Medical Surveillance: Preliminary medical exam to detect chronic diseases of central nervous system, liver, heart, kidneys, lung and skin, as well as endocrinological or immunological disturbances, should protect susceptible individuals. Periodical medical exams of internal organs, skin and eyes are important to avoid chronic occupational intoxications. They should include lab and patch tests when necessary[83]. See a physician if poisoning is suspected or if redness, itching, or burning of the skin or eyes develop
First Aid: If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least 15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately. If this chemical contacts the skin, remove contaminated clothing and wash immediately with soap and water. Seek medical attention immediately. If this chemical has been inhaled, remove from exposure, begin rescue breathing (using universal precautions) if breathing has stopped, and CPR if heart action has stopped. Transfer promptly to a medical facility. When this chemical has been swallowed, get medical attention.

Do not induce vomiting when formulations containing petroleum solvents are ingested. Otherwise, give large quantities of water and induce vomiting. Do not make an unconscious person vomit.

Personal Protective Methods: Applicators and other handlers must wear: Coveralls worn over long-sleeved shirt and long pants; Chemical-resistant gloves such as DuPont™ Tychem® suit fabrics, barrier laminate, or Viton®; Chemical-resistant footwear plus socks; Protective eye wear; Chemical-resistant headgear for overhead exposure; Chemical-resistant apron when cleaning equipment, mixing, or loading[83]. Agricultural Use/Engineering Controls: When handlers use closed systems, enclosed cabs, or aircraft in a manner that meets the requirements listed in the Worker Protection Standard (WPS) for agricultural pesticides, ***40 CFR 170.240(d)(4-6),*** the handler PPE requirements may be reduced or modified as specified in the Worker Protection Standard. Firefighters should wear NIOSH approved self-contained breathing apparatus and full protective clothing.

Respirator Selection: Wherever and whenever workplace conditions warrant respirator use, a respiratory protection program must be followed that meets one or more of the following requirements: OSHA's 29 CFR 1910.134, ANSI Z88.2, or European Standard EN 149.

Storage: Color Code-Blue: Health Hazard/Poison. Store in a secure poison location. Prior to working with this chemical you should be trained on its proper handling and storage. Store in tightly closed containers in a cool, well-ventilated area away from oxidizers.

Shipping: Environmentally hazardous substances, solid or liquid, usually fall in Hazard Class 9.

Spill Handling: For solids, isolate spill or leak area in all directions for at least 50 meters/150 feet. Increase, in the downwind direction, as necessary. Do not touch damaged containers or spilled material unless wearing appropriate protective clothing. Stop leak if you can do it without risk. Prevent entry into waterways, sewers, basements or confined areas. Cover with plastic sheet to prevent spreading. Absorb or cover with dry earth, sand or other non-combustible material and transfer to containers. Do not allow water to get inside containers.

Fire Extinguishing: Decomposition in fire produces toxic hydrogen chloride fumes. *On a small fire:* use dry chemical powder, carbon dioxide or alcohol-resistant foam. *On a large fire:* use water spray, fog or alcohol-resistant foam. Move containers from fire area if you can do it without risk. Dike fire-control water for later disposal. Use water spray or fog; do not scatter material using straight water jet streams. *Fire involving storage or vehicular tanks:* isolate for 800 meters/0.5 mile in all directions; also, consider initial evacuation for 800 meters/0.5 mile in all directions. Fight fire from maximum distance or use unmanned hose holders or monitor nozzles. Do not allow water to get inside containers. Cool containers with flooding quantities of water until well after fire is out. Withdraw immediately in the case of rising sound from venting safety devices or discoloration of tank. *Always* stay away from tanks engulfed in fire. For massive fire, use unmanned hose holders or monitor nozzles; if this is impossible, withdraw from area and let fire burn.

Disposal Method Suggested: Do not discharge into drains or sewers. Dispose of waste material as hazardous waste using a licensed disposal contractor to an approved landfill. Consult with environmental regulatory agencies for guidance on acceptable disposal practices. Incineration with effluent gas scrubbing is recommended. Containers must be disposed of properly by following package label directions or by contacting your local or federal environmental control agency, or by contacting your regional EPA office.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- EXTOXNET, Extension Toxicology Network, "Pesticide Information Profile, 2,4-DB," Oregon State University, Corvallis, OR (June 1996). http://extoxnet.orst.edu/pips/24-DB.htm

DCPA D:0136

Use Type: Herbicide, Pesticide

CAS Number: 1861-32-1

Formula: $C_{10}H_6Cl_4O_4$

Synonyms: Chlorthal-dimethyl; Chlorthal-methyl; Dimethyl tetrachloroterephthalate; Dimethyl 2,3,5,6-tetrachloroterephthalate; Chlorthal dimethyl; 2,3,5,6-Tetrachloro-1,4-benzenedicarboxylic acid, dimethyl ester; Tetrachloroterephthalic acid, dimethyl ester

Note: "DCPA" is also a synonym for Propanil (CAS 709-98-8)

Trade Names: ACME® DCPA; DAC 893; DACTHAL; DACTHAL® W-75; DECIMATE® (with Propachlor); FATAL®, GREEN WEEDER®

Chemical Class: Alkyl Phthalate; Benzenedicarboxylic acid

EPA/OPP PC Code: 078701

California DPR Chemical Code: 179

HSDB Number: 358

UN/NA & ERG Number: UN3077 (solid)/171

RTECS® Number: WZ1500000

EC Number: 217-464-7

Uses: This pre-emergent herbicide is used on annual broadleaf weeds and grasses in a wide spectrum of vegetable crops.

U.S. Maximum Allowable Residue Levels for Chlorthal-dimethyl and its metabolites monoethyl tetrachloroterephthalate and tetrachloroterephthalic acid (calculated as dimethyl tetrachloroterephthalate) [40 CFR 180.185(a)]: in or on the following raw agricultural commodities: Beans (field, dry; mung, dry; snap, succulent) 2 ppm; broccoli 1 ppm; brussels sprouts 1 ppm; cabbage 1 ppm; cantaloups 1 ppm; cauliflower 1 ppm; collards 2 ppm; corn (field, fodder and forage) 0.4 ppm; corn (grain (including field and pop)) 0.05 ppm; corn (pop, fodder and forage) 0.4 ppm; corn (sweet (K+CWHR)) 0.05 ppm; corn (sweet, fodder and forage) 0.4 ppm; cottonseed 0.2 ppm; cress (upland) 5 ppm; cucumbers 1 ppm; eggplant 1 ppm; garlic 1 ppm; honeydew melons 1 ppm; horseradish 2 ppm; kale 2 ppm; lettuce 2 ppm; mustard (greens) 5 ppm; onions 1 ppm; peas (southern, black-eyed) 2 ppm; peppers 2 ppm; pimentos 2 ppm; potatoes 2 ppm; rutabagas 2 ppm; soybeans 2 ppm; squash (summer and winter) 1 ppm; strawberries 2 ppm; sweet potatoes 2 ppm; tomatoes 1 ppm; turnips 2 ppm; turnips (greens) 5 ppm; vegetables (leafy, Brassica (cole)) 5 ppm; watermelons 1 ppm; and yams 2 ppm; ***[40 CFR 180.185(b)]*** in or on the following raw agricultural commodities: radish (roots) 2 ppm; and radish (tops) 15 ppm. (7/1/94).

Regulatory Authority and Advisory Information:

Carcinogenicity: EPA Group C, Possible human carcinogen.

Health Advisory: Developmental/Reproductive Toxin, Endocrine disruptor (S!) (some alkyl phthalates)

Acute Oral Category: 3, CAUTION

Washington state requires supplemental labeling as DACTHAL® W-75

European/International Regulations: Hazard Symbol: N; risk phrases: R51/53; safety phrases: S61 (see Appendix 1)

Description: Colorless to gray crystalline solid. Practically odorless. Molecular weight 331.96; Specific gravity (H_2O:1) = 1.56; Boiling point = 345°C; Freezing/Melting point = 156°C; Vapor pressure <0.4 mmHg @ 30°C. Practically insoluble in water; solubility = 0.5 ppm @ 25°C.

Incompatibilities: May react violently with strong oxidizers, bromine, 90% hydrogen peroxide, phosphorus trichloride, silver powders or dust. Incompatible with silver compounds. Mixture with some silver compounds forms explosive salts of silver oxalate.

Permissible Concentration in Water: Federal Drinking Water Guidelines: 70 ppb[93].

Determination in Water: EPA Methods 8081, 608.2, 515.2; Log K_{ow} = >4.0. Values above 3.0 are likely to bioaccumulate in aquatic organisms. State Drinking Water Guidelines: Arizona 3500 μg/l; California 3500 μg/l; Washington 530 μg/L; Wisconsin 70 μg/L[83].

Routes of Entry: Inhalation, ingestion. Absorbed through the intact skin

Harmful Effects and Symptoms

Short Term Exposure: Symptoms include apprehension, anxiety, confusion, nervous excitation; dizziness; headache; numbness and weakness in limbs; muscle twitching, tremors; nausea and vomiting; slow, shallow respiration, bluish face; convulsions; loss of consciousness; breathing stops; death. LD_{50} (oral, rat) = >3 g/kg; LD_{50} (dermal, rabbit) = >10 g/kg.

Long Term Exposure: May cause reproductive and fetal effects. May affect lungs, thyroid, liver, kidneys. May cause skin sensitization.

Points of Attack: Reproductive cells. Lungs, liver, thyroid, skin.

Medical Surveillance: Preliminary medical exam to detect chronic diseases of central nervous system, liver, heart, kidneys, lung and skin, as well as endocrinological or immunological disturbances, should protect susceptible individuals. Periodical medical exams of internal organs, skin and eyes are important to avoid chronic occupational intoxications. They should include lab and patch tests when necessary[83]. This chemical is a suspected or known human carcinogen. Exposed persons should contact a physician for advice regarding the possible long term health effects and advice for medical monitoring. Medical observation is recommended for 24 to 48 hours after breathing overexposure, as pulmonary edema may be delayed. As first aid for pulmonary edema, consider administering a corticosteroid spray. Cigarette smoking may exacerbate pulmonary injury and should be discouraged for at least 72 hours following exposure. Evaluation by a qualified allergist, including exposure history and testing, may help diagnose allergy.

First Aid: *Eyes:* Speed in removing material from skin is of extreme importance. Eye contact can cause dangerous amounts of these chemicals to be quickly absorbed through the mucous membrane into the bloodstream. Directly, irrigate with large amounts of plain, tepid water or saline for 20 minutes, occasionally lifting the lower and upper lids. During this time, remove contact lenses, if easily removable without additional trauma to the eye. Get medical aid immediately. Have physician check for possible delayed damage. *Skin:* Get medical aid. Skin and/or eye contact can cause dangerous amounts of these chemicals to be absorbed into the bloodstream. Wearing the appropriate PPE equipment and respirator for organochlorine pesticides, immediately flush exposed skin, hair, and under nails with plain, running, tepid water for 20 minutes, then wash twice with mild soap. Shampoo hair promptly if contaminated; protect eyes. Do not scrub skin or hair, since this can increase absorption through the skin. Rinse thoroughly with water. Victims who are able and cooperative may assist with their own decontamination. Remove and double-bag contaminated clothing and personal belongings. Leather absorbs many organochlorines; therefore, items such as leather shoes, gloves, and belts should be discarded. If the skin is swollen or inflamed, cool affected areas with cold compresses. *Ingestion:* Call poison control. Loosen all clothing. Never give anything by mouth to an unconscious person. Get medical aid. *Do not induce vomiting.* * In cases of ingestion, the patient is at risk of central nervous system depression or seizures, which may lead to pulmonary aspiration during vomiting. If the victim is conscious and able to swallow, *administer an aqueous slurry of activated charcoal at 1 g/kg (usual adult dose 60–90 g, child dose 25–50 g). A soda can and straw may be of assistance when offering charcoal to a child. The efficacy of activated charcoal for some organochlorine poisoning (such as chlordane) is uncertain. If victim is *unconscious or having convulsions,* do nothing except keep victim warm. **In some cases you may be specifically instructed by poison control to induce vomiting by way of 2 tablespoons of syrup of ipecac (adult) washed down with a cup of water. Do not give activated charcoal* <u>before or with</u> *ipecac syrup. Inhalation:* Get medical aid. Do not contaminate yourself. Wearing the appropriate PPE equipment and respirator for organochlorine pesticides, immediately remove the victim from the contaminated area to fresh air. For inhalation exposures, monitor for respiratory distress. If the victim is not breathing, administer artificial respiration. Do not use mouth-to-mouth method if victim ingested or inhaled the substance; give artificial respiration with the aid of a pocket mask equipped with a one-way valve or other proper respiratory medical device. If cough or breathing difficulty develops, evaluate for respiratory tract irritation, bronchitis, or pneumonitis. If breathing is difficult, administer 100% humidified supplemental oxygen through bag/mask apparatus until medical help arrives. Do not leave victim unattended

Personal Protective Methods: Wear acid-resistant protective gloves and clothing to prevent any reasonable probability of dermal contact. Safety equipment suppliers/manufacturers can provide recommendations on the most protective glove/clothing material for your operation. All protective clothing (suits, gloves, footwear, headgear) should be clean, available each day, and put on before work. Contact lenses should not be worn when working with this chemical. Wear splash-proof chemical goggles and face shield when working with liquids or dust-proof goggles and faceshield when working with powders or dusts, unless full facepiece respiratory protection is worn. Employees should wash immediately with soap when skin is wet or contaminated. Provide emergency showers and eyewash.

Respirator Selection: Where potential exists for exposures *over 1 ppm*, use an NIOSH/MSHA- or European Standard EN 149-approved supplied-air respirator with a full facepiece operated in the positive-pressure mode, or with a full facepiece, hood, or helmet in the continuous-flow mode; or use an NIOSH/MSHA- or European Standard EN 149-approved self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive-pressure mode.

Storage: Color Code-Blue: Health Hazard/Poison. Store in a secure poison location. Prior to working with this chemical you should be trained on its proper handling and storage. Store in tightly closed containers in a cool, well-ventilated area away from oxidizing agents; acid hydrides, and strong bases.

Shipping: This material may be classified as Environmentally hazardous substances, solid, n. o. s. It usually falls in Hazard Class 9.

Spill Handling: *Liquid or wettable powder:* Evacuate and restrict persons not wearing protective equipment from area of spill or leak until clean up is complete. Remove all ignition sources. Ventilate area of spill or leak. Absorb liquids in vermiculite, dry sand, earth, peat, carbon, or a similar material and deposit in sealed containers. Keep this chemical out of a confined space, such as a sewer, because of the possibility of an explosion, unless the sewer is designed to prevent the build-up of explosive concentrations. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable.

Powder: First remove all sources of ignition. Evacuate persons not wearing protective equipment from area of spill or leak until clean up is complete. Remove all ignition sources. Collect powdered material in the most convenient and safe manner and deposit in sealed containers. Ventilate area after clean up is complete. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable.

Fire Extinguishing: Poisonous gases, including chlorine, are produced in fire. Use dry chemical, carbon dioxide; or foam extinguishers. Vapors are heavier than air and will collect in low areas. Containers may explode in fire. Storage containers and parts of containers may rocket great distances, in many directions. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies. From a secure, explosion-proof location, use water spray to cool exposed containers. If cooling streams are ineffective (venting sound increases in volume and pitch, tank discolors, or shows any signs of deforming), withdraw immediately to a secure position. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode.

Disposal Method Suggested: Incineration in a unit with efficient gas scrubbing. Containers must be disposed of properly by following package label directions or by contacting your local or federal environmental control agency, or by contacting your regional EPA office.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- U.S. Environmental Protection Agency, Office of Pesticide Programs, Pesticide Residue Limits, "Chlorthal-dimethly," 40 CFR 180.185. http://www.epa.gov/pesticides/food/viewtols.htm
- USEPA, "Reregistration Eligibility Decision (RED), DCPA," Office of Prevention, Pesticides and Toxic Substances, Washington DC (November 1998). http://www.epa.gov/REDs/0270red.pdf
- USEPA, "Reregistration Eligibility Decision (RED) Facts, DCPA," Office of Prevention, Pesticides and Toxic Substances, Washington DC (November 1998). http://www.epa.gov/REDs/factsheets/0270fact.pdf

- EXTOXNET, Extension Toxicology Network, "Pesticide Information Profile, DCPA, Chlorthal, Clorthal-dimethyl," Oregon State University, Corvallis, OR (June 1996). http://extoxnet.orst.edu/pips/DCPA.htm
- USEPA, Office of Water; Federal-State Toxicology and Risk Analysis Committee (FSTRAC), Summary of State and Federal Drinking Water Standards and Guidelines, Washington DC (November 1993)

DDT D:0140

Use Type: Insecticide
CAS Number: 50-29-3 (*p,p'*-DDT); 789-02-6 (o,p'-DDT)
Formula: $C_{14}H_9Cl_5$
Synonyms: Benzene, 1,1'-(2,2,2-trichloroethylidene) bis(4-chloro); α,α-Bis(*p*-chlorophenyl)-β,β,β-trichlorethane; 1,1-Bis-(*p*-chlorophenyl)-2,2,2-trichloroethane; 2,2-Bis(*p* -chlorophenyl)-1,1-trichloroethane; Chlorophenothan; Chlorophenothane; α-Chlorophenothane; Chlorophenotoxum; Dichlorodiphenyl trichloroethane 2,2-Bis(*p*-chlorophenyl)-1,1,1-trichloroethane; *p,p*'-DDT; 4,4' DDT; Dichlorodiphenyltrichloroethane; *p,p*'-Dichlorodiphenyltrichloroethane; 4,4'-Dichlorodiphenyltrichloroethane; Diclorodifeniltricloroetano (Spanish); Diphenyltrichloroethane; ENT 1,506; Ethane, 1,1,1-trichloro-2,2-bis(*p*-chlorophenyl)-;NA2761;NCI-C00464;OMS 16; Parachlorocidum; PEB1; Pentachlorin; Trichlorobis(4-chlorophenyl)ethane; 1,1,1-Trichloro-2,2-bis(*p*-chlorophenyl) ethane; 1,1,1-Trichloro- 2,2-di(4-chlorophenyl)-ethane
Trade Names: ARKOTINE®; AGRITAN®; ANOFEX®; AZOTOX®; BOSAN SUPRA®; BOVIDERMOL®; CESAREX®; CITOX®; CLOFENOTANE®; DEDELO®; DICOPHANE®; DIDIGAM®; DIDIMAC®; DINOCIDE®; DODAT®; DYKOL®; ESTONATE®; GENITOX®; GESAFID®; GESAPON®; GESAREX®; GESAROL®; GENITOX®; GEXAREX®; GUESAPON®; GUESAROL®; GYRON®; HAVERO-EXTRA®; HILDIT®; IVORAN®; IXODEX®; KOPSOL®; MUTOXIN; NEOCID®; NIAGARA ZINEB®[C]; PENTECH®; PZEIDAN®; R 50®; RUKSEAM®; SANTOBANE®; ZEIDANE®; ZERDANE®
Chemical Class: Organochlorine
EPA/OPP PC Code: 029201
California DPR Chemical Code: 186
HSDB Number: 200
UN/NA & ERG Number: UN2761 (solid)/151
RTECS® Number: KJ3325000
EC Number: 200-024-3 [*Annex I Index No.:* 602-045-00-7]
Uses: Banned for use in EU (also export). DDT was banned form use in the U.S. on December 31, 1972, but it is still used in some other countries, primarily in the subtropics to control malaria. DDT is an organochlorine insecticide used mainly to control mosquito-borne malaria. It was extensively used during the Second World War among Allied troops and certain civilian populations to control insect typhus and malaria vectors, bubonic plague and body lice and was then extensively used as an agricultural insecticide after 1945. By 1970, the Bald Eagle and the Osprey population in the U.S. were near extinction. DDT was banned for use in Sweden in 1970 and in the United States in 1972. DDT is a relatively low-cost broad-spectrum insecticide. However, following an extensive review of health and environmental hazards of the use of DDT, U.S. EPA decided to ban further use of DDT in December 1972. This decision was based on several properties of DDT that had been well evidenced: (1) DDT and its metabolites are toxins with long-term persistence in soil and water; (2) it is widely dispersed by erosion, runoff and volatization; and (3) the low water solubility and high lipophilicity of DDT result in concentrated accumulation of DDT in the fat of wildlife and humans which may be hazardous. Nevertheless, DDT is used to control malaria in subtropical countries, in Africa and some South American locales, where malaria in of epidemic proportions.
Human toxicity (long-term)[101]: High–1.02941 ppb, CHCL (Chronic Human Carcinogen Level)
Fish toxicity (threshold)[101]: Extra high–0.09855 ppb, MATC (Maximum Acceptable Toxicant Concentration)
Regulatory Authority and Advisory Information:
NTP: 12th Report on Carcinogens, 2011: Reasonably anticipated to be a human carcinogen; EPA Group 2b, Probable human carcinogen; EU GHS Category 2: Suspected human carcinogen
California Proposition 65 Chemical: Cancer (10/1/1987) (DDT); Developmental/Reproductive toxin (female) (5/15/1998) (*p,p'*-DDT)
Rotterdam Convention Annex III [Chemicals Subject to the Prior Informed Consent Procedure (PIC)]
Endocrine disruptor: Known ED
Acute Oral Category: 2, WARNING
Health Advisory: Mutagen, Developmental/Reproductive Toxin
Persistent Organic Pollutants (UN)
Air Pollutant Standard Set. Clean Water Act: Section 311 Hazardous Substances/RQ 40CFR117.3 (same as CERCLA, see below); 40CFR423, appendix A, Priority Pollutants; Section 313 Water Priority Chemicals (57FR41331, 9/9/92); Toxic Pollutant (Section 401.15)
U.S. EPA Hazardous Waste Number (RCRA No.): U061
RCRA 40CFR268.48; 61FR15654, Universal Treatment Standards: Wastewater (mg/L), 0.0039; Nonwastewater (mg/kg), 0.087
RCRA 40CFR264, appendix 9; TSD Facilities Ground Water Monitoring List. Suggested test method(s) (PQL *µ*g/L): 8080 (0.1); 8270 (10)
Reportable Quantity (RQ): 1 lb (0.454 kg)
US DOT Regulated Marine Pollutant (49CFR172.101, appendix B), severe pollutant
Rotterdam Convention Annex III [Chemicals Subject to the Prior Informed Consent Procedure (PIC)]
List of Stockholm Convention POPs: Annex B (Restriction).
European/International Regulations: Hazard Symbol: T, N; risk phrases: R25; R40 (Carcinogen Category 3); R48/25; R50/53; safety phrases: S1/2; S22; S36/37; S45; S60; S61 (see Appendix 1).

WGK (German Aquatic Hazard Class): 3-Severe hazard to waters. (50-29-3 9)

Description: DDT is a waxy solid, colorless crystalline solid, or slightly off-white powder. Weak, chemical odor. Molecular weight = 354.49; Specific gravity (H_2O:1) = 0.98 to 0.99 (no temperature); Boiling point = 185.2°C; Freezing/Melting point = 108.5°C; Flash point = 72–75°C; Vapor pressure = 2.1×10^{-7} mmHg @ 20°C. Hazard Identification (based on NFPA-704 M Rating System): Health 2, Flammability 2, Reactivity 0. Practically insoluble in water; solubility = 3.2×10^{-4} ppm @ 25°C.

Incompatibilities: Contact with alkaline material or strong oxidizers may cause fire and explosion hazard. Incompatible with salts of iron or aluminum, and bases. Do not store in iron containers.

Permissible Exposure Limits in Air: OSHA PEL: 1 mg/m^3 TWA [skin]

NIOSH REL: 0.5 mg/m^3 TWA; Suspected occupational carcinogen. Reduce exposure to lowest feasible level. See *NIOSH Pocket Guide*, Appendix A

ACGIH TLV®[1]: 1 mg/m^3 TWA; confirmed animal carcinogen with unknown relevance to humans.

Protective Action Criteria (PAC) Ver. 27[89]

PAC-1: 1 mg/m^3
PAC-2: 1 mg/m^3
PAC-3: 38 mg/m^3

DFG MAK: 1 mg/m^3 TWA measured as the, inhalable fraction [skin]; Peak Limitation Category II(8).

Determination in Air: Collection on a filter, workup with isooctane, analysis by gas chromatography. See NIOSH Method #S-274[18]

Permissible Concentration in Water: Federal Drinking Water Guidelines: 1.0 ppb[93]. To protect freshwater aquatic life: 0.0010 μg/L as a 24 hr average; never to exceed 1.1 μg/L. To protect saltwater aquatic life: 0.0010 μg/L as a 24 hr average; never to exceed 0.13 μg/L. To protect human health: preferably zero. An additional lifetime cancer risk of 1 in 100,000 is imposed by a level of 0.24 ng/L (0.00024 μg/L).

Determination in Water: EPA Method D3086. GC method with ECD for the determination of organochlorine pesticides in water and wastewater. Gas chromatography (EPA Method 608) or gas chromatography plus mass spectrometry (EPA Method 625); Log K_{ow} = >6.0. Values at or above 3.0 are likely to bioaccumulate in marine organisms.

Routes of Entry: Inhalation, skin absorption, ingestion, eye and dermal contact.

Harmful Effects and Symptoms

DDT is a low-cost broad-spectrum insecticide. However, following an extensive review of health and environmental hazards of the use of DDT, U.S. EPA decided to ban further use of DDT in December 1972. This decision was based on several properties of DDT that had been well evidenced[1]: DDT and its metabolites are toxins with long-term persistence in soil and water[2]; it is widely dispersed by erosion, runoff and volatization; and[3] the low water solubility and high lipophilicity of DDT result in concentrated accumulation of DDT in the fat of wildlife and humans which may be hazardous.

Short Term Exposure: *Inhalation:* Can cause irritation. 500–4200 mg/m^3 has produced dizziness. *Skin:* Can cause irritation in very high concentrations. DDT can be absorbed through the skin if dissolved in vegetable oils or other solvents. *Eyes:* Can cause irritation. *Ingestion:* 1/30- to 1/4-ounce has caused nausea, vomiting, headache and convulsions. Other symptoms include weakness, restlessness, dizziness, incoordination, numbness of face and extremities, abdominal pain, diarrhea, tremors, and death. Symptoms may be delayed from ½ to 3 hours. Estimated lethal dose is between 1 teaspoon and 1 ounce. Can cause a prickling or tingling sensation in the mouth, tongue, lower face, nausea, vomiting, confusion, a sense of apprehension, weakness, loss of muscle control, and tremors, paresthesia tongue, lips, face; tremor; dizziness, confusion, malaise (vague feeling of discomfort), headache, fatigue; convulsions; paresis hands. High exposures can cause convulsions and death. LD_{50} (oral, rat) = 113 mg/kg.

Long Term Exposure: Organochlorine pesticides are highly toxic to mammals and will accumulate in the tissues of living organisms. DDT may cause liver and kidney damage. Prolonged or repeated exposure can cause irritation of the eyes, skin, and throat. Occupational exposure to DDT has been associated with changes in genetic material. DDT levels build up and stay in the body for long periods of time. Exposure to DDT and Aldrin may increase retention of DDT in the body. DDT causes cancer in laboratory animals. The U.S. EPA determined that DDT, DDE, and DDD are probable human carcinogens. There is no evidence that DDT, DDE, or DDD cause birth defects in people. Studies in rats have shown that DDT and DDE can mimic the action of natural hormones and in this way affect the development of the reproductive and nervous systems. Puberty was delayed in male rats given high amounts of DDE as juveniles. This could possibly happen in humans. A study in mice showed that exposure to DDT during the first weeks of life may cause neurobehavioral problems later in life.

Points of Attack: Eyes, skin, central nervous system, kidneys, liver, brain, peripheral nervous system. Cancer site in animals: liver, lung, and lymphatic tumors. May cause reproductive and fetal effects. On January 27, 2014 there were various news reports in the U.S. that a new study published in the *Journal of the American Medical Association Neurology* found DDT may be associated with increased risk of Alzheimer's disease.

Medical Surveillance: This chemical is a suspected or known human carcinogen. Exposed persons should contact a physician for advice regarding the possible long term health effects and advice for medical monitoring. In addition to comprehensive initial medical and work histories emphasizing reproductive experience and menstrual history, patient should have physical examination and testing of genito-urinary tract, sperm count, motility and morphology. If required, other tests, such as serum testosterone, serum follicle stimulating hormone (FSH), and serum lutenizing hormone (LH), may be indicated. Serum

DDT level. Urine *dichlorodiphenyl acetic acid* level. Liver and kidney function tests.

First Aid: Speed in removing material from eyes and skin is of extreme importance. If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least 15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately. If this chemical contacts the skin, remove contaminated clothing and wash immediately with soap and water. Shampoo hair promptly if contaminated. Seek medical attention immediately. If this chemical has been inhaled, remove from exposure, begin rescue breathing (using universal precautions) if breathing has stopped, and CPR if heart action has stopped. Transfer promptly to a medical facility. When this chemical has been swallowed, get medical attention. Give large quantities of water and induce vomiting. Do not make an unconscious person vomit.

Personal Protective Methods: Wear protective gloves and clothing to prevent any reasonable probability of dermal contact. Any barrier will prevent contamination from the dry chemical. Also, safety equipment suppliers/manufacturers can provide recommendations on the most protective glove/clothing material for your operation. All protective clothing (suits, gloves, footwear, headgear) should be clean, available each day, and put on before work. Contact lenses should not be worn when working with this chemical. Wear dust-proof chemical goggles and face shield unless full facepiece respiratory protection is worn. Employees should wash immediately with soap when skin is wet or contaminated. Provide emergency showers and eyewash.

Respirator Selection: SCBA > 1 mg/m^3. NIOSH: *At any concentrations above the NIOSH REL, or where there is no REL, at any detectable concentration:* SCBAF: Pd,Pp (APF = 10,000) (any self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode); or SaF: Pd,Pp: ASCBA (APF = 10,000) (any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary self-contained breathing apparatus operated in a pressure-demand or other positive-pressure mode). *Escape:* GmFOv100 (APF = 50) [any air-purifying, full facepiece respirator (gas mask) with a chin-style, front- or back-mounted organic vapor canister having an N100, R100, or P100 filter]; or SCBAE (any appropriate escape-type, self-contained breathing apparatus).

Storage: Color Code-Blue: Health Hazard/Poison. Store in a secure poison location. Do not store in iron containers. Prior to working with DDT you should be trained on its proper handling and storage. Store in tightly closed containers in a cool, well-ventilated area away from strong oxidizers, strong bases; and heat. Should not be stored in iron containers. A regulated, marked area should be established where this chemical is handled, used, or stored in compliance with OSHA Standard 1910.1045.

Shipping: Organochlorine pesticides, liquid or solid require a "poisonous materials" label. They fall in Hazard Class 6.1.

Spill Handling: First remove all sources of ignition. Evacuate persons not wearing protective equipment from area of spill or leak until clean up is complete. Do not dry sweep. Use vacuum (use special HEPA vac, NOT a standard shop-vac) or a wet method to reduce dust during clean up. Collect powdered material in the most convenient and safe manner and deposit in sealed containers. Ventilate area after clean up is complete. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable.

Fire Extinguishing: This chemical is a combustible solid. Use dry chemical, carbon dioxide; water spray; or alcohol foam extinguishers. Hazardous decomposition includes toxic chlorides. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies. From a secure, explosion-proof location, use water spray to cool exposed containers. If cooling streams are ineffective (venting sound increases in volume and pitch, tank discolors, or shows any signs of deforming), withdraw immediately to a secure position. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode.

Disposal Method Suggested: Incineration has been successfully used on a large scale for several years; huge incinerator equipment with scrubbers to catch HCl, a combustion product, are in use at several facilities, such as Hooker Chemical, Dow Chemical and other producers of chlorinated hydrocarbon products. One incinerator operates @ 900–1400°C with air and steam added which precludes formation of Cl_2. A few companies also constructed incinerator-scrubber combinations of smaller size, e.g., a system built by Garver-Davis, Inc., of Cleveland, Ohio, for the Canadian government, can handle 200–500 lb DDT/day as a kerosene solution. In accordance with 40CFR165, follow recommendations for the disposal of pesticides and pesticide containers. Containers must be disposed of properly by following package label directions or by contacting your local or federal environmental control agency, or by contacting your regional EPA office. Consult with environmental regulatory agencies for guidance on acceptable disposal practices. Generators of waste containing this contaminant (≥100 kg/mo) must conform with EPA regulations governing storage, transportation, treatment, and waste disposal.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov

- EXTOXNET, Extension Toxicology Network, "Pesticide Information Profile, DDT," Oregon State University, Corvallis, OR (June, 1996). ace.orst.edu/info/extoxnet/pips/ddt.htm
- National Pesticide Information Center, "General Fact Sheet, DDT," Oregon State University, Corvallis, OR (December, 1999). npic.orst.edu/factsheets/ddtgen.pdf
- New Jersey Department of Health and Senior Services, Hazardous Substance Fact Sheet, "DDT," Trenton, NJ (September 1996, Rev. July, 2002). http://www.state.nj.us/health/eoh/rtkweb/0596.pdf
- USEPA, DDT: ambient Water Quality Criteria, Washington, DC (1980)
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- Sax, N. I., Ed., "Dangerous Properties of Industrial Materials Report," 1, No. 3, 51-54 (1981) and 5, No. 1, 12-20 (1985)
- New York State Department of Health, "Chemical Fact Sheet: DDT." Albany, NY, Bureau of Toxic Substance Assessment (March 1986 and Version 2)

Decanoic acid D:0164

Use Type: Microbiocide

CAS Number: 334-48-5

Formula: $C_{10}H_{20}O_2$

Synonyms: Acido decanoico (Spanish); Capric acid; *n*-Capric acid; Caprinic acid; Caprynic acid; *n*-Decanoic acid; *n*-Decoic acid; Decylic acid; *n*-Decylic acid; 1-Nonanecarboxylic acid

Trade Names: ECONOSAN®; HEXACID®-1095; NEO-FAT 10®

Chemical Class: Fatty acids, saturated, linear, number of C-atoms>=8 and<=12, with terminating carboxyl group.

EPA/OPP PC Code: 128955

California DPR Chemical Code: 2315

HSDB Number: 2751

UN/NA & ERG Number: UN1993/128

RTECS® Number: HD9100000

EC Number: 206-376-4

Uses: Used in cleaning, sanitizing and disinfecting applications for food processors and dairy farmers.

U.S. Maximum Allowable Residue Levels for Decanoic acid (40 CFR 180.275): [40 CFR 180.940(b)] Residues of the following chemical substances are exempted from the requirement of a tolerance when used in accordance with good manufacturing practice as ingredients in an antimicrobial pesticide formulation, provided that the substance is applied on a semi-permanent or permanent food-contact surface (other than being applied on food packaging) with adequate draining before contact with food. (b) The following chemical substances when used as ingredients in an antimicrobial pesticide formulation may be applied to: Dairy processing equipment, and food-processing equipment and utensils. Decanoic acid is included on this list. Limit: when ready for use, the end-use concentration is not to exceed 90 ppm. (USEPA); U.S. National Archives and Records Administration's Electronic Code of Federal Regulations. ***[40 CFR 180.1225]*** An exemption from the requirement of a tolerance is established for residues of decanoic acid in or on all raw agricultural commodities and in processed commodities, when such residues result from the use of decanoic acid as an antimicrobial treatment in solutions containing a diluted end-use concentration of decanoic acid (up to 170 ppm per application) on food contact surfaces such as equipment, pipelines, tanks, vats, fillers, evaporators, pasteurizers and aseptic equipment in restaurants, food service operations, dairies, breweries, wineries, beverage and food-processing plants.

Regulatory Authority and Advisory Information: WGK (German Aquatic Hazard Class): 1-Low hazard to waters.

Description: White crystalline solid or needles. Unpleasant, rancid odor. Molecular weight = 172.26; Specific gravity (H_2O:1) = 0.8858 @ 40°C; Boiling point = 268–270°C; Freezing/Melting point = 31.5°C; Vapor pressure = 1 mm @ 125°C. Flash point = 112.78°C (cc); Autoignition temperature = 375°C; Explosive limits: LEL = 5.5%; UEL = 0.8%. Hazard Identification (based on NFPA-704 M Rating System): Health Hazards (Blue): 2; Flammability (Red): 1; Reactivity (Yellow): 0. Practically insoluble in water; solubility = <1 mg/mL @ 18°C; 140 mg/L.

Incompatibilities: An organic acid. Keep away from oxidizers, sulfuric acid, caustics, ammonia, aliphatic amines, alkanolamines, isocyanates, alkylene oxides, epichlorohydrin. Corrosive solution; attacks most common metals. Reacts violently with strong oxidizers, bromine, 90% hydrogen peroxide, phosphorus trichloride, silver powders or dust. Mixture with some silver compounds forms explosive salts of silver oxalate. Incompatible with silver compounds.

Determination in Water: Log K_{ow} = ~4.0. Values above 3.0 are likely to bioaccumulate in aquatic organisms.

Routes of Entry: Inhalation, skin and eye contact, ingestion.

Harmful Effects and Symptoms

Short Term Exposure: Vapors cannot be tolerated even at low concentrations; can cause severe irritation of eyes and throat; may cause eye and lung injury. If inhaled, causes coughing or difficult breathing. Contact with liquid or solid causes second and third degree burns in a short time; very injurious to the eyes. If swallowed, causes nausea and vomiting. Toxicity by ingestion: Grade 3. LD_{50} (oral, rat) = >10 g/kg.

Long Term Exposure: May cause lung damage.

Medical Surveillance: Lung x-ray.

First Aid: If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least 15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately. If this chemical contacts the skin, remove contaminated clothing and wash immediately with soap and water. Seek medical attention immediately. If this chemical has been inhaled, remove from exposure, begin rescue breathing (using universal precautions) if breathing has stopped, and CPR if heart action has stopped. Transfer promptly to a medical facility. When this chemical has been swallowed, get medical attention. If victim is conscious and able to swallow, have victim drink 4 to 8 ounces of water. Do not induce vomiting. *Note to physician or authorized medical personnel*: Medical observation is recommended for 24 to 48 hours after breathing overexposure, as pulmonary edema may be delayed. As first aid for pulmonary edema, consider administering a corticosteroid spray. Cigarette smoking may exacerbate pulmonary injury and should be discouraged for at least 72 hours following exposure

Respirator Selection: Wherever and whenever workplace conditions warrant respirator use, a respiratory protection program must be followed that meets one or more of the following requirements: OSHA's 29 CFR 1910.134, ANSI Z88.2, or European Standard EN 149.

Storage: Color Code-Red: Flammability Hazard: Store in a flammable liquid storage area or approved cabinet away from ignition sources and corrosive and reactive materials. Store in tightly closed containers in a cool, well-ventilated area. Before entering confined space where this chemical may be present, check to make sure that an explosive concentration does not exist. Store in tightly closed containers in a cool, well-ventilated area away from heat and incompatible materials. Sources of ignition, such as smoking and open flames, are prohibited where this chemical is used, handled, or stored in a manner that could create a potential fire or explosion hazard. Metal containers involving the transfer of 5 gallons or more of this chemical should be grounded and bonded. Drums must be equipped with self-closing valves, pressure vacuum bungs, and flame arresters. Use only nonsparking tools and equipment, especially when opening and closing containers of this chemical.

Shipping: Combustible liquids, n.o.s. Technical name required.

Spill Handling: As an immediate precautionary measure, isolate spill or leak area for at least 50 meters/150 feet in all directions. *Large spill*: Consider initial downwind evacuation for at least 300 meters/1000 feet. *Eliminate* all ignition sources (no smoking, flares, sparks or flames in immediate area). All equipment used when handling the product must be grounded. Do not touch or walk through spilled material. Stop leak if you can do it without risk. Prevent entry into waterways, sewers, basements or confined areas. A vapor-suppressing foam may be used to reduce vapors. Absorb or cover with dry earth, sand or other non-combustible material and transfer to containers. Use clean non-sparking tools to collect absorbed material. *Large spill*: Dike far ahead of liquid spill for later disposal. Water spray may reduce vapor; but may not prevent ignition in closed spaces. *Fire extinguishing:* decomposition products include oxides of carbon. As an immediate precautionary measure, isolate spill or leak area in all directions for at least 50 meters/150 feet for liquids and at least 25 meters/75 feet for solids. *Fire involving storage or vehicular tanks:* isolate for 800 meters/0.5 mile in all directions; also, consider initial evacuation for 800 meters/0.5 mile in all directions. CAUTION: (1) This product may have a very low flash point: Use of water spray when fighting fire may be inefficient. (2) For mixtures containing alcohol or polar solvent, alcohol-resistant foam may be more effective. *Small fire*: dry chemical, CO_2, water spray or regular foam. *Large fire:* water spray, fog or regular foam. Do not use straight streams. Move containers from fire area if you can do it without risk. *Fire involving tanks or vehicle loads;* fight fire from maximum distance or use unmanned hose holders or monitor nozzles. Cool containers with flooding quantities of water until well after fire is out. Withdraw immediately in the case of rising sound from venting safety devices or discoloration of tank. ALWAYS stay away from tanks engulfed in fire. For massive fire, use unmanned hose holders or monitor nozzles; if this is impossible, withdraw from area and let fire burn.

Disposal Method Suggested: Recycle any unused portion of the material for its approved use or return it to the manufacturer or supplier. Ultimate disposal of the chemical must consider: the material's impact on air quality; potential migration in soil or water; effects on animal, aquatic, and plant life; and conformance with environmental and public health regulations[83].

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- United States National Library of Medicine, ChemIDplus Advanced, Bethesda, MD. http://chem.sis.nlm.nih.gov/chemidplus/rn/334-48-5

Deltamethrin D:0167

Use Type: Insecticide

CAS Number: 52918-63-5

Formula: $C_{22}H_{19}Br_2NO_3$

Synonyms: (*S*)-α-Cyano-*m*-phenoxybenzyl (1R,3R)-3-(2,2-dibromovinyl)-2,2-dimethylcyclopropanecarboxylate; 1R-[1-α(S*),3-α)]- cyano(3-phenoxyphenyl) methyl -3-(2,2-dibromovinyl)-2,2-dimethylcyclopropane carboxylate; Cyclopropanecarboxylic acid, 3-(2,2-dibromoethenyl)-2,2-dimethyl-, cyano(3-phenoxyphenyl)methyl ester, [1R-(1α(*S**,3α)]-; Decamethrin; (1R,3R)-3-(2,2-Dibromovinyl)-2,2-dimethylcyclopropane carboxylic acid, (*S*)-α-cyano-3-phenoxybenzyl ester

Trade Names: BUTOFLIN®; BUTOSS®; BUTOX®; CISLIN®; CRACKDOWN®; DECIS®; DELTA®; DELTAGUARD®; ESBECYTHRIN®; FMC 45498®; JMC 45498®; K-OTHRINE® dust; NRDC 161®; RU 22974®; STRIKER® IEC insecticide (mixture of deltamethrin and tralomethrin)

Chemical Class: Pyrethroid

EPA/OPP PC Code: 097805

California DPR Chemical Code: 3010

HSDB Number: 6604

UN/NA & ERG Number: UN3352 (liquid)/151; UN3349 (solid)/151

RTECS® Number: GZ1233000

EC Number: 258-256-6 [*Annex I Index No.:* 607-319-00-X]

Uses: Some formulations are Restricted Use Pesticides (RUP). Deltamethrin is a synthetic pyrethroid insecticide that kills insects on contact and through digestion. It is used to control a variety of chewing and sucking insects that infest fruit, vegetables and field crops, including apples, pears and plums; peas, glasshouse cucumbers, tomatoes, peppers, potted plants, and ornamentals; hops, oats, cotton and other field crops. Deltamethrin is also used to control residential and commercial insect pests.

U.S. Maximum Allowable Residue Levels for Deltamethrin and its major metabolites, trans deltamethrin (S)-alpha-cyano-m-phenoxybenzyl-(1 R,3 R)-3-(2,2 -dibromovinyl)-2,2-dimethylcyclopropanecarboxylate and alpha-R-deltamethrin[(R)-alpha-cyano- m -phenoxybenzyl-(1 R,3 R)- 3-(2,2-dibromovinyl)-2,2-dimethylcyclopropanecarboxylate][40CFR180.435(a)(1)]: Almond, hulls 2.5 ppm; apple, wet pomace 1.0 ppm; artichoke, globe 0.5 ppm; barley, bran 5.0 ppm; cattle, fat 0.05 ppm; cattle, meat 0.02 ppm; cattle, meat byproducts 0.05 ppm; corn, field, forage 0.7 ppm; corn, field, refined oil 2.5 ppm; corn, field, stover 5.0 ppm; corn, pop, stover 5.0 ppm; corn, sweet, forage 10 ppm; corn, sweet, kernel plus cob with husks removed 0.03 ppm; corn, sweet, stover 15 ppm; cotton, refined oil 0.2 ppm; cotton, undelinted seed 0.04 ppm; egg 0.02 ppm; fruit, pome, group 11, 0.2 ppm; goat, fat 0.05 ppm; goat, meat 0.02 ppm; goat, meat byproducts 0.05 ppm; grain, aspirated fractions 65 ppm; grain, cereal, group 15, except sweet corn 1.0 ppm; hog, fat 0.05 ppm; horse, fat 0.05 ppm; horse, meat 0.02 ppm; horse, meat byproducts 0.05 ppm; lychee (There are no U.S. registrations for use of deltamethrin on starfruit and lychee.) 0.2 ppm; milk, fat (reflecting 0.02 ppm; ppm in whole milk) 0.1 ppm; Nut, tree, group 14, 0.1 ppm; onion, bulb 0.1 ppm; onion, green 1.5 ppm; poultry, fat 0.05 ppm; poultry, meat 0.02 ppm; poultry, meat byproducts 0.02 ppm; radish, tops 4.0 ppm; rapeseed 0.2 ppm; rice, hulls 2.5 ppm; rye, bran 5.0 ppm; sheep, fat 0.05 ppm; sheep, meat 0.02 ppm; sheep, meat byproducts 0.05 ppm; sorghum, grain, forage 0.5 ppm; sorghum, grain, stover 1.0 ppm; soybean, seed 0.1 ppm; soybean, hulls 0.2 ppm; starfruit (There are no U.S. registrations for use of deltamethrin on starfruit and lychee) 0.2 ppm; sunflower, seed 0.1 ppm; tomato 0.2 ppm; tomato, paste 1.0 ppm; Tomato, puree 1.0 ppm; Vegetable, cucurbit, Group 9, 0.2 ppm; Vegetable, fruiting, Group 8, 0.3 ppm; vegetable, root, except sugar beet, subgroup IB, 0.2 ppm; vegetable, tuberous and corm, subgroup IC, 0.04 wheat, bran 5.0 ppm. ***[40 CFR 180.435(a)(2)]*** A tolerance of 0.05 ppm is established for residues of the insecticide as follows: (i) In or on all food/feed items (other than those covered by a higher tolerance as a result of use on growing crops) in food/feed handling establishments. (ii) The insecticide may be present as a residue from application of deltamethrin in food handling establishments, including food service, manufacturing and processing establishments, such as restaurants, cafeterias, supermarkets, bakeries, breweries, dairies, meat slaughtering and packing plants, and canneries, feed handling establishments including feed manufacturing and processing establishments, in accordance with the following prescribed conditions: (A) Application shall be limited to general surface and spot and/or crack and crevice treatment in food/feed handling establishments where food/feed and food/feed products are held, processed, prepared and served. General surface application may be used only when the facility is not in operation provided exposed food/feed has been covered or removed from the area being treated. Spot and/or crack and crevice application may be used while the facility is in operation provided exposed food/feed is covered or removed from the area being treated prior to application. Spray concentration shall be limited to a maximum of 0.06 percent active ingredient. Contamination of food/feed or food/feed contact surfaces shall be avoided. (B) To ensure safe use of the insecticide, its label and labeling shall conform to that registered with the U.S. Environmental Protection Agency and shall be used in accordance with such label and labeling.

Human toxicity (long-term)[101]: Low–70.00 ppb, Health Advisory.

Fish toxicity (threshold): Extra high–0.02258 ppb, MATC (Maximum Acceptable Toxicant Concentration)

Regulatory Authority and Advisory Information:

Carcinogenicity: IARC, Animal Inadequate Evidence; Human Inadequate Evidence*, not classifiable as carcinogenic to humans*, Group 3; EPA, Not likely to be carcinogenic to humans

Health Advisory: Mutagen

Toxicity (oral) Category (range depending on carrier solvent): 1, DANGER–POISON to Category: 3, CAUTION

European/International Regulations: Hazard Symbol: T, N; risk phrases: R23/25; R50/53; safety phrases: S1/2; S24; S28; S36/37/39; S38; S45; S60; S61 (see Appendix 1)

WGK (German Aquatic Hazard Class): 3-Severe hazard to waters

Description: Colorless, white, or off-white crystalline solid or powder. Odorless. Combustible. Molecular weight = 505.21; Freezing/Melting point = 98–100°C; Boiling point decomposes on distillation; Vapor pressure = 2×10^{-8} mmHg @ 25°C; 0.002 mmHg @ 25°C; Specific gravity (H_2O:1) = 1.22 @ 25°C. Practically insoluble in water; solubility = ≤0.002 mg/L.

Incompatibilities: May react violently with strong oxidizers, bromine, 90% hydrogen peroxide, phosphorus trichloride, silver powders or dust. Incompatible with silver compounds. Mixture with some silver compounds forms explosive salts of silver oxalate.

Permissible Exposure Limits in Air: ACGIH TLV®[1]: (all pyrethrins) 5 mg/m^3 TWA

Determination in Air: Collection by impinger or fritted bubbler, analysis by gas-liquid chromatography/ultraviolet. See NIOSH IV, Method #5008[18], as pyrethroid.

Determination in Water: Collection by impinger or fritted bubbler, analysis by gas-liquid chromatography/ultraviolet. See NIOSH IV, Method #5008[18]. Log K_{ow} = 5.41. Values above 3.0 are likely to bioaccumulate in marine organisms.

Routes of Entry: Inhalation, ingestion, absorbed through the skin.

Harmful Effects and Symptoms

Short Term Exposure: Poisonous. May be fatal if inhaled, swallowed, or absorbed through skin. Contact may cause severe irritation and burns to skin and eyes. Pyrethrins can affect you when breathed in and by passing through your skin. Irritates the eyes and respiratory tract. High exposure can affect the nervous system causing headache, nausea, vomiting, fatigue, and restlessness, rhinorrhea (discharge of thin nasal mucous). LD_{50} (oral), depending on carrier solvent = 30–2000 mg/kg; LD_{50} (dermal, rabbit) = >2 g/kg.

Long Term Exposure: High or repeated exposure can cause lung allergy (with cough, wheezing and/or shortness of breath) or hay fever symptoms (sneezing, runny or stuffy nose). Allergic "pneumonia" can also occur with cough, chest pain, breathing difficulty and abnormal chest x-ray. Repeated attacks may lead to permanent scarring. Skin allergy may also develop with rash and itching, even with lower exposures. Dermal contact can cause rash with redness, blisters and intense itching. A severe generalized allergy can occur with weakness and collapse. May cause reproductive and fetal effects. May cause tumors.

Points of Attack: Respiratory system, skin, central nervous system, brain. Reproductive cells.

Medical Surveillance: In addition to comprehensive initial medical and work histories emphasizing reproductive experience and menstrual history, patient should have physical examination and testing of genito-urinary tract, sperm count, motility and morphology. If required, other tests, such as serum testosterone, serum follicle stimulating hormone (FSH), and serum lutenizing hormone (LH), may be indicated. Employees should be screened for history of certain medical conditions which might place the employee at increased risk from pyrethroid exposure. Chronic respiratory disease: In persons with chronic respiratory disease, especially asthma, the inhalation of pyrethroids might cause exacerbation of symptoms due to its sensitizing properties. Lung function tests. These may be normal if the person is not having an attack at the time of the test. Consider chest x-ray if lung symptoms are present. Skin disease: Pyrethroids can cause dermatitis which may be allergic in nature. Persons with preexisting skin disorders may be more susceptible to the effects of this agent. Evaluation by a qualified allergist, including exposure history and testing, may help diagnose allergy. Any employee developing the above-listed conditions should be referred for further medical examination[9].

First Aid: If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least 15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately. If this chemical contacts the skin, remove contaminated clothing and wash immediately with soap and water. Seek medical attention immediately. If this chemical has been inhaled, remove from exposure, begin rescue breathing (using universal precautions) if breathing has stopped, and CPR if heart action has stopped. Transfer promptly to a medical facility. When this chemical has been swallowed, get medical attention. *Do not induce vomiting when formulations containing petroleum solvents are ingested*. Otherwise, give large quantities of water and induce vomiting. Do not make an unconscious person vomit.

Personal Protective Methods: Applicators and other handlers must wear: Coveralls worn over long-sleeved shirt and long pants; Chemical-resistant gloves such as DuPont™ Tychem® suit fabrics, barrier laminate, or Viton®; Chemical-resistant footwear plus socks; Protective eye wear; Chemical-resistant headgear for overhead exposure; Chemical-resistant apron when cleaning equipment, mixing, or loading[83]. Agricultural Use/Engineering Controls: When handlers use closed systems, enclosed cabs, or aircraft in a manner that meets the requirements listed in the Worker Protection Standard (WPS) for agricultural pesticides, ***40 CFR 170.240(d)(4-6),*** the handler PPE requirements may be reduced or modified as specified in the Worker Protection Standard. Firefighters should wear NIOSH approved self-contained breathing apparatus and full protective clothing.

Respirator Selection: NIOSH/OSHA *for pyrethrum*: *50 mg/m³:* CcrOv95 (APF = 10) [any air-purifying half-mask respirator equipped with an organic vapor cartridge(s) in combination with an N95, R95, or P95 filter. The following filters may also be used: N99, R99, P99, N100, R100, P100]; or Sa (APF = 10) (any supplied-air respirator).*125 mg/m³:* Sa:Cf (APF = 25) (any supplied-air respirator operated in a continuous-flow mode); or PaprOvHie (APF = 25) (any air-purifying full facepiece respirator equipped with an organic vapor cartridge in combination with a high-efficiency particulate filter).*250 mg/m³:* CcrFOv100 (APF = 50) [any air-purifying full facepiece respirator equipped with organic vapor cartridge(s) in combination with an N100, R100, or P100 filter]; or PaprTOvHie (APF = 50) [any powered, air-purifying respirator with a tight-fitting face-piece and organic vapor cartridge(s) in combination with a high-efficiency particulate filter]; or SCBAF (APF = 50) (any self-contained breathing apparatus with full facepiece); or SaF (APF = 50) (any supplied-air respirator with a full facepiece).*5000 mg/m³:* SaF:Pd,Pp (APF = 2000) (any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode). *Emergency or planned entry into unknown concentrations or IDLH conditions:* SCBAF:Pd,Pp (APF = 10,000) (any self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode); or SaF:Pd,Pp:ASCBA (APF = 10,000) (any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary self-contained breathing apparatus operated in a pressure-demand or other positive-pressure mode). *Escape:* GmFOv100 (APF = 50) [any air-purifying, full facepiece respirator (gas mask) with a chin-style, front- or back-mounted organic vapor canister having an N100, R100, or P100 filter]; or SCBAE (any appropriate escape-type, self-contained breathing apparatus).

Storage: Color Code-Blue: Health Hazard/Poison. Store in a secure poison location at temperature <35°C and away from alkaline materials. Prior to working with this chemical you should be trained on its proper handling and storage. Store in tightly closed containers in a cool, well-ventilated area.

Shipping: This material is a toxic pesticide and should be labeled "poisonous materials." It falls into Hazard Class 6.1. PG III.

Spill Handling: First remove all sources of ignition. Evacuate persons not wearing protective equipment from area of spill or leak until clean up is complete. Remove all ignition sources. Ventilate area of spill or leak. Use water spray to reduce vapor. Absorb liquids in vermiculite, dry sand, earth, or a similar material and deposit in sealed containers. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable.

Fire Extinguishing: Hazardous decomposition includes oxides of nitrogen and oxygen and hydrogen bromide gas. *On a small fire:* use dry chemical, CO_2 or water spray. *On a large fire:* use water spray, fog or regular foam. Move containers from fire area if you can do it without risk. Dike fire-control water for later disposal; do not scatter the material. Use water spray or fog; do not use straight streams. *Fire involving storage or vehicular tanks:* isolate for 800 meters/0.5 mile in all directions; also, consider initial evacuation for 800 meters/0.5 mile in all directions. Fight fire from maximum distance or use unmanned hose holders or monitor nozzles. Do not get water inside containers. Cool containers with flooding quantities of water until well after fire is out. Withdraw immediately in the case of rising sound from venting safety devices or discoloration of tank. ALWAYS stay away from tanks engulfed in fire. For massive fire, use unmanned hose holders or monitor nozzles; if this is impossible, withdraw from area and let fire burn. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies.

Disposal Method Suggested: Incineration would be an effective disposal procedure where permitted. If an efficient incinerator is not available, the product should be mixed with large amounts of combustible material and contact with the smoke should be avoided. In accordance with 40CFR165, follow recommendations for the disposal of pesticides and pesticide containers.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- EXTOXNET, Extension Toxicology Network, "Pesticide Information Profile, Deltamethrin," Oregon State University, Corvallis, OR (September 1995). http://extoxnet.orst.edu/pips/deltamet.htm
- USEPA, Office of Pesticide Programs, Pesticide Residue Limits, "Deltamethrin", 40 CFR 180.435. http://www.epa.gov/pesticides/food/viewtols.htm
- Johnson, M.; Luukinen, B.; Buhl, K.; Stone, D., *Deltamethrin Technical Fact Sheet*; National Pesticide Information Center, Oregon State University Extension Services, Corvallis, OR (2010)
- National Pesticide Information Center, *Deltamethrin Technical Fact Sheet*; Oregon State University Extension Services, Corvallis, OR (2010)

Demeton D:0170

Use Type: Insecticide, Acaricide

CAS Number: 8065-48-3 (mixture of demeton-*O*+demeton-*S*); 298-03-3 (demeton-*O*); 126-75-0 (demeton-*S*); 919-86-8 (demeton-*S*-methyl)

Formula: $C_8H_{19}O_3PS_2$

Synonyms: *Demeton:* Demetona (Spanish); Demeton-*O*+demeton-*S* mixture; Diethoxy thiophosphoric acid ester of 2-ethylmercaptoethanol; *O,O*-Diethyl *S*-2-(ethylthio)ethyl phosphorothioate mixed with phosphorothioic acid, *O,O*-diethyl *O*-2-(ethylthio)ethyl ester; *O,O*-Diethyl-2-ethylmercaptoethyl thiophosphate, diethoxythiophosphoric acid; ENT 17295; Phosphorothioic acid,*O,O*-diethyl *O*-2-(ethylthio)ethyl ester, mixed with *O,O*-diethyl *S*-2-(ethylthio)ethyl phosphorothioate

Demeton-O: *O,O*-Diethyl *O*-(2-(ethylthio)ethyl) phosphorothioate; *O*-(2-(Ethylthio)ethyl) *O,O*-diethyl thiophosphate; Phosphorothioic acid, *O,O*-diethyl *O*-(2-ethylthio) ethyl ester; Thionodemeton

Demeton-S: *O,O*-Diaethyl-*S*(2-aethyltio-aethyl) monothiophosphat (Russia); *O,O*-Diethyl-*S*-ethyl-2-ethylmercaptophosphorothiolate; *O,O*-Diethyl-*S*-(2-ethylthio-ethyl)-monothiofosfaat; Diethyl-*S*-(2-(ethylthio) ethyl)phosphorothiolate; *O,O*-Diethyl *S*-(2-(ethylthio) ethyl) phosphorothioate; *O,O*-Dietil-*S*-(2-etiltio-etil) monotiofosfato; *O,O*-Diethyl *S*-(2-ethioethyl)phosphorothioate; Ethanethiol, 2-(ethylthio)-, *S*-ester with *O*, salt *O*-diethylphosphorothioate; *S*-2-(Ethylthio)ethyl *O,O*-diethyl thiophosphate; *S*-2-(Ethylthio)ethyl phosphoric acid, *O,O*-diethyl ester; Isodemeton; Mercaptofos teolery; Phosphorothioic acid, *O,O*-diethyl *S*-(2-ethylthio)ethyl ester; Thiolodemeton; Thiophosphate de *O,O*-diethyle et de *S*-(2-ethylthioethyle)

Trade Names: BAYER 8169®; BAYER 10756®; BAYER 25/154; BAY 18436®; DEMOX®[C]; DEMOX®; DENOX®; DURATOX®; E-1059®;

ISOMETASYSTOX®; ISOMETHYLSYSTOX®; ISOSYSTOX®; METAISOSEPTOX®; METAISOSYSTOX®; METASYSTOX FORTE®; METHYL ISOSYSTOX®; MITOL®[C]; PO-SYSTOX®; PS-SYSTOX®; SYSTEMOX®; SYSTOX®[C]; SYSTOX THIOL®; THIOL-SYSTOX®; UL®

Demeton-O: BAYER® 8169; DI-SEPTON®; E-1059; DISYSTON®; THIODEMETON®; THIONODEMETON®; THIOLMECAPTOPHOS®

Chemical Class: Organophosphate

EPA/OPP PC Code: 057601 (mixture of demeton-*O*+demeton-*S*); 057602 (demeton-*O*); 057603 (demeton-*S*)

California DPR Chemical Code: 566 (Demeton)

HSDB Number: 201; 6201 (demeton-*S as Isosystox*)

UN/NA & ERG Number: UN3018 (liquid)/152

RTECS® Number: TF3150000 (mixture of demeton-*O*+demeton-*S*); TF3125000 (demeton-*O*); FT3130000 (demeton-*S*)

EC Number: 204-801-8 [*Annex I Index No.:* 015-029-00-4] (demeton-S); 206-053-8 [*Annex I Index No.:* 015-028-00-9] (demeton-O); [*Annex I Index No.:* 015-118-00-8] (mixture)

Uses: Not approved for use in EU countries[115]. Not registered for use in the U.S. Demeton is a mixture of Demeton-*O* (I) and Demeton-*S* (II). Demeton mixture is a plant systemic and extremely toxic to bees, fish and wildlife.

U.S. Maximum Allowable Residue Levels for Demeton [40 CFR 180.3(d)(2)]: Where tolerances are established for residues of both *O,O*-diethyl S-[2-(ethylthio)ethyl] phosphorodithioate and demeton (a mixture of *O,O*-diethyl *O*-(and *S*-) [2-(ethylthio)ethyl] phosphorothioates) on the same raw agricultural commodity, the total amount of such pesticides shall not yield more residue than that permitted by the larger of the two tolerances, calculated as demeton **[*40CFR180.183(a)*]** Barley, grain 0.75 ppm; barley, straw 5.0 ppm; bean, dry, seed 0.75 ppm; bean, lima 0.75 ppm; bean, snap, succulent 0.75 ppm; broccoli 0.75 ppm; Brussels sprouts 0.75 ppm; cabbage 0.75 ppm; cauliflower 0.75 ppm; coffee, bean 0.3 0 ppm; cotton, undelinted seed 0.75 ppm; lettuce 0.75 ppm; peanut 0.75 ppm; pea 0.75 ppm; pea, field, vines 5.0 0 ppm; pepper 0.1 0 ppm; potato 0.75 ppm; sorghum, forage 5.0 ppm; sorghum, grain, grain 0.75 ppm; sorghum, grain, stover 5.0 ppm; soybean 0.1 ppm; soybean, forage 0.25 ppm; soybean, hay 0.25 ppm; spinach 0.75 ppm; sugarcane, cane 0.3 ppm; tomato 0.75 ppm; wheat, hay 5.0 ppm; wheat, grain 0.3 ppm; wheat, straw 5.0 ppm. ***Regional registration, as defined in section 180.1(n) [40 CFR180.183(c)]:*** Asparagus, 0.1 ppm.

Human toxicity (long-term)[101]: Extra high–0.28 ppb, Health Advisory

Fish toxicity (threshold)[101]: High–3.85101 ppb, MATC (Maximum Acceptable Toxicant Concentration)

Regulatory Authority and Advisory Information:

Air Pollutant Standard Set. US DOT 49CFR172.101, Inhalation Hazardous Chemical as organophosphates

For Demeton and Demeton-S:

Acute Oral Category: 1, DANGER–POISON

Superfund/EPCRA 302, Extremely Hazardous Substances: TPQ = 500 lb (227 kg)

Health Advisory: Nerve toxin, Mutagen

Reportable Quantity (RQ): 500 lb (227 kg).

European/International Regulations (*O-; 298-03-3* & *mixture 8065-48-3*): Hazard Symbol: T+, N; risk phrases: R27/28; R50; safety phrases: S1/2; 28; S36/37; S45; S60; S61; (*S-; 126-75-0*): Hazard Symbol: T+, N; risk phrases: R27/28; safety phrases: S1/2; S28; S36/37; S45 (see Appendix 1).

WGK (German Aquatic Hazard Class): No value assigned.

Description: Demeton is a light-brown liquid with an odor of sulfur compounds. Molecular weight = 516.72; Specific gravity (H_2O:1) = 1.112 @ 20°C; 1.21 @ 20°C (*126-75-0*) Boiling point = 134°C @ 2 mmHg @ 20°C; 125°C; Freezing/Melting point ≤–13°C; Flash point = 45°C; Explosive limits: LEL = 1%; UEL = 5.3%. Hazard Identification (based on NFPA-704 M Rating System): Health 3, Flammability 2, Reactivity 0. Highly soluble in water.

Incompatibilities: Forms explosive mixture with air. Strong oxidizers, strong bases, soluble mercury, other pesticides, and water. In the presence of strong reducing agents such as hydrides, organophosphates form highly toxic and flammable phosphine gas. Contact with oxidizers can cause the release of toxic oxides of phosphorus.

Permissible Exposure Limits in Air: *8065-48-3*

OSHA PEL: 0.1 mg/m^3 TWA[skin]

NIOSH REL: 0.1 mg/m^3 TWA [skin]

8065-48-3 & *919-86-8*

ACGIH TLV®[1]: 0.01 mg/m^3 TWA, inhalable fraction and vapor [skin]; BEI_A: Acetylcholinesterase inhibiting pesticides; methemoglobin in blood; 1.5% of hemoglobin, during or end-of-shift as methemoglobin inducers.

919-86-8

Protective Action Criteria (PAC) *8065-48-3 demeton* Ver. 27[89]

PAC-1: 0.18 mg/m^3
PAC-2: 2 mg/m^3
PAC-3: 20 mg/m^3

Protective Action Criteria (PAC) *126-75-0* (demeton-*S*-methyl) Ver. 27[89]

PAC-1: 0.45 mg/m^3
PAC-2: 2 mg/m^3
PAC-3: 22 mg/m^3

DFG MAK: [skin]; BAT information, as acetylcholine esterase inhibitors.

Determination in Air: Filter/XAD-2® (tube); Toluene; Gas chromatography/Flame photometric detection for sulfur, nitrogen, or phosphorus; NIOSH IV Method #5514.[18].

Determination in Water: Log K_{ow} = 3.2. Values above 3.0 are likely to bioaccumulate in aquatic organisms.

Routes of Entry: Inhalation, skin absorption, ingestion, eye and dermal contact

Harmful Effects and Symptoms

Organophosphates are highly toxic. Symptoms may develop rapidly, or there may be a delay of several hours following exposure before they become noticeable. The delay tends to be longer in the case of some compounds that dissolve fats, lipids, oils and non-polar solvents such as toluene. Symptoms may increase in severity for more than a single day and last for several days. In severe cases of organophosphate intoxication, respiratory failure may occur.

Short Term Exposure: Demeton can be absorbed through the skin, thereby increasing exposure. Demeton may cause effects on the nervous system by cholinesterase inhibiting effect, causing convulsions, respiratory failure and possible death. High exposure (above OEL) may result in unconsciousness and death. Acute exposure to demeton may produce the following symptoms of exposure: pinpoint pupils, blurred vision, headache, dizziness, muscle spasms, and profound weakness. Vomiting, diarrhea, abdominal pain, seizures, and coma may also occur. The heart rate may decrease following oral exposure or increase following dermal exposure. Chest pain may be noted. Hypotension (low blood pressure) may occur, although hypertension (high blood pressure) is not uncommon. Respiratory symptoms include dyspnea (shortness of breath), respiratory depression, and respiratory paralysis. Psychosis may occur.

This material is an acetylcholinesterase inhibitor. It is readily absorbed through the skin and is extremely toxic. Probable human lethal oral dose is 5–50 mg/kg or 7 drops to 1 teaspoonful for 150 lb person. Acute dose is believed to be 12 to 20 mg by oral route. The effects may be delayed. Medical observation is indicated. LD_{50} (oral, rat) = 2.5 mg/kg.

Long Term Exposure: May cause mutations. May damage the developing fetus. May damage the nervous system, causing sensation of “pins and needles” in the hands and feet. May cause depression, irritability and personality changes. Cumulative effect is possible. Demeton may affect cholinesterase, causing significant depression of blood cholinesterase.

Points of Attack: Respiratory system, lungs, central nervous system, cardiovascular system, skin, eyes, plasma and red blood cell cholinesterase.

Medical Surveillance: Routine biological monitoring of pesticide applicators and field workers includes testing of plasma and red blood cell acetylcholinesterase levels (for enzyme poisoned by this chemical). These tests are normally accurate only if done within about two hours of exposure. If exposure stops, plasma levels return to normal in 1–2 weeks while red blood cell levels may be reduced for 1–3 months. When acetylcholinesterase enzyme levels are reduced by 25% or more below preemployment levels, risk of poisoning is increased, even if results are in lower ranges of “normal.” Reassignment to work not involving organophosphate pesticides is recommended until enzyme levels recover. Do not drink any alcoholic beverages before or during use as it promotes absorption of organophosphates.

First Aid: **Treatment for organophosphate poisoning consists of thorough decontamination, cardiorespiratory support, and administration of the antidotes atropine and pralidoxime. In cases of severe poisoning, diazepam, an anticonvulsant, should also be administered. Antidotes should be administered as prevention even if the diagnosis is in doubt**. Speed in removing material from eyes and skin is of extreme importance. If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least 15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately. If this chemical contacts the skin, remove contaminated clothing and wash immediately with soap and water. Shampoo hair promptly if contaminated. Seek medical attention immediately. If this chemical has been inhaled, remove from exposure, begin rescue breathing (using universal precautions) if breathing has stopped, and CPR if heart action has stopped. Transfer promptly to a medical facility. When this chemical has been swallowed, get medical attention. Give large quantities of water and induce vomiting. Do not make an unconscious person vomit. Effects may be delayed; medical observation is recommended

Personal Protective Methods: Wear protective gloves and clothing to prevent any reasonable probability of dermal contact. Safety equipment suppliers/manufacturers can provide recommendations on the most protective glove/clothing material for your operation. One recommendation is the use of DuPont™ Tychem® suit fabrics[88]. All protective clothing (suits, gloves, footwear, headgear) should be clean, available each day, and put on before work. Contact lenses should not be worn when working with this chemical. Wear splash-proof chemical goggles and face shield unless full facepiece respiratory protection is worn. Employees should wash immediately with soap when skin is wet or contaminated. Provide emergency showers and eyewash.

Respirator Selection: SCBA 0.18 mg/m^3. Engineering controls should be used wherever feasible to maintain airborne concentrations of this chemical below the prescribed exposure limit. Respirators and protective equipment are less effective than engineering controls, and should be used only in non-routine or emergency situations which may result in exposure concentrations in excess of the TWA environmental limit. *At any concentrations above the NIOSH REL, or where there is no REL, at any detectable concentration:* SCBAF: Pd,Pp (APF = 10,000) (any NIOSH/MSHA- or European Standard EN 149-approved self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode); or SaF: Pd,Pp: ASCBA (APF = 10,000) (any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary, self-contained breathing apparatus operated in a pressure-demand or other positive-pressure mode).

Storage: Color Code-Blue: Health Hazard/Poison. Store in a secure poison location. Prior to working with this chemical you should be trained on its proper handling and storage. Where possible, automatically transfer material from other storage containers to process containers.

Shipping: Organophosphorus pesticides, solid or liquid (nonflammable), require a "poisonous materials" label. This chemical falls in Hazard Class 6.1.

Spill Handling: First remove all sources of ignition. Evacuate persons not wearing protective equipment from area of spill or leak until clean up is complete. Remove all ignition sources. Stay upwind; keep out of low areas. Ventilate area of spill or leak. Remove and isolate contaminated clothing at the site. Do not touch spilled material; stop leak if you can do so without risk. Use water spray to reduce vapors. *Small spills:* absorb with sand or other noncombustible absorbent material and place into containers for later disposal. *Large spills:* dike far ahead of spill for later disposal. Collect powdered material in the most convenient and safe manner and deposit in sealed containers. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable. Seek professional environmental engineering assistance from the U.S. EPA Environmental Response Team at (908) 548-8730 (24-hour response line).

Fire Extinguishing: Poisonous gases are produced in fire, including oxides of phosphorus, sulfur, and nitrogen. May be fatal if inhaled, ingested or absorbed through skin. Inhalation or contact with some of these materials will irritate or burn skin and eyes. Vapors may cause dizziness or suffocation. *Small fires:* dry chemical, carbon dioxide; water spray; or foam. *Large fires:* water spray, fog, or foam. Stay upwind; keep out of low areas. Ventilate closed spaces before entering them. Firefighting gear (including SCBA) may not provide adequate protection. If exposure occurs, remove and isolate gear immediately and thoroughly decontaminate personnel. Wear positive-pressure breathing apparatus and special protective clothing. Remove and isolate contaminated clothing at the site. Move container from fire area if you can do so without risk. Fight fire from maximum distance. Dike fire-control water for later disposal; do not scatter the material. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies. From a secure, explosion-proof location, use water spray to cool exposed containers. If cooling streams are ineffective (venting sound increases in volume and pitch, tank discolors, or shows any signs of deforming), withdraw immediately to a secure position. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode.

Disposal Method Suggested: Destruction by alkali hydrolysis or incineration. Containers must be disposed of properly by following package label directions or by contacting your local or federal environmental control agency, or by contacting your regional EPA office.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- U.S. Environmental Protection Agency, "Chemical Profile: Demeton," Washington DC, Chemical Emergency Preparedness Program (November 30, 1987)
- New Jersey Department of Health, "Hazardous Substance Fact Sheet: Demeton," Trenton, NJ (April 1999). http://www.state.nj.us/health/eoh/rtkweb/0604.pdf
- New York State Department of Health, "Chemical Fact Sheet: Demeton," Albany, NY, Bureau of Toxic Substance Assessment (April 1986)

Desmedipham D:0185

Use Type: Herbicide

CAS Number: 13684-56-5

Formula: $C_{16}H_{16}N_2O_4$

Synonyms: Carbamic acid, *N*-phenyl-, 3-[(ethoxycarbonyl)amino]phenyl ester; *m*-Carbaniloyloxycarbanilic acid ethyl ester; 3-[(Ethoxycarbonyl)amino]phenyl *N*-phenylcarbamate; Ethyl *m*-hydroxycarbanilate carbanilate; Ethyl phenylcarbamoyloxyphenylcarbamate; Phenylcarbamoyloxyphenylcarbamate

Trade Names: BETANAL® AM; BETANAL®-475; BETANEX®; BETAMIX® 70 WP; BETANEX® 70 WP; EP 475®; PROGRESS®; SCHERING® 38107; SN-475®; SN-38107®

Chemical Class: Bis-Carbamate

EPA/OPP PC Code: 104801

California DPR Chemical Code: 1748

UN/NA & ERG Number: UN3077 (solid)/171;UN2757 (solid)/151

RTECS® Number: FD0425000

EC Number: 237-198-5 [*Annex I Index No.:* 616-113-00-9]

Uses: Post-emergence sugarbeet herbicide for control of annual weeds such as pigweed, wild mustard, lamb's quarters, nightshade, chickweed, buckwheat, goosefoot, ragweed, fiddleneck, and kochia.

U.S. Maximum Allowable Residue Levels for Desmedipham [40 CFR 180.353 (a)]: beet, garden, roots 0.05 ppm; beet, garden, tops 1.0 ppm; beet, sugar, roots 0.1 ppm; beet, sugar, tops 5.0 ppm; spinach 6.0 ppm.

Human toxicity (long-term) [101]***:*** Very low–280.00 ppb, Health Advisory

Fish toxicity (threshold) [101]***:*** Low–225.68038 ppb, MATC (Maximum Acceptable Toxicant Concentration)

Regulatory Authority and Advisory Information:

Carcinogenicity: EPA Group E, evidence of non-carcinogenicity for humans

Acute Oral Category: 4, Caution

EPCRA Section 313 Form R *de minimis* concentration reporting level: 1.0%

European/International Regulations: Hazard Symbol: N; risk phrases: R50/53; safety phrases: S60; S61 (see Appendix 1)

Description: Colorless, crystalline solid. Molecular weight = 300.34; Boiling point = (decomposes); Freezing/Melting point = 120°C; Vapor pressure = 2.9×10^{-9} mmHg @ 20°C. Low solubility in water.

Incompatibilities: Esters interact with acids to liberate heat along with alcohols and acids. Strong oxidizing acids may cause a vigorous reaction that is sufficiently exothermic to ignite the reaction products. Heat is also generated by the interaction of esters with caustic solutions. Flammable hydrogen is generated by mixing esters with alkali metals and hydrides. Carbamates are incompatible with reducing agents, strong acids, oxidizing acids, peroxides, and bases. Contact with active metals or nitrides causes the release of flammable, and potentially explosive, hydrogen gas. Forms carbon monoxide and toxic nitrogen oxides when heated to decomposition.

Determination in Air: Filter; none; Gravimetric; NIOSH IV [Particulates NOR; #0500 (total), #0600 (respirable)].[18].

Determination in Water: Log K_{ow} = 3.4. Values above 3.0 are likely to bioaccumulate in aquatic organisms.

Routes of Entry: Skin absorption, ingestion, inhalation

Harmful Effects and Symptoms

Short Term Exposure: Eye pupils are small; blurred vision; eye watering; runny nose; cough; shortness of breath; salivation; nausea, stomach cramps, diarrhea, and vomiting; increased blood pressure; profuse sweating; hypermotility, hallucinations; agitation; tingling of the skin; slow heartbeat; convulsions; fluid in lungs; loss of consciousness; incontinence; breathing stops; death. Carbamate insecticides inhibit the cholinesterase activity of enzymes, causing accumulation of acetylcholine at synapses and altering the way in which nervous impulses are transmitted. However, within several hours carbamates spontaneously detach from the enzymes. LD_{50} (oral, rat) = >4500 mg/kg.

Long Term Exposure: A potent acetylcholinesterase (AChE) inhibitor; cumulative effect is possible. This chemical may damage the nervous system with repeated exposure, resulting in convulsions, respiratory failure. May cause dermatitis; liver damage.

Points of Attack: Respiratory system, lungs, central nervous system, cardiovascular system, skin, eyes, plasma and red blood cell cholinesterase

Medical Surveillance: Preliminary medical exam to detect chronic diseases of central nervous system, liver, heart, kidneys, lung and skin, as well as endocrinological or immunological disturbances, should protect susceptible individuals. Periodical medical exams of internal organs, skin and eyes are important to avoid chronic occupational intoxications. They should include lab and patch tests when necessary[83]. Medical observation is recommended for 24 to 48 hours after breathing overexposure, as pulmonary edema may be delayed. As first aid for pulmonary edema, consider administering a corticosteroid spray. Cigarette smoking may exacerbate pulmonary injury and should be discouraged for at least 72 hours following exposure. Before employment and at regular times after that, the following are recommended: Plasma and red blood cell cholinesterase levels (tests for the enzyme poisoned by this chemical). If exposure stops, plasma levels return to normal in 1–2 weeks while red blood cell levels may be reduced for 1–3 months. When acetylcholinesterase enzyme levels are reduced by 25% or more below preemployment levels, risk of poisoning is increased, even if results are in lower ranges of "normal." Reassignment to work not involving carbamate pesticides is recommended until enzyme levels recover. If symptoms develop or overexposure occurs, repeat the above tests as soon as possible and get an exam of the nervous system. Also consider complete blood count and chest x-ray following acute overexposure

First Aid: Speed in removing material from eyes and skin is of extreme importance. *Eyes:* Eye contact can cause dangerous amounts of these chemicals to be quickly absorbed through the mucous membrane into the bloodstream. Immediately and gently flush eyes with plenty of warm or cold water (NO hot water) for at least 15 minutes, occasionally lifting the upper and lower eyelids. Get medical aid immediately. *Skin:* Get medical aid. Dermal contact can cause dangerous amounts of these chemicals to be absorbed into the bloodstream. Wearing the appropriate PPE equipment and respirator for carbamate pesticides, immediately flush skin with plenty of soap and water for at least 15 minutes while removing contaminated clothing and shoes. Shampoo hair promptly if contaminated; protect eyes. *Ingestion:* Call poison control. Loosen all clothing. Never give anything by mouth to an unconscious person. Get medical aid. Do NOT induce vomiting. * If conscious, alert, and able to swallow, rinse mouth and have victim drink 4 to 8 ounces of water. Check to see if poison control instructs you to use ipecac syrup, otherwise administer slurry of activated charcoal (2 oz in 8 oz of water). If victim is *UNCONSCIOUS OR HAVING CONVULSIONS,* do nothing except keep victim warm. **In some cases you may be specifically instructed by poison control to induce vomiting by way of 2 tablespoons of syrup of ipecac (adult) washed down with a cup of water.* Do NOT give activated charcoal before or with ipecac syrup. *Inhalation:* Get medical aid. Do not contaminate yourself. Wearing the appropriate PPE equipment and respirator for carbamate pesticides, immediately remove the victim from the contaminated area to fresh air. If the victim is not breathing, administer artificial respiration. Do not use mouth-to-mouth method if victim ingested or inhaled the substance; give artificial respiration with the aid of a pocket mask equipped with a one-way valve or other proper respiratory medical device. If breathing is difficult, administer oxygen through bag/mask apparatus until medical help arrives. Do not leave victim unattended. *Note to physician or authorized medical personnel.* Administer atropine, 2 mg (1/30 gr) intramuscularly or intravenously as soon as any local or systemic signs or symptoms of an intoxication are noted; repeat the administration of atropine every 3 to 8 minutes until signs of atropinization (mydriasis, dry mouth, rapid pulse, hot and dry skin) occur; initiate treatment in children with 0.05 mg mg/kg of atropine; repeat at 5 to 10 minute intervals. Watch respiration, and remove bronchial secretions if they appear to be obstructing the airway; intubate if necessary. *Medical note:* 2-PAMCI may be contraindicated in the case of some carbamate poisonings.

Personal Protective Methods: Wear protective gloves and clothing to prevent any reasonable probability of dermal contact. Safety equipment suppliers/manufacturers can provide recommendations on the most protective glove/clothing material for your operation. DuPont™ Tychem® suit fabrics[88]. All protective clothing (suits, gloves, footwear, headgear) should be clean, available each day, and put on before work. Contact lenses should not be worn when working with this chemical. Wear dust-proof chemical goggles and face shield unless full facepiece respiratory protection is worn. Employees should wash immediately with soap when skin is wet or contaminated. Provide emergency showers and eyewash.

Respirator Selection: *At concentrations above the NIOSH REL, or where there is no REL, at any detectable concentration:* SCBAF:Pd,Pp (APF = 10,000): (any self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode); or SaF:Pd,Pp:ASCBA (APF = 10,000) (any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary self-contained positive-pressure breathing apparatus). *Escape*: GmFOv100 (APF = 50) [any air-purifying, full facepiece respirator (gas mask) with a chin-style, front- or back-mounted organic vapor canister having an N100, R100, or P100 filter]; or SCBAE (any appropriate escape-type, self-contained breathing apparatus).

Storage: Color Code-Blue: Health Hazard/Poison. Store in a secure poison location. Prior to working with this chemical you should be trained on its proper handling and storage. Store in tightly closed containers in a cool, well-ventilated area away from strong alkalis (i.e., sodium hydroxide, sodium bicarbonate, etc.).

Shipping: The solid toxic carbamate should be labeled "poisonous materials." It falls into Hazard Class 6.1.

Spill Handling: For solids, isolate spill or leak area in all directions for at least 25 meters/75 feet. Increase, in the downwind direction, as necessary. Do not touch damaged containers or spilled material unless wearing appropriate protective clothing. Stop leak if you can do it without risk. Prevent entry into waterways, sewers, basements or confined areas. Cover with plastic sheet to prevent spreading. Absorb or cover with dry earth, sand or other non-combustible material and transfer to containers. Do not allow water to get inside containers.

Fire Extinguishing: Decomposes above 230°C releasing toxic carbons of nitrogen and carbon. *On a small fire:* use dry chemical powder, carbon dioxide, water spray, or foam. *On a large fire:* use water spray, fog or alcohol-resistant foam. Do not scatter material using straight water jet streams. Dike fire-control water for later disposal; do not scatter the material. Move containers from fire area if you can do it without risk. *Fire involving storage or vehicular tanks:* isolate for 800 meters/0.5 mile in all directions; also, consider initial evacuation for 800 meters/0.5 mile in all directions. Fight fire from maximum distance or use unmanned hose holders or monitor nozzles. Do not allow water to get inside containers. Cool containers with flooding quantities of water until well after fire is out. Withdraw immediately in the case of rising sound from venting safety devices or discoloration of tank. *Always* stay away from tanks engulfed in fire. For massive fire, use unmanned hose holders or monitor nozzles; if this is impossible, withdraw from area and let fire burn.

Disposal Method Suggested: Do not discharge into drains or sewers. Dispose of waste material as hazardous waste using a licensed disposal contractor to an approved landfill. Consult with environmental regulatory agencies for guidance on acceptable disposal practices. Incineration with effluent gas scrubbing is recommended. Containers must be disposed of properly by following package label directions or by contacting your local or federal environmental control agency, or by contacting your regional EPA office.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- Pesticide Management Education Program, "Desmedipham (Betanex) Herbicide Profile 3/85," Cornell University, Ithaca, NY (March 1985). http://pmep.cce.cornell.edu/profiles/herb-growthreg/dalapon-ethephon/desmedipham/herb-prof-desmedipham
- USEPA, Office of Pesticide Programs, Pesticide Residue Limits, "Desmedipham", 40 CFR 180.353. http://www.epa.gov/pesticides/food/viewtols.htm

2,4-DES-sodium D:0190

Use Type: Herbicide

CAS Number: 136-78-7

Formula: $C_8H_7Cl_2NaO_5$; $Cl_2C_6H_3O(CH_2)_2OSO_3Na$

Synonyms: 2,4-DES-Na; 2-(2,4-Dichlorophenoxy)ethanol hydrogen sulfate sodium salt; 2,4-Dichlorophenoxyethyl sulfate, sodium salt; Disul; Disul-Na; Disul-sodium; SES; Sesone; Sodium-2-(2,4-dichlorophenoxy)ethyl sulfate; Sodium-2,4-dichlorophenoxyethyl sulphate; Sodium-2,4-dichlorophenyl cellosolve sulfate

Trade Names: CRAG HERBICIDE 1®; CRAG SESONE®; SCATHE PEANUT HERBICIDE®[C]

Chemical Class: Chlorophenoxy

EPA/OPP PC Code: 030602

HSDB Number: 2522

UN/NA & ERG Number: UN3345 (solid)/153; UN3348 (liquid)/153

RTECS® Number: KK4900000

EC Number: 205-259-5 [*Annex I Index No.:* 016-025-00-5]

Uses: Not registered for use in the U.S. Herbicidal pre-emergence control of annual weeds in certain fruits and berries, corn and maize, rhubarb, flowers, ornamental shrubs and trees. Used as corrosion inhibitor, pharmaceutical intermediate and emulsifier.

U.S. Maximum Allowable Residue Levels for Sesone (40 CFR 180.102): in or on the raw agricultural commodities indicated: in or on potatoes 6 ppm; peanuts 6 ppm; peanut hulls 6 ppm; peanut hay 6 ppm; asparagus 2 ppm;, strawberries 2 ppm.

Regulatory Authority and Advisory Information:

Carcinogenicity: ACGIH, A4, Not classifiable as a human carcinogen.

Health Advisory: Skin irritant/sensitizer, Endocrine disruptor (?)

European/International Regulations: Hazard Symbol: Xn; risk phrases: R22; R38; R41; safety phrases: S2; S26 (see Appendix 1)

Description: Sesone or Crag® pesticide is a colorless, crystalline solid. Odorless. It's a noncombustible solid, but commercial products may be formulated using flammable organic solvents, which can change the physical properties shown here. Molecular weight = 309.10; Specific gravity (H_2O:1) = 1.70; Freezing/Melting point = 245°C (decomposes); Vapor pressure = 0.1 mmHg. Hazard Identification (based on NFPA-704 M Rating System): Health 3, Flammability 0, Reactivity 0. Soluble in water; solubility = 26% @ 25°C.

Permissible Exposure Limits in Air: OSHA PEL: 15 mg/m^3 TWA, total dust; 5 mg/m^3 TWA, respirable fraction

NIOSH REL: 10 mg/m^3 TWA, total dust; 5 mg/m^3 TWA, respirable fraction

ACGIH TLV®[1]: 10 mg/m^3 TWA; Not Suspected as a Human carcinogen, as Sesone

NIOSH IDLH: 500 mg/m^3

No Protective Action Criteria (PAC) Available.

Determination in Air: See NIOSH Method # S-356 (II)5[18]

Permissible Concentration in Water: Runoff from spills or fire control may cause water pollution.

Routes of Entry: Inhalation, ingestion skin and eye contact.

Harmful Effects and Symptoms

Short Term Exposure: Irritates eyes, skin, and respiratory tract. High levels of exposure may cause central nervous system effects, convulsions. May affect the kidneys and liver. LD_{50} (oral, rat) = 1500 mg/kg.

Long Term Exposure: May cause liver and kidney damage.

Points of Attack: Eyes, skin, central nervous system, liver, kidneys.

Medical Surveillance: Preliminary medical exam to detect chronic diseases of central nervous system, liver, heart, kidneys, lung and skin, as well as endocrinological or immunological disturbances, should protect susceptible individuals. Periodical medical exams of internal organs, skin and eyes are important to avoid chronic occupational intoxications. They should include lab and patch tests when necessary[83]. Liver function. Kidney function. Tests of nervous system.

First Aid: If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least 15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately. If this chemical contacts the skin, remove contaminated clothing and wash immediately with soap and water. Seek medical attention immediately. If this chemical has been inhaled, remove from exposure, begin rescue breathing (using universal precautions) if breathing has stopped, and CPR if heart action has stopped. Transfer promptly to a medical facility. When this chemical has been swallowed, get medical attention. Give large quantities of water and induce vomiting. Do not make an unconscious person vomit.

Personal Protective Methods: Wear protective gloves and clothing to prevent any reasonable probability of dermal contact. Safety equipment suppliers/manufacturers can provide recommendations on the most protective glove/clothing material for your operation. All protective clothing (suits, gloves, footwear, headgear) should be clean, available each day, and put on before work. Contact lenses should not be worn when working with this chemical. Wear dust-proof chemical goggles and face shield unless full facepiece respiratory protection is worn. Employees should wash immediately with soap when skin is wet or contaminated. Provide emergency showers and eyewash.

Respirator Selection: NIOSH: *50 mg/m^3*: Qm (APF = 25) (any quarter-mask respirator (N, R, or P filters). *100 mg/m^3*: Any particulate respirator equipped with an N95, R95, or P95 filter (including N95, R95, and P95 filtering facepieces) except quarter-mask respirators. The following filters may also be used: N99, R99, P99, N100, R100, P100; or Sa (APF = 10) (any supplied-air respirator). *250 mg/m^3*: PaprHie (APF = 25) (any powered, air-purifying respirator with a high-efficiency particulate filter); or Sa:Cf (APF = 25) (any powered, air-purifying respirator with a dust and mist filter). *500 mg/m^3*: 100 F (APF = 50) (any air purifying, full facepiece respirator with an N100, R100, or P100 filter); or SCBAF (APF = 50) (any powered, air-purifying respirator with a tight-fitting face-piece and a high-efficiency particulate filter)*; or SaF (APF = 50) (any supplied-air respirator that has a tight-fitting face-piece and is operated in a continuous-flow mode)*; PaprTHie (APF = 50) (any self-contained breathing apparatus with a full facepiece); or SaT: Cf (APF = 50) (any supplied-air respirator with a full facepiece). *Emergency or planned entry into unknown concentrations or IDLH conditions:* SCBAF: Pd,Pp (APF = 10,000) (any self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode); or SaF: Pd,Pp: ASCBA (APF = 10,000) (any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary self-contained breathing apparatus operated in a pressure-demand or other positive-pressure mode.) *Escape:* 100 F (APF = 50) (any air-purifying, full facepiece respirator with an N100, R100, or P100 filter); or SCBAE (any appropriate escape-type, self-contained breathing apparatus).

*Substance reported to cause eye irritation or damage; may require eye protection.

Storage: Color Code-Blue: Health Hazard/Poison. Store in a secure poison location. Prior to working with this chemical you should be trained on its proper handling and storage. Store in tightly closed containers in a cool, well-ventilated area away from oxidizers and acids. Where possible, automatically pump liquid from drums or other storage containers to process containers.

Shipping: Phenoxyacetic acid derivative pesticides, solid or liquid, toxic, require a shipping label of "poisonous materials" and fall in Hazard Class 6.1.

Spill Handling: First remove all sources of ignition. Evacuate persons not wearing protective equipment from area of spill or leak until clean up is complete. Remove all ignition sources. Collect powdered material in the most convenient and safe manner and deposit in sealed containers. Ventilate area after clean up is complete. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable.

Fire Extinguishing: This chemical is a noncombustible solid. Use dry chemical, carbon dioxide; water spray; or alcohol foam extinguishers. Poisonous gases are produced in fire including oxides of sulfur and sodium and chlorine gas. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies. From a secure, explosion-proof location, use water spray to cool exposed containers. If cooling streams are ineffective (venting sound increases in volume and pitch, tank discolors, or shows any signs of deforming), withdraw immediately to a secure position. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode.

Disposal Method Suggested: Sesone is hydrolyzed by alkali to $NaHSO_4$ and apparently dichlorophenoxyethanol. In accordance with 40CFR165, follow recommendations for the disposal of pesticides and pesticide containers. Containers must be disposed of properly by following package label directions or by contacting your local or federal environmental control agency, or by contacting your regional EPA office.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- U.S. Environmental Protection Agency, Office of Pesticide Programs, Pesticide Residue Limits, "Sesone", 40 CFR 180.102. http://frwebgate.access.gpo.gov/cgi-bin/get-cfr.cgi
- New Jersey Department of Health and Senior Services, Hazardous Substance Fact Sheet," Sesone," Trenton, NJ (October 2001) http://www.state.nj.us/health/eoh/rtkweb/1654.pdf

Dialifor D:0210

Use Type: Insecticide, Acaricide

CAS Number: 10311-84-9

Formula: $C_{14}H_{17}ClNO_4PS_2$

Synonyms: *N*-(2-Chloro-1-(diethoxyphosphinpthioylthio) ethyl)phthalimide; *S*-(2-Chloro-1-(1,3-dihydro-1,3-dioxo-2*H*-isoindol-2-yl)ethyl)-*O,O*-diethyl phosphorodithioate; *S*-(2-Chloro-1-phthalimidoethyl)-*O,O*-diethylphosphorodithioate; Dialifos; *O,O*-Diethyl-*S*-(2-chloro-1-phthalimidoethyl)phosphorodithioate; *O,O*-Diethyl phosphorodithioate *S*-ester with *N*-(2-Chloro-1-mercaptoethyl)phthalimide; ENT 27,320; Phosphorodithioic acid *S*-[2-chloro-1-(1,3-dihydro-1,3-dioxo-2*H*-isoindol-2-yl)ethyl]-*O,O*-diethyl ester; Phosphorodithioic acid-*S*-(2-chloro-1-phthalimidoethyl)-*O,O*-diethyl ester

Trade Names: HERCULES 14503®[C]; TORAK®[C]

Chemical Class: Organophosphate

EPA/OPP PC Code: 102501

California DPR Chemical Code: 1799

HSDB Number: 1559

UN/NA & ERG Number: UN2783 (solid)/152

RTECS® Number: TD5165000

EC Number: 233-689-3 [*Annex I Index No.:* 015-088-00-6]

Uses: Not registered for use in the U.S. Sixteen global suppliers[97].

Regulatory Authority and Advisory Information:

Health Advisory: Nerve Toxin, Reproduction Hazard

U.S. DOT 49CFR172.101, Inhalation Hazard Chemical as organophosphates

Superfund/EPCRA 302 Extremely Hazardous Substances: TPQ = 100/10,000 lb (45.4/4,540 kg)

U.S. DOT Regulated Marine Pollutant (49CFR172.101, Appendix B)

European/International Regulations: Hazard Symbol: T+, N; risk phrases R24; R28; R50/53; safety phrases: S1/2; S28; S36/37; S45; S60; S61 (see Appendix 1)

WGK (German Aquatic Hazard Class): 3-Severe hazard to waters

Description: Dialifor, when pure, is a white crystalline solid. The commercial product may also be available as a colorless oil. Molecular weight = 393.846; Freezing/Melting point (solid) = 67.2–68.9°C; Vapor pressure = 1×10^{-3} mmHg @ 35°C[83]. Hazard Identification (based on NFPA-704 M Rating System): Health 3, Flammability 0, Reactivity 0. Insoluble in water. Physical and toxicological properties may be affected by the carrier solvents used in commercial formulations.

Incompatibilities: Strong bases. In the presence of strong reducing agents such as hydrides, organophosphates form highly toxic and flammable phosphine gas. Contact with oxidizers can cause the release of toxic oxides of phosphorus. Imides react with azo and diazo compounds to generate toxic gases. Flammable gases are formed by the reaction of organic imides with strong reducing agents. Imides are extremely weak bases (weaker than water). React with strong bases to form salts. That is, they can react as acids.

Permissible Exposure Limits in Air: Protective Action Criteria (PAC) Ver. 27[89]

PAC-1: 0.45 mg/m^3
PAC-2: 5 mg/m^3
PAC-3: 5 mg/m3

Determination in Air: OSHA versatile sampler-2; Toluene/Acetone; Gas chromatography/Flame photometric detection for sulfur, nitrogen, or phosphorus; NIOSH Method IV Method #5600, Organophosphorus pesticides[18].

Permissible Concentration in Water: Runoff from spills or fire control may cause water pollution.

Determination in Water: EAD Method 1657. The determination of organophosphorus pesticides in municipal and industrial wastewater by gas chromatography. Detection limit = 6.0 ng/L. Log K_{ow} = 4–4.7. Values above 3.0 are likely to bioaccumulate in aquatic organisms.

Routes of Entry: Inhalation, passing through the skin, ingestion.

Harmful Effects and Symptoms

Organophosphates are highly toxic. Symptoms may develop rapidly, or there may be a delay of several hours following exposure before they become noticeable. The delay tends to be longer in the case of some compounds that dissolve fats, lipids, oils and non-polar solvents such as toluene. Symptoms may increase in severity for more than a single day and last for several days. In severe cases of organophosphate intoxication, respiratory failure may occur.

Short Term Exposure: This material is highly toxic. This material can cause serious symptoms and in extreme cases death by respiratory arrest. Organic phosphorus insecticides are absorbed by the skin, as well as by the respiratory and gastrointestinal tracts. They are cholinesterase inhibitors. Symptoms of exposure include headache, giddiness, blurred vision, nervousness, weakness, nausea, cramps, diarrhea, and discomfort in the chest. Signs include sweating, tearing, salivation, vomiting, cyanosis, convulsions, coma, loss of reflexes and loss of sphincter control. Delayed pulmonary edema may occur after inhalation. LD_{50} (oral, rat) = 5–71 mg/kg.

Long Term Exposure: Cholinesterase inhibitor; cumulative effect is possible. This chemical may damage the nervous system with repeated exposure, resulting in convulsions, respiratory failure. May cause liver damage. A possible neurotoxin.

Points of Attack: Respiratory system, lungs, central nervous system, cardiovascular system, skin, eyes, plasma and red blood cell cholinesterase.

Medical Surveillance: Medical observation is recommended for 24 to 48 hours after breathing overexposure, as pulmonary edema may be delayed. Routine biological monitoring of pesticide applicators and field workers includes testing of plasma and red blood cell acetylcholinesterase levels (for enzyme poisoned by this chemical). These tests are normally accurate only if done within about two hours of exposure. If exposure stops, plasma levels return to normal in 1–2 weeks while red blood cell levels may be reduced for 1–3 months. When acetylcholinesterase enzyme levels are reduced by 25% or more below preemployment levels, risk of poisoning is increased, even if results are in lower ranges of "normal." Reassignment to work not involving organophosphate pesticides is recommended until enzyme levels recover. Do not drink any alcoholic beverages before or during use as it promotes absorption of organophosphates.

First Aid: **Treatment for organophosphate poisoning consists of thorough decontamination, cardiorespiratory support, and administration of the antidotes atropine and pralidoxime. In cases of severe poisoning, diazepam, an anticonvulsant, should also be administered. Antidotes should be administered as prevention even if the diagnosis is in doubt**. Speed in removing material from eyes and skin is of extreme importance. *Eyes:* Eye contact can cause dangerous amounts of these chemicals to be quickly absorbed through the mucous membrane into the bloodstream. Immediately and gently flush eyes with plenty of warm or cold water (NO hot water) for at least 15 minutes, occasionally lifting the upper and lower eyelids. Get medical aid immediately. *Skin:* Get medical aid. Dermal contact can cause dangerous amounts of these chemicals to be absorbed into the bloodstream. Wearing the appropriate PPE equipment and respirator for organophosphate/carbamate pesticides, immediately flush skin with plenty of soap and water for at least 15 minutes while removing contaminated clothing and shoes. Shampoo hair promptly if contaminated. The removed, contaminated clothing and shoes should be double-bagged and left in Hot Zone for later disposal by hazardous materials experts. Skin may also be decontaminated with diluted hypochlorite solution. *Inhalation:* Get medical aid. Do not contaminate yourself. Wearing the appropriate PPE equipment and respirator for organophosphate pesticides, immediately remove the victim from the contaminated area to fresh air. If the victim is not breathing, administer artificial respiration. Do not use mouth-to-mouth method if victim ingested or inhaled the substance; give artificial respiration with the aid of a pocket mask equipped with a one-way valve or other proper respiratory medical device. If breathing is difficult, administer oxygen through bag/mask apparatus until medical help arrives. Do not leave victim unattended. *Ingestion:* Call poison control. Loosen all clothing. Never give anything by mouth to an unconscious person. If victim is *unconscious or having convulsions,* do nothing except keep victim warm. Get medical aid. Transfer promptly to a medical facility. In cases of ingestion, **do not induce vomiting**. If the victim is alert and asymptomatic, administer a slurry of activated charcoal at a dose of 1 g/kg (infant, child, and adult dose). A soda can and straw may be of assistance when offering charcoal to a child. *In some cases you may be specifically instructed* *by poison control to induce vomiting by way of 2 tablespoons of syrup of ipecac (adult) washed down with a cup of water*. Do NOT give activated charcoal before or with ipecac syrup

Note to physician or authorized medical personnel: Treat cases of respiratory compromise, coma, or excessive pulmonary secretions with respiratory support using protocols and techniques available and within the scope of training. Some cases may necessitate procedures such as endotracheal intubation or cricothyrotomy by properly trained and equipped personnel. When possible, atropine (see *Antidotes*, below) should be given under medical supervision. Patients who are comatose, hypotensive, or having seizures or cardiac arrhythmias should be treated according to advanced life support protocols. *Antidotes:* Two antidotes are administered to treat organophosphate poisoning. Atropine is a competitive antagonist of acetylcholine at muscarinic receptors and is used to control the excessive bronchial secretions which are often responsible for death. Pralidoxime relieves both the nicotinic and muscarine effects of organophosphate poisoning by regenerating acetylcholinesterase and can reduce both the bronchial secretions and the muscle weakness associated with poisoning. The initial intravenous dose of atropine in adults should be determined by the severity of symptoms: An initial adult dose of 1.0 to 2.0 mg or pediatric dose of 0.01 mg/kg (minimum 0.01 mg) should be administered intravenously. If intravenous access cannot be established, atropine may also be given intramuscularly, subcutaneously or via endotracheal tube. Doses should be repeated every 15 minutes until excessive secretions and sweating have been controlled. Once bronchial secretion has been controlled, atropine administration should be repeated whenever the secretions begin to recur. In seriously poisoned patients, very large doses may be required. Alterations of pulse rate and pupillary size should not be used as indicators of treatment adequacy. Pralidoxime should be administered as early in poisoning as possible as its efficacy may diminish when given more than 24 to 36 hours after exposure. Doses are as follows: adult 1.0 g; pediatric 25 to 50 mg/kg. The drug should be administered intravenously over 30 to 60 minutes, but in a life-threatening situation one-half of the total dose can be given per minute for a total administration time of 2 minutes. Treatment should begin to take effect within 40 minutes with a reduction in symptoms and the amount of atropine necessary to control bronchial secretion. The initial dose can be repeated in 1 hour and then every 8 to 12 hours until the patient is clinically well and no longer requires atropine. If intravenous access cannot be established, pralidoxime may also be given intramuscularly. Early administration of diazepam in addition to the combined atropine and pralidoxime treatment may help prevent the onset of seizures and potential brain and cardiac morphologic damage following high-level organophosphate poisoning.

Respirator Selection: Wherever and whenever workplace conditions warrant respirator use, a respiratory protection program must be followed that meets one or more of the following requirements: OSHA's 29 CFR 1910.134, ANSI Z88.2, or European Standard EN 149.

Storage: Color Code-Blue: Health Hazard/Poison. Store in a secure poison location. Prior to working with this chemical you should be trained on its proper handling and storage. Where possible, automatically transfer material from other storage containers to process containers.

Shipping: Organophosphorus pesticides, solid or liquid (nonflammable), require a "poisonous materials" label. This chemical falls in Hazard Class 6.1.

Spill Handling: First remove all sources of ignition. Evacuate persons not wearing protective equipment from area of spill or leak until clean up is complete. Remove all ignition sources. Stay upwind; keep out of low areas. Ventilate area of spill or leak. Remove and isolate contaminated clothing at the site. Do not touch spilled material; stop leak if you can do so without risk. Use water spray to reduce vapors. *Small spills:* absorb with sand or other noncombustible absorbent material and place into containers for later disposal. *Large spills:* dike far ahead of spill for later disposal. Collect powdered material in the most convenient and safe manner and deposit in sealed containers. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable. Seek professional environmental engineering assistance from the U.S. EPA Environmental Response Team at (908) 548-8730 (24-hour response line).

Fire Extinguishing: Poisonous and corrosive gases are produced in fire including hydrogen chloride and oxides of phosphorus, sulfur, and nitrogen. May be fatal if inhaled, ingested or absorbed through skin. Inhalation or contact with some of these materials will irritate or burn skin and eyes. Vapors may cause dizziness or suffocation. *Small fires:* dry chemical, carbon dioxide; water spray; or foam. *Large fires:* water spray, fog, or foam. Stay upwind; keep out of low areas. Ventilate closed spaces before entering them. Firefighting gear (including SCBA) may not provide adequate protection. If exposure occurs, remove and isolate gear immediately and thoroughly decontaminate personnel. Wear positive-pressure breathing apparatus and special protective clothing. Remove and isolate contaminated clothing at the site. Move container from fire area if you can do so without risk. Fight fire from maximum distance. Dike fire-control water for later disposal; do not scatter the material. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies. From a secure, explosion-proof location, use water spray to cool exposed containers. If cooling streams are ineffective (venting sound increases in volume and pitch, tank discolors, or shows any signs of deforming), withdraw immediately to a secure position. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode.

Disposal Method Suggested: Destruction by alkali hydrolysis or incineration. Containers must be disposed of properly by following package label directions or by contacting your local or federal environmental control agency, or by contacting your regional EPA office.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- Sax, N. I., Ed., "Dangerous Properties of Industrial Materials Report," 2, No. 5, 43-45 (1982)
- USEPA, "Chemical Profile: Dialifor," Washington DC, Chemical Emergency Preparedness Program (November 30, 1987)
- Agency for Toxic Substances and Disease Registry, U.S. Department of Health and Human Services, Public Health Service, "Managing Hazardous Materials Incidents," Atlanta, GA (June 2003)

Diallate D:0220

Use Type: Herbicide

CAS Number: 2303-16-4; 17708-58-6 (trans-isomer); 17708-57-5 (cis-isomer)

Formula: $C_{10}H_{17}Cl_2NOS$; $[(CH_3)_2CH]_2NCOSCH_2CCl = CHCl$

Synonyms: Bis(1-methylethyl) carbamothioic acid, *S*-(2,3-dichloro-2-propenyl)ester; Carbamothioic acid, Bis(1-methylethyl)-*S*-(2,3-dichloro-2-propenyl) ester; CP 15,336; DATC; 2,3-DCDT; Di-allate; Diallate carbamate herbicide; Dichloroallyldiisopropylthiocarbamate; *S*-2,3-Dichloroallyldiisopropylthiocarbamate; 2,3-Dichloroallyl *N,N*-diisopropylthiolcarbamate; 2,3-Dichloro-2-propene-1-thiol, diisopropylcarbamate; Diisopropylthiocarbamic acid, -(2,3-dichloroallyl) ester; 2-Propene-1-thiol, 2,3-dichloro-,diisopropylcarbamate; *S*-2,3-Dichloroallyl diisopropylthiocarbamate; *S*-2,3-Dichloroallyl di-isopropyl(thiocarbamate); *S*-(2,3-Dichloroallyl) diisopropylthiocarbamate); *S*-(2,3-Dichloro-2-propenyl)bis(1-methylethtl) carbamothioate

Trade Names: AVADEX®[C]

Chemical Class: Thiocarbamate

EPA/OPP PC Code: 078801

California DPR Chemical Code: 48

HSDB Number: 1566

UN/NA & ERG Number: UN2902 (liquid)/151 UN2757 (solid)/151

RTECS® Number: EX8225000

EC Number: 218-961-1 [*Annex I Index No.:* 006-019-00-0]

U.S. Maximum Allowable Residue Levels for Diallate (40 CFR 180.277): in or on the raw agricultural commodities: alfalfa (fresh and hay) 0.05 ppm; barley (grain, forage, and straw) 0.05 ppm; clover (fresh and hay) 0.05 ppm; field corn 0.05 ppm; grain 0.05 ppm; fodder and forage 0.05 ppm; flaxseed 0.05 ppm; lentils 0.05 ppm; peas 0.05 ppm; pea forage and hay 0.05 ppm; potatoes 0.05 ppm; safflower seed 0.05 ppm; soybeans 0.05 ppm; soybean forage and hay 0.05 ppm; and sugar beet roots and tops 0.05 ppm.

Uses: Not registered for use in the U.S. Used as a before or after planting treatment depending on the crop for control of wild oats. For use on alfalfa, alsike clover, barley, corn, flax, soybeans, lentils, peas, potatoes, red clover, sugar beets and sweet clover. Twenty global suppliers[97].

Human toxicity (long-term)[101]: Intermediate–35.00 ppb, Health Advisory

Fish toxicity (threshold)[101]: Low–344.93242 ppb, MATC (Maximum Acceptable Toxicant Concentration)

Regulatory Authority and Advisory Information:

Carcinogenicity: EPA Group C, limited evidence in animals, Possible human carcinogen; IARC, Animal Inadequate Evidence; Human Inadequate Evidence*, not classifiable as carcinogenic to humans*, Group 3

EPA Hazardous Waste Number (RCRA No.): U062

RCRA 40CFR264, Appendix 9; TSD Facilities Ground Water Monitoring List. Suggested test method(s) (PQL *u*g/L): 8270(10)

Superfund/EPCRA 40CFR302.4 RQ: CERCLA, 100 lb (45.4 kg)

EPCRA Section 313 Form R *de minimus* concentration reporting level: 1.0%

U.S. DOT Regulated Marine Pollutant (49CFR172.101, Appendix B)

European/International Regulations: Hazard Symbol: Xn, N; risk phrases: R22; R40; R50/53; safety phrases: S2; S25; S36/37; S60; S61 (see Appendix 1)

Description: Diallate is a brown liquid. Molecular weight = 270.21; Boiling point = 150°C @ 9 mmHg; Freezing/Melting point = 25–30°C. Flash point = 77°C (c.c.). Hazard Identification (based on NFPA-704 M Rating System) (solid): Health 2, Flammability 0, Reactivity 0. Slightly soluble in water; solubility = 14 mg/L @ 25°C.

Incompatibilities: Alkalis. Decomposes above 200°C. Flammable gases are generated by the combination of thiocarbamates with aldehydes, nitrides, and hydrides. Thiocarbamates are incompatible with acids, peroxides, and acid halides.

Permissible Concentration in Water: Federal Drinking Water Guidelines: 6 ppb[107]. State Drinking Water Guidelines: Florida 0.57 μg/L; Maine 3.5 μg/L.

Determination in Water: Log K_{ow} = 3.3. Values at or above 3.0 are likely to bioaccumulate in marine organisms.

Routes of Entry: Inhalation, passing through the skin, ingestion.

Harmful Effects and Symptoms

Short Term Exposure: Some thiocarbamates may react with recently ingested alcohol or alcohol-containing products including wine, medications, and cold remedies such as cough-syrups. Eye contact can irritate and possibly cause burns. Inhalation caused irritation of the respiratory tract with chest tightness and/or difficulty breathing. Higher levels can affect the nervous system. With nausea, vomiting, diarrhea, abdominal pain, reduced muscle coordination, blurred vision, muscle twitching, convulsions, coma and possible death. LD_{50} (oral, rat) = >350 mg/kg. Moderately toxic.

Long Term Exposure: High or repeated exposures can cause liver and kidney damage. There is limited evidence that diallate causes liver cancer in animals.

Points of Attack: Skin, eyes, nervous system.

Medical Surveillance: Preliminary medical exam to detect chronic diseases of central nervous system, liver, heart, kidneys, lung and skin, as well as endocrinological or immunological disturbances, should protect susceptible individuals. Periodical medical exams of internal organs, skin and eyes are important to avoid chronic occupational intoxications. They should include lab and patch tests when necessary[83]. This chemical is a suspected or known human carcinogen. Exposed persons should contact a physician for advice regarding the possible long term health effects and advice for medical monitoring. Lung function tests. Kidney and liver function tests. Examination of the nervous system. Interview exposed person for brain effects, including memory, mood, concentration, headaches, malaise, and altered sleep patterns.

First Aid: If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least 15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately. If this chemical contacts the skin, remove contaminated clothing and wash immediately with soap and water. Seek medical attention immediately. If this chemical has been inhaled, remove from exposure, begin rescue breathing (using universal precautions) if breathing has stopped, and CPR if heart action has stopped. Transfer promptly to a medical facility. When this chemical has been swallowed, get medical attention. Give large quantities of water and induce vomiting. Do not make an unconscious person vomit.

Personal Protective Methods: Reacts with the following absorbent materials: Cellulose-Based; Mineral- and Clay-Based; Dirt/Earth[88]. Wear protective gloves and clothing to prevent any reasonable probability of dermal contact. Safety equipment suppliers/manufacturers can provide recommendations on the most protective glove/clothing material for your operation. All protective clothing (suits, gloves, footwear, headgear) should be clean, available each day, and put on before work. Contact lenses should not be worn when working with this chemical. Wear splash-proof chemical goggles and face shield unless full facepiece respiratory protection is worn. Employees should wash immediately with soap when skin is wet or contaminated. Provide emergency showers and eyewash.

Respirator Selection: *At any detectable concentration:* SCBAF: Pd,Pp (APF = 10,000) (any NIOSH/MSHA- or European Standard EN 149-approved self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode); or SaF: Pd,Pp: ASCBA (APF = 10,000) (any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary, self-contained breathing apparatus operated in a pressure-demand or other positive-pressure mode). *Escape:* 100 F (APF = 50) (any air-purifying, full facepiece respirator with an N100, R100, or P100 filter k-mounted organic vapor canister having a high-efficiency particulate filter); or SCBAE (any appropriate escape-type, self-contained breathing apparatus).

Storage: Color Code-Blue: Health Hazard/Poison. Store in a secure poison location. Prior to working with diallate you should be trained on its proper handling and storage. Store in tightly closed containers in a cool, well-ventilated area away from alkalies. Where possible, automatically pump liquid from drums or other storage containers to process containers. A regulated, marked area should be established where this chemical is handled, used, or stored in compliance with OSHA Standard 1910.1045.

Shipping: Pesticides, solid, toxic, n.o.s. must bear a "poisonous materials" label. They fall in DOT Hazard Class 6.1 and diallate falls in Packing Group III.

Spill Handling: Evacuate and restrict persons not wearing protective equipment from area of spill or leak until clean up is complete. Remove all ignition sources. Ventilate area of spill or leak. Absorb liquids in vermiculite, dry sand, earth, peat, carbon, or a similar material and deposit in sealed containers. Keep this chemical out of a confined space, such as a sewer, because of the possibility of an explosion, unless the sewer is designed to prevent the build-up of explosive concentrations. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable.

Fire Extinguishing: Hazardous decomposition including oxides of sulfur, nitrogen and carbon and hydrogen chloride gas are produced in fire. *On a small fire:* use dry chemical, CO_2 or water spray. *On a large fire:* use water spray, fog or regular foam. Move containers from fire area if you can do it without risk. Dike fire-control water for later disposal; do not scatter the material. Use water spray or fog; do not use straight streams. *Fire involving storage or vehicular tanks:* isolate for 800 meters/0.5 mile in all directions; also, consider initial evacuation for 800 meters/0.5 mile in all directions. Fight fire from maximum distance or use unmanned hose holders or monitor nozzles. Do not get water inside containers. Cool containers with flooding quantities of water until well after fire is out. Withdraw immediately in the case of rising sound from venting safety devices or discoloration of tank. ALWAYS stay away from tanks engulfed in fire. For massive fire, use unmanned hose holders or monitor nozzles; if this is impossible, withdraw from area and let fire burn. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies.

Disposal Method Suggested: Land burial is acceptable for small quantities. Larger quantities can be incinerated. Containers must be disposed of properly by following package label directions or by contacting your local or federal environmental control agency, or by contacting your regional EPA office. Consult with environmental regulatory agencies for guidance on acceptable disposal practices. Generators of waste containing this contaminant (≥100 kg/mo) must conform with EPA regulations governing storage, transportation, treatment, and waste disposal.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- New Jersey Department of Health and Senior Services, Hazardous Substance Fact Sheet, “Diallate,” Trenton, NJ (April 1997). http://www.state.nj.us/health/eoh/rtkweb/0608.pdf
- Pesticide Management Education Program (PEMP), “Diallate (Avadex) Herbicide Profile 3/85,” Cornell University, Ithaca, NY (March 11, 1985, modified January 16, 2003). http://pmep.cce.cornell.edu/profiles/herb-growthreg/dalapon-ethephon/diallate/herb-prof-diallate.html
- Sax, N. I., Ed., “Dangerous Properties of Industrial Materials Report,” 3, No. 1, 50-53 (1983)

Diatomaceous earth D:0260

Use Type: Diatomaceous earth is used as insecticide, molluscicide, and as a filler in pesticides.

CAS Number: 61790-53-2 (uncalcined); 7631-86-9 [Silica, amorphous-diatomaceous earth (uncalcined)]; 68855-54-9 (flux calcinated)

Formula: SiO_2

Synonyms: Amorphous silica; Diatomaceous silica; Diatomite, uncalcined; Silica, amorphous diatomaceous earth; Precipitated amorphous silica; Silicon dioxide (amorphous)

Trade Names: CELITE®; CROP GUARD®; DIACTIV®; DIAFIL®; DI-ATOMATE®; DIE-SECTICIDE®; KENITE®; PRIMISIL®

Chemical Class: Inorganic

EPA/OPP PC Code: 072605

California DPR Chemical Code: 195

HSDB Number: 682 as amorphous silica

UN/NA & ERG Number: No citation

RTECS® Number: HL8600000

EC Number: 231-545-4 (silicon dioxide)

Uses: Diatomaceous earth kills and repels insects, including bed bugs, fleas, cockroaches, and carpet beetles, by dehydrating them, rather than chemically poisoning them, and has been used since early times. It is also used as a filtering agent and as a filler in construction materials, pesticides, paints, and varnishes. The calcined version (which has been heat treated) is the most dangerous and contains crystallized silica, and should be handled as silica.

U.S. Maximum Allowable Residue Levels for Amorphous silica (40 CFR 180.950): Tolerance exemptions for minimal risk active and inert ingredients. Unless specifically excluded, residues resulting from the use of the following substances as either an inert or an active ingredient in a pesticide chemical formulation, including antimicrobial pesticide chemicals, are exempted from the requirement of a tolerance under FFDCA section 408, if such use is in accordance with good agricultural or manufacturing practices. Silica, amorphous, fumed (crystalline-free); silica, amorphous, precipitated and gel; silica gel; silica gel, precipitated, crystalline-free, silica, hydrate; and silica, vitreous are included on this list.

Regulatory Authority and Advisory Information:

Carcinogenicity: IARC: Animal Inadequate Evidence; Human Inadequate Evidence, *not classifiable as carcinogenic to humans*, Group 3, 1997; NIOSH (*Silica, amorphous silica, fused*): Potential occupational carcinogen

WGK (German Aquatic Hazard Class): Non-water polluting agent

Description: Diatomaceous earth is a transparent to gray, odorless amorphous powder. Molecular weight = 60.78; Specific gravity (H_2O:1) = 1.9–2.35 (uncalcined); 2.2 (calcined); Boiling point = 2230°C (uncalcined); 2595 (calcined); Freezing/Melting point = 1710°C (uncalcined); 1083°C (calcined). Hazard Identification (based on NFPA-704 M Rating System): Health 1, Flammability 0, Reactivity 0. Insoluble in water.

Incompatibilities: High temperatures cause the formation of crystalline silica. Incompatible with oxygen difluoride, chlorine difluoride.

Permissible Exposure Limits in Air: *diatomaceous earth, uncalcined & Silica, amorphous precipitated and gel*

OSHA PEL: either one **of the methods:** 20 mppcf [millions of particles per cubic foot of air, based on impinger samples counted by light-field techniques] or 80 mg/m^3 divided by the value “%SiO_2,” TWA

NIOSH REL: 6 mg/m^3 TWA

ACGIH TLV®[1]: withdrawn for the following: *silica amorphous, precipitated and gel; silica fume; silica fused; diatomaceous earth, calcined.*

NIOSH IDLH: 3000 mg/m^3

Protective Action Criteria (PAC) Ver. 27[89]

Diatomaceous earth (flux calcinated)

PAC-1: 0.9 mg/m^3
PAC-2: 9.9 mg/m^3
PAC-3: 59 mg/m^3

Diatomaceous earth (uncalcined)

PAC-1: 18 mg/m^3

PAC-2: 200 mg/m^3
PAC-3: 1200 mg/m^3
DFG MAK (*diatomaceous earth, uncalcined)*: 4 mg/m^3, inhalable fraction; Pregnancy Risk Group C.

Determination in Air: Filter; Low-temperature ashing; x-ray diffraction spectrometry; NIOSH IV, Method #7501[18]; or, Gravimetric plus OSHA Method ID/42[58]

Permissible Concentration in Water: Runoff from spills or fire control may cause water pollution.

Routes of Entry: Inhalation

Harmful Effects and Symptoms

Short Term Exposure: Inhalation can irritate the nose and nasal passages. High inhalation exposure may cause cough and shortness of breath. Skin contact can cause irritation and dryness. Following inhalation of *amorphous* diatomaceous earth, it is rapidly eliminated from lung tissue. However, *crystalline* diatomaceous earth is much smaller, and it may accumulate in lung tissue and lymph nodes. May irritate the eyes, due to its abrasive nature. Any dust, including silica, can be irritating to the eyes. When ingested, very little is absorbed into the body[NPIC]. The remaining portion is rapidly excreted. Small amounts of silica are normally present in all body tissues, and it is normal to find silicon dioxide in urine.

Long Term Exposure: Exposure can cause permanent scarring of the lungs, especially if diatomaceous earth has been calcined (heat treated).When mice were forced to breathe diatomaceous earth for one hour each day for a year, there was an increase in lung cancers. When rats were fed silica at a high dose for two years, there was no increase in cancer development. Very small amount of *crystalline* diatomaceous earth may be found in pesticide products. Long-term inhalation of the crystalline form is associated with silicosis, chronic bronchitis, and other respiratory problems. The bulk of diatomaceous earth is *amorphous*, not crystalline. The *amorphous* form is only associated with mild, reversible lung inflammation. This can begin anywhere from months to years after exposure. The name of this disease is silicosis. With heavy exposure, individuals may become respiratory cripples. This can be fatal.

Points of Attack: Lungs. Silicosis and potential for lung cancer.

Medical Surveillance: Diagnosis of chronic silicosis is confirmed with a positive x-ray. Before first exposure to calcined diatomaceous earth and at regular times after, the following are recommended: Medical exam of the lungs. Lung function tests. Chest x-ray (every two to five years).

First Aid: If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least 15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately. If this chemical has been inhaled, remove from exposure, begin rescue breathing (using universal precautions) if breathing has stopped, and CPR if heart action has stopped. Transfer promptly to a medical facility.

Personal Protective Methods: Wear protective gloves and clothing. Safety equipment suppliers/manufacturers can provide recommendations on the most protective glove/clothing material for your operation. All protective clothing (suits, gloves, footwear, headgear) should be clean, available each day, and put on before work. Contact lenses should not be worn when working with this chemical. Wear dust-proof chemical goggles and face shield unless full facepiece respiratory protection is worn. Employees should wash immediately with soap when skin is wet or contaminated. Provide emergency showers and eyewash.

Respirator Selection: SCBA > **0.9 mg/m^3**; *(uncalcined)* > **18 mg/m^3.** NIOSH: *30 mg/m^3*: Qm (APF = 25) (any quarter-mask respirator). *60 mg/m^3:* Any particulate respirator equipped with an N95, R95, or P95 filter (including N95, R95, and P95 filtering face-pieces) except quarter-mask respirators. The following filters may also be used: N99, R99, P99, N100, R100, P100; or Sa (APF = 10) (any supplied-air respirator). *150 mg/m^3:* Sa:Cf (APF = 25) (any supplied-air respirator operated in a continuous-flow mode); or PaprHie (APF = 25) (any powered, air-purifying respirator with a high-efficiency particulate filter). *300 mg/m^3:* 100 F (APF = 50) (any air-purifying, full facepiece respirator with an N100, R100, or P100 filter); or SaT: Cf (APF = 50) (any supplied-air respirator that has a tight-fitting face-piece and is operated in a continuous-flow mode); or PaprTHie (APF = 50) (any powered, air-purifying respirator with a tight-fitting facepiece and a high-efficiency particulate filter); or SCBAF (APF = 50) (any self-contained breathing apparatus with a full facepiece); or SaF (APF = 50) (any supplied-air respirator with a full facepiece). *3000 mg/m^3:* SaF: Pd,Pp (APF = 2000) (any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode). *Emergency or planned entry into unknown concentrations or IDLH conditions:* SCBAF: Pd,Pp (APF = 10,000) (any self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode); or SaF: Pd,Pp: ASCBA (APF = 10,000) (any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary, self-contained breathing apparatus operated in a pressure-demand or other positive-pressure mode). *Escape:* 100 F (APF = 50) (any air-purifying, full facepiece respirator with an N100, R100, or P100 filter); or SCBAE (any appropriate escape-type, self-contained breathing apparatus).

Storage: Color Code-Green: General storage may be used. Store in tightly closed containers in a cool well-ventilated area.

Shipping: This material is not listed by DOT[19] in its Performance-Oriented Packaging Standards.

Spill Handling: Collect powdered material in the most convenient and safe manner and deposit in sealed containers. Ventilate area after clean up is complete. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations.

If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable.

Fire Extinguishing: Use any extinguishing agent suitable for surrounding fire. Poisonous gases are produced in fire. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies. From a secure, explosion-proof location, use water spray to cool exposed containers. If cooling streams are ineffective (venting sound increases in volume and pitch, tank discolors, or shows any signs of deforming), withdraw immediately to a secure position. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- New Jersey Department of Health, "Hazardous Substance Fact Sheet: Diatomaceous Earth," Trenton, NJ (August 1985, revised May 1999). http://www.state.nj.us/health/eoh/rtkweb/0616.pdf
- *Diatomaceous Earth Fact Sheet*; National Pesticide Information Center, Oregon State University Extension Services, Corvallis, OR (January 2013)

Diazinon D:0280

Use Type: Insecticide, Acaricide

CAS Number: 333-41-5

Formula: $C_{12}H_{21}O_3N_2SP$

Synonyms: Diethyl 4-(2-isopropyl-6-methylpyrimidinl)phosphorothionate; Diethyl 2-isopropyl-4-methyl-6-pyrimidinl phosphorothionate; *O,O*-Diethyl *O*-2-isopropyl-6-methylpyrimidin-4-ylphosphorothionate; *O,O*-Diethyl-*O*-(2-isopropyl-4-methyl-6-pyrimidyl) phosphorothionate; *O,O*-Diethyl 2-isopropyl-4-methylpyrimidyl-6-thiophosphate; *O,O*-Diethyl *O*-(2-isopropyl-4-methyl-6-pyrimidyl)thionophosphate; Diethyl 2-isopropyl-4-methyl-6-pyrimidylthionophosphate; *O,O*-Diethyl *O*-6-methyl-2-isopropyl-4-pyrimidinyl phosphorothioate; *O,O*-Diethyl *O*-(6-methyl-2-(1-methylethyl)-4-pyrimidinyl) phosphorothioate; ENT 19,507; Isopropylmethylpyrimidyl diethyl thiophosphate; *O*-2-Isopropyl-4-methylpyrimyl-*O,O*-diethyl phosphorothioate; NCI-C08673; Phosphoric acid, *O,O*-diethyl *O*-6-methyl-2-(1-methylethyl)-4-pyrimidinyl ester; Phosphorothioate, *O,O*-diethyl *O*-6-(2-isopropyl-4-methylpyrimidyl; Phosphorothioic acid, *O,O*-diethyl *O*-(2-isopropyl-6-methyl-4-pyrimidinl) ester; Phosphorothioic acid, *O,O*-diethyl *O*-(isopropylmethylpyrimidyl) ester; Phosphorothioic acid, *O,O*-diethyl *O*-(6-methyl-2-(1-methylethyl)-4-pyrimidinyl) ester; 4-Pyrimidinol, 2-isopropyl-6-methyl-, *O*-ester with *O,O*-diethylphosphorothioate; Thiophosphoric acid 2-isopropyl-4-methyl-6-pyrimidyl diethyl ester

Trade Names: AG-500®; AI3-19507®; ALFA-TOX®[C]; ANTIGAL®; ANTLAK®; BASUDIN®; BAZUDEN®; CASWELL No. 342®; DACUTOX®; DASSITOX®; DAZZEL®; DIAGRAN®; DIANON®; DIATERR-FOS®; DIAZAJET®; DIAZATOL®; DIAZIDE®; DIAZINON AG 500 WBC®; DIAZINONE®; DIAZITOL®; DIAZOL®; DICID®; DIMPYLATE®; DIPOFENE®; DIZIKTOL®; DIZINON®[C]; DRAWIZON®; DYMET®; DYZOL®); D.Z.N.®; EXODIN®; FEZUDIN®; FLYTROL®; G 301®; G-24480®; GALESAN®; GARDENTOX®; GEIGY 24480®; KAYAZINON®; KAYAZOL®; NEOCIDOL® (OIL); NEOCIDOL®; NIPSAN®; NUCIDOL®; OLEODIAZINON®; ROOT GUARD; SAROLEX®[C]; SPECTRACIDE®; SROLEX®; SUZON®

Chemical Class: Organophosphate

EPA/OPP PC Code: 057801

California DPR Chemical Code: 198

HSDB Number: 303

UN/NA & ERG Number: UN3018 (liquid)/152; UN2783/152

RTECS® Number: TF3325000

EC Number: 206-373-8 [*Annex I Index No.:* 015-040-00-4]

Uses: Diazinon is the most widely used pesticide by homeowners on lawns, and is one of the most widely used pesticide ingredients for application around the home and in gardens. It is used to control insects and grub worms. It is a nonsystemic organophosphate insecticide used to control cockroaches, silverfish, ants, and fleas in residential, non-food buildings. Bait is used to control scavenger yellow jackets in the western U.S. It is used on home gardens and farms to control a wide variety of sucking and leaf-eating insects. It is used on rice, fruit trees, sugarcane, corn, tobacco, potatoes and on horticultural plants, and is also an ingredient in pest strips. Diazinon has veterinary uses against fleas and ticks. It is available in dust, granules, seed dressings, wettable powder, and emulsifiable solution formulations. In 1988, there were 500 different products containing diazinon on the market, and used in such products as agricultural sprays and granules, animal ear tags, household sprays and dust and veterinary products. Not approved for use in EU countries[115]. A U.S. EPA restricted Use Pesticide (RUP). The U.S. EPA initiated a program to phase out all non-agricultural uses of diazinon commencing in March, 2001. Many commercial outdoor uses of diazinon have been canceled or restricted to licensed pesticide applicators because of its known toxicity to birds and aquatic life. Diazinon is highly toxic to bees and very highly toxic to birds, fish and aquatic invertebrates. Diazinon was canceled for use on golf courses and sod farms in 1988 because of its high risk to birds.

U.S. Maximum Allowable Residue Levels for Diazinon [40 CFR 180.153 (a)]: Almond, hulls 3. 0 ppm; apple 0.50 ppm; apricot 0.20 ppm; bean, lima 0.50 ppm; bean, snap, succulent 0.50 ppm; beet, garden, roots 0.75 ppm; beet, garden, tops 0.70 ppm; blueberry 0.50 ppm; caneberry subgroup 13-07A, 0.75 ppm; carrot, roots 0.75 ppm; cattle, fat 0.50 ppm; cherry, sweet 0.20 ppm; cherry, tart 0.20 ppm; cranberry 0.50 ppm; endive 0.70 ppm; fig 0.50 ppm; ginseng 0.75 ppm; hazelnut 0.50 ppm; lettuce 0.70 ppm; melon 0.75 ppm; nectarine 0.20 ppm; onion, bulb 0.75 ppm; onion, green 0.75 ppm; pea, succulent 0.50 ppm; peach 0.20 ppm; pear 0.50 ppm; pineapple 0.50 ppm; plum, prune, fresh 0.20 ppm; radish 0.50 ppm; rutabaga 0.75 ppm; spinach 0.70 ppm; strawberry 0.50 ppm; tomato 0.75 ppm; vegetable, brassica, leafy, group 5, 0.70 ppm; watercress 0.05 ppm; ***[40CFR180.153 (c)]*** almond 0.50 ppm; banana 0.20 ppm; celery 0.70 ppm; cucumber 0.75 ppm; parsley, leaves 0.75 ppm; parsnip 0.50 ppm; pepper 0.5 ppm; potato 0.10 ppm; squash, summer 0.50 ppm; squash, winter 0.75 ppm; sweet potato, roots 0.10 ppm; swiss chard 0.70 ppm; turnip, roots 0.50 ppm; turnip, tops 0.75 ppm.

***Human toxicity (long-term)* *[101]*:** Extra high–0.60 ppb, Health Advisory

***Fish toxicity (threshold)* *[101]*:** Extra high–0.09200 ppb, MATC (Maximum Acceptable Toxicant Concentration)

Regulatory Authority and Advisory Information:

Carcinogenicity: EPA, Not likely to be carcinogenic to humans; ACGIH, A4 Not classifiable as a human carcinogen.

Acute Oral Category: 2, WARNING to Poison (oral) Category: 3, CAUTION

Health Advisory: Nerve toxin, Mutagen, Developmental/Reproductive Toxin, Skin irritant/sensitizer, Developmental toxin

EPA Population Adjusted Dose (aPAD) is 0.0025 mg/kg/day.

Potential Ground Water Pollutant [California FAC Section 13145(d)/12811, active]

Air Pollutant Standard Set. US DOT 49CFR172.101, Inhalation Hazardous Chemical as organophosphates

Clean Water Act: Section 311 Hazardous Substances/RQ 40CFR117.3 (same as CERCLA, see below)

Reportable Quantity (RQ): 1 lb (0.454 kg)

EPCRA Section 313 Form R *de minimis* concentration reporting level: 1.0%.

US DOT Regulated Marine Pollutant (49CFR172.101, appendix B), severe pollutant

European/International Regulations: Hazard Symbol: Xn, N; risk phrases: R22; R50/53; safety phrases: S2; S24/25; S60; S61 (see Appendix 1).

WGK (German Aquatic Hazard Class): 3-Severe hazard to waters.

Description: Diazinon is a combustible, colorless, oily liquid with a faint amine odor. Technical grade is pale to dark brown. Commercial formulations may use carrier solvents of acetone, ethanol or xylene which can change the physical properties listed here. Molecular weight = 304.35; Specific gravity (H_2O:1) = 1.12 @ 20°C; Boiling point = (decomposes) @ 120°C; Flash point = 28–82°C (depending on carrier). Hazard Identification (based on NFPA-704 M Rating System): Health 3, Flammability 1, Reactivity 0. Low solublility in water; solubility = 40–60 mg/L.

Incompatibilities: Hydrolyzes slowly in water and dilute acid. Reacts with strong acids and alkalis with possible formation of highly toxic tetraethyl thiopyrophosphates. Incompatible with copper-containing compounds. In the presence of strong reducing agents such as hydrides, organophosphates form highly toxic and flammable phosphine gas. Contact with oxidizers can cause the release of toxic oxides of phosphorus.

Permissible Exposure Limits in Air: OSHA PEL: None

NIOSH REL: 0.1 mg/m^3 TWA [skin]

ACGIH TLV®[1]: 0.01 mg/m^3 TWA, inhalable fraction and vapor [skin]; not classifiable as a human carcinogen; TLV-BEI$_A$ issued (2000), Acetylcholinesterase inhibiting pesticides

No Protective Action Criteria (PAC) available

DFG MAK: 0.1 mg/m^3 (measured as the, inhalable fraction); Peak Limitation Category II(2) [skin]; Pregnancy Risk Group C

Determination in Air: OSHA versatile sampler-2; Toluene/Acetone; Gas chromatography/Flame photometric detection for sulfur, nitrogen, or phosphorus; NIOSH IV Method #5600[18], Organophosphorus pesticides. See also OSHA Method #62[58]

Permissible Concentration in Water: Federal Drinking Water Guidelines: EPA 1 μg/L. State Drinking Water Guidelines: Arizona 0.63 μg/L; Florida 6.3 μg/L; California 6 μg/L. The U.S. EPA has set a non-enforceable lifetime health advisory at 0.001 mg/L for diazinon in drinking water.

Determination in Water: EAD Method 1657. The determination of organophosphorus pesticides in municipal and industrial wastewater by gas chromatography. Detection limit = 6.0 ng/L. Log K_{ow} = >3.0. Values above 3.0 are likely to bioaccumulate in aquatic organisms.

Routes of Entry: Inhalation, skin absorption, ingestion, skin and/or eye contact.

Harmful Effects and Symptoms

Organophosphates are highly toxic. Symptoms may develop rapidly, or there may be a delay of several hours following exposure before they become noticeable. The delay tends to be longer in the case of some compounds that dissolve fats, lipids, oils and non-polar solvents such as toluene. Symptoms may increase in severity for more than a single day and last for several days. In severe cases of organophosphate intoxication, respiratory failure may occur.

Short Term Exposure: Diazinon can affect you when breathed in and quickly enters the body by passing through the skin. May cause skin and eye irritation. Exposure can cause organophosphate poisoning with headache, sweating, nausea, and vomiting, diarrhea, muscle twitching and possible death. It is a moderately toxic organophosphate chemical. Delayed pulmonary edema may occur after inhalation. Diazinon has a low acute oral toxicity in male and female rats. The acute oral LD_{50} for female rats was 1160 mg/kg and 1340 mg/kg for male rats. Other reported LD_{50} values (mg/kg) include: 300–850 (rats), 80–135 (mice), 250–355 (guinea pigs), 130 (rabbits), 8 (hens), 3 (pheasants), 3.5 (ducks) and 100 (pigs). LD_{50} (dermal, rat) = >2 g/kg.

Long Term Exposure: Damage to the pancreas has developed in some people and in laboratory animals exposed to large amounts of diazinon. In animal studies, high doses of diazinon produced effects on the nervous system similar to those seen in people. May cause tumors.

Points of Attack: Eyes, respiratory system, central nervous system, cardiovascular system, blood cholinesterase.

Medical Surveillance: Medical observation is recommended for 24 to 48 hours after breathing overexposure, as pulmonary edema may be delayed. Routine biological monitoring of pesticide applicators and field workers includes testing of plasma and red blood cell acetylcholinesterase levels (for enzyme poisoned by this chemical). These tests are normally accurate only if done within about two hours of exposure. If exposure stops, plasma levels return to normal in 1–2 weeks while red blood cell levels may be reduced for 1–3 months. When acetylcholinesterase enzyme levels are reduced by 25% or more below preemployment levels, risk of poisoning is increased, even if results are in lower ranges of "normal." Reassignment to work not involving organophosphate pesticides is recommended until enzyme levels recover. Do not drink any alcoholic beverages before or during use as it promotes absorption of organophosphates. Liver function tests. Exam of the nervous system. Complete blood count

First Aid: **Treatment for organophosphate poisoning consists of thorough decontamination, cardiorespiratory support, and administration of the antidotes atropine and pralidoxime. In cases of severe poisoning, diazepam, an anticonvulsant, should also be administered. Antidotes should be administered as prevention even if the diagnosis is in doubt**. Speed in removing material from eyes and skin is of extreme importance. *Eyes:* Eye contact can cause dangerous amounts of these chemicals to be quickly absorbed through the mucous membrane into the bloodstream. Immediately and gently flush eyes with plenty of warm or cold water (NO hot water) for at least 15 minutes, occasionally lifting the upper and lower eyelids. Get medical aid immediately. *Skin:* Get medical aid. Dermal contact can cause dangerous amounts of these chemicals to be absorbed into the bloodstream. Wearing the appropriate PPE equipment and respirator for organophosphate/carbamate pesticides, immediately flush skin with plenty of soap and water for at least 15 minutes while removing contaminated clothing and shoes. Shampoo hair promptly if contaminated. The removed, contaminated clothing and shoes should be double-bagged and left in Hot Zone for later disposal by hazardous materials experts. Skin may also be decontaminated with diluted hypochlorite solution. *Inhalation:* Get medical aid. Do not contaminate yourself. Wearing the appropriate PPE equipment and respirator for organophosphate pesticides, immediately remove the victim from the contaminated area to fresh air. If the victim is not breathing, administer artificial respiration. Do not use mouth-to-mouth method if victim ingested or inhaled the substance; give artificial respiration with the aid of a pocket mask equipped with a one-way valve or other proper respiratory medical device. If breathing is difficult, administer oxygen through bag/mask apparatus until medical help arrives. Do not leave victim unattended. *Ingestion:* Call poison control. Loosen all clothing. Never give anything by mouth to an unconscious person. If victim is *unconscious or having convulsions,* do nothing except keep victim warm. Get medical aid. Transfer promptly to a medical facility. In cases of ingestion, **do not induce vomiting**. If the victim is alert and asymptomatic, administer a slurry of activated charcoal at a dose of 1 g/kg (infant, child, and adult dose). A soda can and straw may be of assistance when offering charcoal to a child. *In some cases you may be specifically instructed by poison control to induce vomiting by way of 2 tablespoons of syrup of ipecac (adult) washed down with a cup of water*. Do NOT give activated charcoal before or with ipecac syrup

Note to physician or authorized medical personnel: Treat cases of respiratory compromise, coma, or excessive pulmonary secretions with respiratory support using protocols and techniques available and within the scope of training. Some cases may necessitate procedures such as endotracheal intubation or cricothyrotomy by properly trained and equipped personnel. When possible, atropine (see *Antidotes*, below) should be given under medical supervision. Patients who are comatose, hypotensive, or having seizures or cardiac arrhythmias should be treated according to advanced life support protocols. *Antidotes:* Two antidotes are administered to treat organophosphate poisoning. Atropine is a competitive antagonist of acetylcholine at muscarinic receptors and is used to control the excessive bronchial secretions which are often responsible for death. Pralidoxime relieves both the nicotinic and muscarine effects of organophosphate poisoning by regenerating acetylcholinesterase and can reduce both the bronchial secretions and the muscle weakness associated with poisoning. The initial intravenous dose of atropine in adults should be determined by the severity of symptoms: An initial adult dose of 1.0 to 2.0 mg or pediatric dose of 0.01 mg/kg (minimum 0.01 mg) should be administered intravenously. If intravenous access cannot be established, atropine may also be given intramuscularly, subcutaneously or via endotracheal tube. Doses should be repeated every 15 minutes until excessive secretions and sweating have been controlled. Once bronchial secretion has been controlled, atropine administration should be repeated whenever the secretions begin to recur. In seriously poisoned patients, very large doses may be required. Alterations of pulse rate and pupillary size should not be used as indicators of treatment adequacy. Pralidoxime should be administered as early in poisoning as possible as its efficacy may diminish when given more than 24 to 36 hours after exposure. Doses are as follows: adult 1.0 g; pediatric 25 to 50 mg/kg. The drug should be administered intravenously over 30 to 60 minutes, but in a life-threatening situation one-half of the total dose can be given per minute for a total administration time of 2 minutes. Treatment should begin to take effect within 40 minutes with a reduction in symptoms and the amount of atropine necessary to control bronchial secretion. The initial dose can be repeated in 1 hour and then every 8 to 12 hours until the patient is clinically well and no longer requires atropine. If intravenous access cannot be established, pralidoxime may also be given intramuscularly. Early administration of diazepam in addition to the combined atropine and pralidoxime treatment may help prevent the onset of seizures and potential brain and cardiac morphologic damage following high-level organophosphate poisoning.

Personal Protective Methods: Wear protective gloves and clothing to prevent any reasonable probability of dermal contact. Safety equipment suppliers/manufacturers can provide recommendations on the most protective glove/clothing material for your operation. One recommendation is the use of DuPont™ Tychem® suit fabrics[88]. All protective clothing (suits, gloves, footwear, headgear) should be clean, available each day, and put on before work. Contact lenses should not be worn when working with this chemical. Wear splash-proof chemical goggles and face shield unless full facepiece respiratory protection is worn. Employees should wash immediately with soap when skin is wet or contaminated. Provide emergency showers and eyewash.

Respirator Selection: Engineering controls should be used wherever feasible to maintain airborne concentrations of this chemical below the prescribed exposure limit. Respirators and protective equipment are less effective than engineering controls, and should be used only in non-routine or emergency situations which may result in exposure concentrations in excess of the TWA environmental limit. *At any concentrations above the NIOSH REL, or where there is no REL, at any detectable concentration:* SCBAF: Pd,Pp (APF = 10,000) (any NIOSH/MSHA- or European Standard EN 149-approved self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode); or SaF: Pd,Pp: ASCBA (APF = 10,000) (any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary, self-contained breathing apparatus operated in a pressure-demand or other positive-pressure mode).

Storage: Color Code-Blue: Health Hazard/Poison. Store in a secure poison location. Prior to working with this chemical you should be trained on its proper handling and storage. Where possible, automatically transfer material from other storage containers to process containers.

Shipping: Organophosphorus pesticides, solid or liquid (nonflammable), require a "poisonous materials" label. This chemical falls in Hazard Class 6.1.

Spill Handling: First remove all sources of ignition. Evacuate persons not wearing protective equipment from area of spill or leak until clean up is complete. Remove all ignition sources. Stay upwind; keep out of low areas. Ventilate area of spill or leak. Remove and isolate contaminated clothing at the site. Do not touch spilled material; stop leak if you can do so without risk. Use water spray to reduce vapors. *Small spills:* absorb with sand or other noncombustible absorbent material and place into containers for later disposal. *Large spills:* dike far ahead of spill for later disposal. Collect powdered material in the most convenient and safe manner and deposit in sealed containers. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable. Seek professional environmental engineering assistance from the U.S. EPA Environmental Response Team at (908) 548-8730 (24-hour response line).

Fire Extinguishing: Poisonous gases are produced in fire, including oxides of phosphorus, sulfur, and nitrogen. May be fatal if inhaled, ingested or absorbed through skin. Inhalation or contact with some of these materials will irritate or burn skin and eyes. Vapors may cause dizziness or suffocation. *Small fires:* dry chemical, carbon dioxide; water spray; or foam. *Large fires:* water spray, fog, or foam. Stay upwind; keep out of low areas. Ventilate closed spaces before entering them. Firefighting gear (including SCBA) may not provide adequate protection. If exposure occurs, remove and isolate gear immediately and thoroughly decontaminate personnel. Wear positive-pressure breathing apparatus and special protective clothing. Remove and isolate contaminated clothing at the site. Move container from fire area if you can do so without risk. Fight fire from maximum distance. Dike fire-control water for later disposal; do not scatter the material. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies. From a secure, explosion-proof location, use water spray to cool exposed containers. If cooling streams are ineffective (venting sound increases in volume and pitch, tank discolors, or shows any signs of deforming), withdraw immediately to a secure position. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode.

Disposal Method Suggested: Destruction by alkali hydrolysis or incineration. Containers must be disposed of properly by following package label directions or by contacting your local or federal environmental control agency, or by contacting your regional EPA office.

References:

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- Sax, N. I., Ed., "Dangerous Properties of Industrial Materials Report," 7, No. 5, 36-43 (1987)
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Dibromochloropropane D:0360

Use Type: Nematicide, Fumigant

CAS Number: 96-12-8

Formula: $C_3H_5Br_2Cl$; $CH_2BrCHBrCH_2Cl$

Synonyms: 1,2-Dibromo-3-cloropropano (Spanish); 1-Chloro-2,3-dibromopropane; 3-Chloro-1,2-dibromopropane; DBCP; NCI-C00500; Propane, 1,2-dibromo-3-chloro-

Trade Names: BBC 12®; FUMAGONE®; FUMAZONE®[C]; MEMATOCIDE®; NEMABROM®; NEMAFUM®; NEMAGON®[C]; NEMAGON SOIL FUMIGANT®[C]; NEMANAX®; NEMAPAZ®; NEMASET®; NEMATOCIDE®[C]; NEMATOX®; NEMAZON®; OS 1897®; OXY BCP®[C]; SD 1897®

Chemical Class: Halogenated organic compound (Alkane)

EPA/OPP PC Code: 011301

California DPR Chemical Code: 183

HSDB Number: 1629

UN/NA & ERG Number: UN2872/159

RTECS® Number: TX8750000

EC Number: 202-479-3 [*Annex I Index No.:* 602-021-00-6]

Uses: DBCP has been used in agriculture as a nematicide since 1955, being supplied for such use in the forms of liquid concentrate, emulsifiable concentrate, powder, granules, and solid material. A rebuttable presumption against registration for pesticide uses was issued by U.S. EPA on September 22, 1977, on the basis of oncogenicity and reproductive effects. Then, as of November 3, 1977, EPA in a further action suspended all registrations of end-use products, subject to various specific restrictions. Not listed as registered in EU countries[115].

U.S. Maximum Allowable Residue Levels: Tolerances are established for residues of inorganic bromides (calculated as Br) in or on the following raw agricultural commodities grown in soil fumigated with combinations of chloropicrin, methyl bromide, and propargyl bromide. No tolerances are established for chloropicrin since it has been established that no residue of this substance remains in the raw agricultural commodity: ***[40 CFR 180.199(a)]***: broccoli 25 ppm; cauliflower 25 ppm; eggplant 60 ppm; muskmelon 40 ppm; pepper 25 ppm; pineapple 25 ppm; strawberry 25 ppm; and tomato 40 ppm. ***Tolerances with regional registration, as defined in 180.1(n), are established for residues of inorganic bromides (calculated as Br) [40 CFR 180.199(b)]:*** in or on the following raw agricultural commodities grown in soil fumigated with combinations of chloropicrin, methyl bromide, and propargyl bromide: asparagus 300 ppm; lettuce 300 ppm; and onion, dry bulb 300 ppm.

Human toxicity (long-term) [101]***:*** Extra high–0.20 ppb, MCL (Maximum Contaminant Level)

Regulatory Authority and Advisory Information:

Carcinogenicity: EPA, B2, Probable human carcinogen; IARC: Human Inadequate Evidence; Animal Sufficient Evidence, *possibly carcinogenic to humans*, Group 2b, 1999; NTP: 12th Report on Carcinogens, 2011: Reasonably anticipated to be a human carcinogen

California Proposition 65 Chemical: Cancer (7/1/1987); reproductive, male (2/27/87)

Health Advisory: Endocrine disruptor

Acute Oral Category: 2, WARNING

OSHA, 29CFR1910 Specifically Regulated Chemicals (See CFR 1910.1044)

Clean Air Act: Hazardous Air Pollutants (Title I, Part A, Section 112)

U.S. EPA Hazardous Waste Number (RCRA No.): U066

RCRA 40CFR268.48; 61FR15654, Universal Treatment Standards: Wastewater (mg/L), 0.11; Nonwastewater (mg/kg), 15

RCRA 40CFR264, appendix 9; TSD Facilities Ground Water Monitoring List. Suggested test method(s) (PQL μg/L): 8010 (100); 8240 (5); 8270 (10)

Safe Drinking Water Act: MCL, 0.0002 mg/L; MCLG, zero; Regulated chemical (47FR9352)

Reportable Quantity (RQ): 1 lb (0.454 kg)

EPCRA Section 313 Form R *de minimis* concentration reporting level: 0.1%

European/International Regulations: Hazard Symbol: T, Xn, N; risk phrases: R25; R45(2); R46(1); R48/20/22; R52/53; R60; safety phrases: S2; S53; S61 (see Appendix 1)

Description: DBCP is a flammable amber to brown liquid (a solid below 6°C). Strong, pungent odor. It has an odor and taste threshold at 0.01 mg/L in water. Molecular weight = 236.33; Specific gravity (H_2O:1) = 1.093 @ 14°C; Boiling point = 196°C (decomposes); Freezing/Melting point = 5–6.1°C; Vapor pressure = 0.8 mmHg @ 20°C; Flash point = 77°C. Hazard Identification (based on NFPA-704 M Rating System): Health 2, Flammability 2, Reactivity 0. High solubility in water; solubility = >1000 mg/L.

Incompatibilities: Reacts, possibly violently, with oxidizers and chemically active metals (i.e., aluminum, magnesium and tin alloys). Attacks some rubber materials and coatings; corrosive to some metals.

Permissible Exposure Limits in Air: OSHA PEL: [1910.1044] TWA 0.001 ppm
NIOSH REL: Carcinogen; Limit exposure to lowest feasible concentration
Protective Action Criteria (PAC) Ver. 27[89]
PAC-1: 0.003 ppm
PAC-2: 0.41 ppm
PAC-3: 0.45 ppm
DFG MAK: [skin] Carcinogen Category 2; Germ Cell Mutation Category 2

Permissible Concentration in Water: Federal and State drinking water guidelines: EPA 0.2 μg/L; State Drinking Water Standards: California 0.2 μg/L; Hawaii 0.04 μg/L; State Drinking Water Guidelines: Arizona 0.025 μg/L; Maine 0.25 μg/L.

Determination in Water: By purge-and-trap gas chromatography[47]. Log K_{ow} = 2.43–2.96. Values above 3.0 are likely to bioaccumulate in aquatic organisms.

Routes of Entry: Inhalation, skin absorption, ingestion, skin and/or eye contact

Harmful Effects and Symptoms

Short Term Exposure: Symptoms include severe local irritation to eyes, skin and mucous membranes. Nausea and vomiting may occur after ingestion. Exposure to DBCP can cause headache, nausea, vomiting, weakness, lightheadedness, unconsciousness, and possible death. Higher exposures can cause pulmonary edema, a medical emergency that can be delayed for several hours. This can cause death. Narcotic at high levels of concentration. LD_{50} (oral, rat) = 170 mg/kg; LD_{50} (dermal, rat) = >1000 mg/kg.

Long Term Exposure: The possible effects on the health of employees chronically exposed to repeated or lower expsures of DBCP may include sterility, diminished renal function, and degeneration and cirrhosis of the liver. DBCP is a probable carcinogen in humans. It has been shown to cause stomach, breast, tongue, and nasal cavity cancer in animals. May damage the testes and decrease fertility in males and females. Repeated exposure can damage the eyes, causing clouding of lens or cornea, and cause open sores on the skin, liver and kidney damage.

Points of Attack: Eyes, skin, respiratory system, central nervous system, liver, kidneys, spleen, reproductive system, digestive system. Potential neurotoxin.

Medical Surveillance: This chemical is a suspected or known human carcinogen. Exposed persons should contact a physician for advice regarding the possible long term health effects and advice for medical monitoring. Comprehensive physical examination with emphasis on the genito-urinary tract analysis to include sperm count, motility and morphology. Other tests, such as serum testosterone, serum follicle stimulating hormone (FSH), and serum lutenizing hormone (LH), may be carried out if, in the opinion of a physician, they are indicated. In addition, screening tests of the renal and hepatic systems may be considered. A judgment of the worker's ability to use positive-pressure respirators. In addition, they should be made aware that cancer was produced in some animals. While the relevance of these findings is not yet clearly defined, they do indicate that both employees and employers should do everything possible to minimize exposure to DBCP. Periodic examinations containing the elements of the preplacement or initial examination shall be made available on at least an annual basis. Examinations of current employees shall be made available as soon as practicable after the promulgation of a standard for DBCP. Medical surveillance shall be made available to any worker suspected of having been exposed to DBCP. Pertinent medical records shall be maintained for all employees subject to exposure to DBCP in the workplace. Such records shall be maintained for 30 years and shall be available to medical representatives of the U.S. Government, the employer and the employee.

First Aid: If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least 20–30 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately. If this chemical contacts the skin, remove contaminated clothing and wash immediately with soap and water. Seek medical attention immediately. If this chemical has been inhaled, remove from exposure, begin rescue breathing (using universal precautions) if breathing has stopped, and CPR if heart action has stopped. Transfer promptly to a medical facility. When this chemical has been swallowed, get medical attention. Contact local poison control center for advice about inducing vomiting. Medical observation is recommended for 24 to 48 hours after breathing overexposure, as pulmonary edema may be delayed. As first aid for pulmonary edema, a doctor or authorized paramedic may consider administering a corticosteroid spray.

Personal Protective Methods: Wear protective gloves and clothing to prevent any reasonable probability of dermal contact. Safety equipment suppliers/manufacturers can provide recommendations on the most protective glove/clothing material for your operation. All protective clothing (suits, gloves, footwear, headgear) should be clean, available each day, and put on before work. Contact lenses should not be worn when working with this chemical. Wear splash-proof chemical goggles and face shield unless full facepiece respiratory protection is worn. Employees should wash immediately with soap when skin is wet or contaminated. Provide emergency showers and eyewash.

Note: Protective clothing shall be resistant to the penetration and to the chemical action of dibromochloropropane. Additional protection, including gloves, bib-type aprons, boots, and overshoes, shall be provided for, and worn by, each employee during any operation that may cause direct contact with liquid dibromochloropropane. Supplied-air hoods or suits resistant to penetration by dibromochloropropane shall be worn when entering confined spaces, such as pits, or storage tanks. In situations where heat stress is likely to occur, supplied-air suits, preferably cooled, are recommended. The employer shall ensure that all personal protective clothing is inspected regularly for defects and is maintained in a clean and satisfactory condition by the employee.

Respirator Selection: Engineering controls shall be used wherever needed to keep airborne dibromochloropropane concentrations below the recommended occupational exposure limit. Compliance with this limit may be achieved by the use of respirators under the following conditions only. During the time necessary to install or test the required engineering controls. For nonroutine operations, such as emergency maintenance or repair activities. During emergencies when air concentrations of dibromochloropropane may exceed the recommended occupational exposure limit. When a respirator is permitted, NIOSH recommends the following: *At any detectable concentration:* SCBAF: Pd,Pp (APF = 10,000) (any NIOSH/MSHA- or European Standard EN 149-approved self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode); or SaF: Pd,Pp: ASCBA (APF = 10,000) (any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary, self-contained breathing apparatus operated in a pressure-demand or other positive-pressure mode). *Escape:* GmFOv100 (APF = 50) [any air-purifying, full facepiece respirator (gas mask) with a chin-style, front- or back-mounted organic vapor canister having an N100, R100, or P100 filter]; or SCBAE (any appropriate escape-type, self-contained breathing apparatus).

Storage: Color Code-Blue: Health Hazard/Poison. Store in a secure poison location. Prior to working with DBCP you should be trained on its proper handling and storage. Store in a refrigerator. Protect from alkalis and reactive metals. Protection from light is recommended for long term storage. Where possible, automatically pump liquid from drums or other storage containers to process containers. A regulated, marked area should be established where this chemical is handled, used, or stored in compliance with OSHA Standard 1910.1045.

Shipping: DBCP requires a "poisonous materials" label. It usually falls in Hazard Class 6.1.

Spill Handling: Evacuate and restrict persons not wearing protective equipment from area of spill or leak until clean up is complete. Remove all ignition sources. Ventilate area of spill or leak. Absorb liquids in vermiculite, dry sand, earth, peat, carbon, or a similar material and deposit in sealed containers. Keep this chemical out of a confined space, such as a sewer, because of the possibility of an explosion, unless the sewer is designed to prevent the build-up of explosive concentrations. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable.

Fire Extinguishing: This chemical is a combustible liquid. Hazardous decomposition includes hydrogen bromide. Use dry chemical, carbon dioxide; or foam extinguishers. Vapors are heavier than air and will collect in low areas. Vapors may travel long distances to ignition sources and flashback. Vapors in confined areas may explode when exposed to fire. Containers may explode in fire. Storage containers and parts of containers may rocket great distances, in many directions. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies. From a secure, explosion-proof location, use water spray to cool exposed containers. If cooling streams are ineffective (venting sound increases in volume and pitch, tank discolors, or shows any signs of deforming), withdraw immediately to a secure position. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode.

Disposal Method Suggested: Use incinerator equipped with afterburner and scrubber. Consult with environmental regulatory agencies for guidance on acceptable disposal practices. Generators of waste containing this contaminant (≥100 kg/mo) must conform with EPA regulations governing storage, transportation, treatment, and waste disposal.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- National Institute for Occupational Safety and Health, Criteria for a Recommended Standard: Occupational Exposure to Dibromochloropropane, NIOSH Doc. No. 78-115 (1978)
- Sax, N. I., Ed., "Dangerous Properties of Industrial Materials Report," 1, No. 3, 55-57 (1981)
- New Jersey Department of Health and Senior Services, Hazardous Substance Fact Sheet, "DBCP." Trenton, NJ (June 1998). http://www.state.nj.us/health/eoh/rtkweb/0595.pdf

1,2-Dibromo-2,4-dicyanobutane D:0363

Use Type: Microbiocide
CAS Number: 35691-65-7
Formula: $C_6H_6Br_2N_2$
Synonyms: 2-Bromo-2-(bromomethyl)glutaronitrile; 1-Bromo-1-(bromomethyl)-1,3-propanedicarbonitrile; Dibromodicyanobutane; Glutaronitrile, 2-bromo-2-(bromomethyl)-; Pentanedinitrile, 2-bromo-2-(bromomethyl)-
Trade Names: BIOCHEK®; BIOCLEAR®; MERCK® 48051; METACIDE® 38; METASOL; TEKTAMER
Chemical Class: Nitrile
EPA/OPP PC Code: 111001; (217700 and 218500 are old EPA code numbers)
California DPR Chemical Code: 2313
HSDB Number: 7313
UN/NA & ERG Number: UN3261/154
RTECS® Number: MA5599000

EC Number: 262-281-0

Uses: Tolerances have been established by the U.S. Food and Drug Administration when this substances is used as a preservative in food-grade adhesives and as a slimicide in the manufacture of food-grade paper and paperboard. Used to control slime-forming bacteria and fungi in recirculating water cooling system; oil-recovery drilling mud systems; paper mill and pulp mill water systems and similar industrial processing and chemical systems.

Regulatory Authority and Advisory Information:

EPCRA Section 313 Form R *de minimis* concentration reporting level: 1.0%

WGK (German Aquatic Hazard Class): No value assigned.

Description: Light yellow crystalline solid or powder. Commercial products may be soluble concentrate (liquid or solid); pellets/tablets. Mild, acrid, sweet odor. Molecular weight = 265.93; Specific gravity (H_2O:1) = 0.970 @ 20°C; Freezing/Melting point = 52°C; Vapor pressure = 5.03×10^{-5} @25°C. Henry's Law constant = 3.9×10^{-10} atm-m^3/mol @ 25°C (est)[83]. Slightly soluble in water; solubility 0.212 g/100 mL.

Incompatibilities: Corrosive. Strong oxidizers and reducing agents, strong acids and bases. Reacts with acids, steam, warm water, producing toxic and flammable hydrogen cyanide fumes. Hydrogen cyanide is produced when propionitrile is heated to decomposition.

Determination in Water: Log K_{ow} = <2.0. Unlikely to bioaccumulate in marine organisms.

Routes of Entry: Inhalation, skin absorption, ingestion, skin and/or eye contact.

Harmful Effects and Symptoms

Short Term Exposure: Contact may cause burns to skin and eyes. May affect the iron metabolism, causing asphyxia. It is highly toxic. Forms cyanide in the body. Exposure results in headache, dizziness, rapid pulse, deep-rapid breathing, nausea, vomiting, unconsciousness, convulsions and sometimes death. May cause cyanosis (blue coloration of skin and lips caused by lack of oxygen). LD_{50} (oral, rat) = 0.77 g/kg[83].

Long Term Exposure: Chronic exposure over long periods may cause fatigue and weakness. Can cause same general symptoms as hydrogen cyanide but onset of symptoms is likely to be slower. May cause liver and kidney damage.

Points of Attack: In animals: liver, kidney damage.

Medical Surveillance: Liver and kidney function tests.

First Aid: If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least 15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately. If this chemical contacts the skin, remove contaminated clothing and wash immediately with soap and water. Seek medical attention immediately. If this chemical has been inhaled, remove from exposure, begin rescue breathing (using universal precautions) if breathing has stopped, and CPR if heart action has stopped. Transfer promptly to a medical facility. When this chemical has been swallowed, get medical attention. Give large quantities of water and induce vomiting. Do not make an unconscious person vomit. Use amyl nitrate capsules if symptoms develop. All area employees should be trained regularly in emergency measures for cyanide poisoning and in CPR. A cyanide antidote kit should be kept in the immediate work area and must be rapidly available. Kit ingredients should be replaced every 1–2 years to ensure freshness. Persons trained in the use of this kit, oxygen use, and CPR must be quickly available.

Personal Protective Methods: Wear positive-pressure self-contained breathing apparatus (SCBA). Wear chemical protective clothing that is specifically recommended by the manufacturer. DuPont™ Tychem® Suit Fabrics is recommended by one government source[88]. It may provide little or no thermal protection. Structural firefighters' protective clothing provides limited protection in fire situations ONLY; it is not effective in spill situations where direct contact with the substance is possible.

Respirator Selection: Wherever and whenever workplace conditions warrant respirator use, a respiratory protection program must be followed that meets one or more of the following requirements: OSHA's 29 CFR 1910.134, ANSI Z88.2, or European Standard EN 149.

Spill Handling: For *liquids*, isolate spill or leak area in all directions for at least 50 meters /150 feet. Increase, in the downwind direction, as necessary. Do not touch damaged containers or spilled material unless wearing appropriate protective clothing. Stop leak if you can do it without risk. Prevent entry into waterways, sewers, basements or confined areas. Cover with plastic sheet to prevent spreading. Absorb or cover with dry earth, sand or other non-combustible material and transfer to containers. Do not allow water to get inside containers. For *solids*, isolate spill or leak area in all directions for at least 25 meters/75 feet. Increase, in the downwind direction, as necessary. Do not touch damaged containers or spilled material unless wearing appropriate protective clothing. Stop leak if you can do it without risk. Prevent entry into waterways, sewers, basements or confined areas. Cover with plastic sheet to prevent spreading. Absorb or cover with dry earth, sand or other non-combustible material and transfer to containers. Do not allow water to get inside containers.

Shipping: "Corrosive solid, acidic, orgainc, n.o.s." It falls into Hazard Class 8, and Packing Group II.

Fire Extinguishing: Hazardous decomposition includes poisonous gases, including oxides of nitrogen and carbon and hydrogen bromide gas. *Fire involving storage or vehicular tanks:* isolate for 800 meters/0.5 mile in all directions; also, consider initial evacuation for 800 meters/0.5 mile in all directions. *Small fire:* dry chemical, carbon dioxide or water spray. *Large fire:* dry chemical, carbon dioxide, alcohol-resistant foam or water spray. Move containers from fire area if you can do it without risk. Dike fire-control water for later disposal; do not scatter the material. *Fire involving tanks or car/trailer loads:* fight fire from maximum distance or use unmanned hose holders or monitor nozzles. Do not get water inside containers. Cool containers with flooding quantities of water until well after fire is out. Withdraw immediately in the case of rising sound from venting safety devices or discoloration of tank.

Always stay away from tanks engulfed in fire. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode.

Disposal Method Suggested: Recycle any unused portion of the material for its approved use or return it to the manufacturer or supplier. Ultimate disposal of the chemical must consider: the material's impact on air quality; potential migration in soil or water; effects on animal, aquatic, and plant life; and conformance with environmental and public health regulations[83].

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- U.S. Environmental Protection Agency, "Reregistration Eligibility Decision (RED), Dibromodicyanobutane," Office of Prevention, Pesticides and Toxic Substances, Washington DC (June 1996). http://www.epa.gov/REDs/factsheets/2780fact.pdf

Dicamba D:0420

Use Type: Herbicide

CAS Number: 1918-00-9

Formula: $C_8H_6Cl_2O_3$

Synonyms: AI3-27556; *o*-Anisic acid, 3,6-dichloro-; Benzoic acid, 3,6-dichloro-2-methoxy-; Dicamba benzoic acid herbicide; 3,6-Dichloro-*o*-anisic acid; 2,5-Dichloro-6-methoxybenzoic acid; 3,6-Dichloro-2-methoxybenzoic acid; 3,6-Dichloro-2-methoxybenzoic acid; MDBA; 2-Methoxy-3,6-dichlorobenzoic acid

Trade Names: BANEX®; BANLEN®; BANVEL®; BANVEL 4S®; BANVEL 4WS®; BANVEL CST®; BANVEL HERBICIDE®; BANVEL II HERBICIDE®; BRUSH BUSTER®; BUSHWHACKER®; CADENCE®; CASWELL No. 295®; CLARITY®; COMPOUND B DICAMBA®; DIANATE®; DISTINCT®; DYVEL®; FALLOWMASTER®; FLOWMASTER®; GORDON'S TRIGUARD®; GORDON'S TRI-MEC®; MARKSMAN®; MEDIBEN®; NORTHSTAR®; SUMMIT®; TARGET®; TRACKER®; TROOPER®; VANQUISH®; VELSICOL 58-CS-11®; VELSICOL COMPOUND R®; WEEDMASTER®; YUKON®

Chemical Class: Benzoic acid

EPA/OPP PC Code: 029801

California DPR Chemical Code: 200

HSDB Number: 311

UN/NA & ERG Number: UN3077 (solid)/171;UN3082 (liquid)/171

RTECS® Number: DG7525000

EC Number: 217-635-6 [*Annex I Index No.:* 607-043-00-X]

Uses: Used to control annual and perennial broadleaf weeds in corn, sorghum, small grains, pastures, hay, rangeland, sugarcane, asparagus, turf, grass-seed crops, and non-croplands. It can be applied to the leaves or to the soil. Dicamba controls annual and perennial broadleaf weeds in grain crops and grasslands, and it is used to control brush and bracken in pastures. It will kill broadleaf weeds before and after they sprout. Legumes will be killed by dicamba. In combination with a phenoxyalkanoic acid or other herbicide, dicamba is used in pastures, range land, and non-crop areas such as fence-rows and roadways to control weeds.

U.S. Maximum Allowable Residue Levels for Dicamba and its metabolite, 3,6-dichloro-5-hydroxy-anisic acid [40CFR180.227(a)(1)]: barley, grain 6.0 ppm; barley, hay 2.0 ppm; barley, straw 15.0 ppm; corn, field, forage 3.0 ppm; corn, field, grain 0.1 ppm; corn, field, stover 3.0 ppm; corn, pop, grain 0.1 ppm; corn, pop, stover 3.0 ppm; corn, sweet, forage 0.50 ppm; corn, sweet, kernel plus cob with husks removed 0.04 ppm; corn, sweet, stover 0.50 ppm; corn, undelinted seed 0.2 ppm; Grass, forage, fodder and hay, group 17, forage 125.0 ppm; grass, forage, fodder and hay, group 17, hay 200.0 ppm; millet, proso, forage 90.0 ppm; millet, proso, grain 2.0 ppm; millet, proso, hay 40.0 ppm; millet, proso, straw 30.0 ppm; oat, forage 90.0 ppm; oat, grain 2.0 ppm; oat, hay 40.0 ppm; oat, straw 30.0 ppm; rye, forage 90.0 ppm; rye, grain 2.0 ppm; rye, straw 30.0 ppm; sorghum, grain, forage 3.0 ppm; sorghum, grain 4.0 ppm; sorghum, grain, stover 10.0 ppm; sugarcane, cane 0.1 ppm; sugarcane, molasses 2.0 ppm; wheat, forage 90.0 ppm; wheat, grain 2.0 ppm; wheat, hay 40.0 ppm; wheat, straw 30.0 ppm; ***[40CFR180.227(a)(2)]*** asparagus 4.0 ppm; cattle, fat 0.3 ppm; cattle, kidney 25.0 ppm; cattle, meat 0.25 ppm; cattle, meat byproducts, except kidney 3.0 ppm; goat, fat 0.3 ppm; goat, kidney 25.0 ppm; goat, meat 0.25 ppm; goat, meat byproducts, except kidney 3.0 ppm; hog, fat 0.3 ppm; hog, kidney 25.0 ppm; hog, meat 0.25 ppm; hog, meat byproducts, except kidney 3.0 ppm; horse, fat 0.3 ppm; horse, kidney 25.0 ppm; horse, meat 0.25 ppm; horse, meat byproducts, except kidney 3.0 ppm; milk 0.2 ppm; Sheep, fat 0.3 ppm; sheep, kidney 25.0 ppm; sheep, meat 0.25 ppm; sheep, meat byproducts, except kidney 3.0 ppm; **[*40CFR180.227(a)(3)*]** grain, aspirated fractions 1000 ppm; soybean, hulls 30.0 ppm; soybean, seed 10.0 ppm.

Human toxicity (long-term)[101]: Very low–200.00 ppb, Health Advisory

Fish toxicity (threshold)[101]: Very low–4918.96611 ppb, MATC (Maximum Acceptable Toxicant Concentration)

Regulatory Authority and Advisory Information:

Carcinogenicity: EPA Group D, Not classifiable as a human carcinogen.

Health Advisory: Mutagen, Developmental toxin (TRI)

Acute Oral Category: 3, CAUTION

Potential Ground Water Pollutant [California FAC Section 13145(d)/12811, active], includes sodium, diglycolamine and dimethylamine salts.

Clean Water Act: Section 311 Hazardous Substances/RQ 40CFR117.3 (same as CERCLA, see below)

Safe Drinking Water Act: Priority List (55 FR 1470)

Reportable Quantity (RQ): 1000 lb (454 kg)

EPCRA Section 313 Form R *de minimis* concentration reporting level: 1.0%

European/International Regulations: Hazard Symbol: N; risk phrases: R51/53; safety phrases: S61 (see Appendix 1)

Description: Dicamba is a white or brown nonflammable, colorless solid. Usually dissolved in a liquid (water emulsifiable) carrier. Odorless. Molecular weight = 221.04; Specific gravity (H_2O:1) = 1.57; Boiling point = (decomposes) 195°C; Freezing/Melting point = 114–116°C. Hazard Identification (based on NFPA-704 M Rating System): Health 1, Flammability 0, Reactivity 0. Highly soluble in water. Physical and toxicological properties may be affected by the carrier solvents used in commercial formulations.

Incompatibilities: A strong acid. Incompatible with sulfuric acid, bases, ammonia, aliphatic amines, alkanolamines, isocyanates, alkylene oxides, epichlorohydrin.

Permissible Concentration in Water: Federal Drinking Water Guidelines: 200 ppb[93]; State Drinking Water Guidelines: Florida 210 μg/L; Minnesota 200 μg/L; Arizona 9 μg/L; Wisconsin 300 μg/L.

Determination in Water: A detection limit of 1 ppb for dicamba by electron-capture gas chromatography has been reported by NAS/NRC[46]. Log K_{ow} = <2.5. Unlikely to bioaccumulate in marine organisms.

Routes of Entry: Ingestion, inhalation, and through the skin

Harmful Effects and Symptoms

Short Term Exposure: Dicamba irritates the eyes, skin, and respiratory tract. Exposure can cause nausea, vomiting, loss of appetite and weight, muscle weakness, and exhaustion. The acute toxicity of dicamba is relatively low. Dicamba produced no adverse effect when fed to rats at up to 19.3 mg/kg/day and 25 mg/kg/day in subchronic and chronic studies. The no-adverse-effect dose in dogs was 1.25 mg/kg/day in a 2-year feeding study. Based on these data, an ADI (EPA Acceptable Daily Intake) was calculated at 0.0012 mg/kg/day. LD_{50} (oral, rat) = 1 to >2 g/kg; LD_{50} (dermal, rat) = >1 g/kg.

Long Term Exposure: May cause reproductive and fetal effects. May affect the liver, kidneys. May cause skin sensitization.

Points of Attack: Liver. Reproductive cells.

Medical Surveillance: In addition to comprehensive initial medical and work histories emphasizing reproductive experience and menstrual history, patient should have physical examination and testing of genito-urinary tract, sperm count, motility and morphology. If required, other tests, such as serum testosterone, serum follicle stimulating hormone (FSH), and serum lutenizing hormone (LH), may be indicated. Liver function tests. Evaluation by a qualified allergist, including exposure history and testing, may help diagnose allergy.

First Aid: If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least 15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately. If this chemical contacts the skin, remove contaminated clothing and wash immediately with soap and water. Seek medical attention immediately. If this chemical has been inhaled, remove from exposure, begin rescue breathing (using universal precautions) if breathing has stopped, and CPR if heart action has stopped. Transfer promptly to a medical facility. When this chemical has been swallowed, get medical attention. Give large quantities of water and induce vomiting. Do not make an unconscious person vomit.

Personal Protective Methods: Wear protective gloves and clothing to prevent any reasonable probability of dermal contact. Safety equipment suppliers/manufacturers can provide recommendations on the most protective glove/clothing material for your operation. All protective clothing (suits, gloves, footwear, headgear) should be clean, available each day, and put on before work. Contact lenses should not be worn when working with this chemical. Wear dust-proof chemical goggles and face shield unless full facepiece respiratory protection is worn. Employees should wash immediately with soap when skin is wet or contaminated. Provide emergency showers and eyewash.

Respirator Selection: *At any detectable concentration:* SCBAF: Pd,Pp (APF = 10,000) (any NIOSH/MSHA- or European Standard EN 149-approved self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode); or SaF: Pd,Pp: ASCBA (APF = 10,000) (any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary, self-contained breathing apparatus operated in a pressure-demand or other positive-pressure mode). *Escape:* 100 F (APF = 50) (any air-purifying, full facepiece respirator with an N100, R100, or P100 filter k-mounted organic vapor canister having a high-efficiency particulate filter); or SCBAE (any appropriate escape-type, self-contained breathing apparatus).

Storage: Color Code-Blue: Health Hazard/Poison. Store in a secure poison location. Prior to working with dicamba you should be trained on its proper handling and storage. Store in tightly closed containers in a cool, well ventilated area away from incompatible materials listed above, heat and water.

Shipping: This material may be classified as Environmentally hazardous substances, solid, n. o. s. It usually falls in Hazard Class 9.

Spill Handling: First remove all sources of ignition. Evacuate persons not wearing protective equipment from area of spill or leak until clean up is complete. Remove all ignition sources. Collect powdered material in the most convenient and safe manner and deposit in sealed containers. Ventilate area after clean up is complete. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable.

Fire Extinguishing: Hazardous decomposition includes toxic and corrosive fumes including hydrogen chloride. This chemical is a noncombustible solid. Use extinguishers suitable for surrounding fire. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies. From a secure, explosion-proof location, use water spray to cool exposed containers. If cooling streams are ineffective (venting sound increases in volume and pitch, tank discolors, or shows any signs of deforming), withdraw immediately to a secure position. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode.

Disposal Method Suggested: Land disposal or incineration are disposal options. Containers must be disposed of properly by following package label directions or by contacting your local or federal environmental control agency, or by contacting your regional EPA office.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- EXTOXNET, Extension Toxicology Network, “Pesticide Information Profile, Dicamba,” Oregon State University, Corvallis, OR (June 1996). http://ace.orst.edu/info/extoxnet/pips/dicamba.htm
- USEPA, Office of Pesticide Programs, Pesticide Residue Limits, “Dicamba”, 40 CFR 180.227. http://www.epa.gov/pesticides/food/viewtols.htm
- USEPA, National Pesticide Information Center, “NPIC Technical Fact Shhet, Dicamba,” Washington DC (January 2002). http://npic.orst.edu/factsheets/dicamba_tech.pdf
- USEPA, “Health Advisory: Dicamba,” Washington DC, Office of Drinking Water (August 1987)
- New Jersey Department of Health and Senior Services, Hazardous Substance Fact Sheet, “Dicamba,” Trenton, NJ (January 1999). http://www.state.nj.us/health/eoh/rtkweb/0634.pdf
- Bunch, T. R; Gervais, J. A.; Buhl, K.; Stone, D., *Dicamba Technical Fact Sheet*; National Pesticide Information Center, Oregon State University Extension Services, Corvallis, OR (2012)

Dichlobenil D:0423

Use Type: Herbicide

CAS Number: 1194-65-6

Formula: $C_7H_3Cl_2N$

Synonyms: Benzonitrile, 2,6-dichloro-; DCBN; DBN; 2,6-DBN; DCB; Decabane; 2,6-Dichlorobenzonitrile; 2,6-Dichlorocyanobenzene

Trade Names: BARRIER®; BH Prefix D®; CARSORON®; CASORON® 133; CARSORON® G; CARSORON® G4; CARSORON® G20-SR; CODE H 133®; DECABANE®; DU-SPREX®; DYCLOMEC®; FYDULAN; FYDUMAS; FYDUSIT; H 133®; H 1313®; NIA 5996®; NIAGARA® 5006; NIAGARA 5,996; NOROSAC®; PREFIX D®

Chemical Class: Substituted benzene; Benzonitrile

EPA/OPP PC Code: 027401

California DPR Chemical Code: 112

HSDB Number: 312

UN/NA & ERG Number: UN3077 (solid)/171

RTECS® Number: DI3500000

EC Number: 214-787-5 [*Annex I Index No.:* 608-015-00-X]

Uses: Dichlobenil is a herbicide used on cranberry bogs, dichondra, ornamentals, blackberry, raspberry, and blueberry fields, apple, pear, filbert and cherry orchards, vineyards, hybrid poplar-cottonwood plantations, and rights-of-way to control weeds; and sewers to remove roots. It acts on dandelion, prickly oxtongue (pre-emergence), and tree roots. Not approved for use in EU countries[115]. Actively registered in the U.S.

U.S. Maximum Allowable Residue Levels for Dichlobenil and its metabolite, 2,6-dichlorobenzamide (40 CFR 180.231): apple 0.5 ppm; blackberry 0.1 ppm; blueberry 0.15 ppm; cranberry 0.1 ppm; filbert 0.1 ppm; fruit, stone, group 12, 0.15 ppm; grape 0.15 ppm; pear 0.5 ppm; raspberry 0.1 ppm.

Human toxicity (long-term)[101]: High–9.10 ppb, Health Advisory

Fish toxicity (threshold)[101]: Very low–973.64357 ppb, MATC (Maximum Acceptable Toxicant Concentration)

Regulatory Authority and Advisory Information:

Carcinogenicity: EPA Group C, Possible human carcinogen

Acute Oral Category: 4, Caution

Potential Ground Water Pollutant [California FAC Section 13145(d)/12811, active]

Clean Water Act: Section 311 Hazardous Substances/RQ (same as CERCLA)

EPCRA Section 304 RQ: CERCLA, 100 lb (45.4 kg)

European/International Regulations: Hazard Symbol: Xn, N; risk phrases: R21; R50/R53; safety phrases: S2; S36/37; S61 (see Appendix 1)

Description: White solid. Molecular weight = 172.01; Boiling point = 269°C; Boiling point = decomposes @ 120°C before boiling; Freezing/Melting point = 143–146°C; Vapor pressure = 1×10^{-3} mmHg @ 25. Practically insoluble in water; solubility = 18 ppm @ 20°C.

Determination in Air: Filter; none; Gravimetric; NIOSH IV [Particulates NOR; #0500 (total), #0600 (respirable)][18].

Permissible Concentration in Water: Federal Drinking Water Guidelines: 9 ppb[14].

Determination in Water: Log K_{ow} = 2.6–2.7. Unlikely to bioaccumulate in marine organisms.

Routes of Entry: Absorbed by dry skin and inhalation.

Harmful Effects and Symptoms

Short Term Exposure: Contact can irritate the skin and eyes. Inhalation may irritate the nose and throat. High exposure can cause headache, dizziness, a drop in blood pressure, rapid pulse, loss of appetite, seizures, coma and death. Repeated high exposure may result in a loss of smell, acne-like rash. LD_{50} (oral, rat) = >2500 mg/kg. Moderately toxic.

Points of Attack: Eyes, skin, liver and kidneys.

Medical Surveillance: This chemical is a suspected or known human carcinogen. Exposed persons should contact a physician for advice regarding the possible long term health effects and advice for medical monitoring. Preliminary medical exam to detect chronic diseases of central nervous system, liver, heart, kidneys, lung and skin, as well as endocrinological or immunological disturbances, should protect susceptible individuals. Periodical medical exams of internal organs, skin and eyes are important to avoid chronic occupational intoxications. They should include lab and patch tests when necessary[83].

First Aid: If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least 15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately. If this chemical contacts the skin, remove contaminated clothing and wash immediately with soap and water. Seek medical attention immediately. If this chemical has been inhaled, remove from exposure, begin rescue breathing (using universal precautions) if breathing has stopped, and CPR if heart action has stopped. Transfer promptly to a medical facility. When this chemical has been swallowed, get medical attention. Give large quantities of water and induce vomiting. Do not make an unconscious person vomit. Do not induce vomiting when formulations containing petroleum solvents are ingested

Personal Protective Methods: Wear protective gloves and clothing to prevent any reasonable probability of dermal contact. Safety equipment suppliers/manufacturers can provide recommendations on the most protective glove/clothing material for your operation. All protective clothing (suits, gloves, footwear, headgear) should be clean, available each day, and put on before work. Contact lenses should not be worn when working with this chemical. Wear dust-proof chemical goggles and face shield unless full facepiece respiratory protection is worn. Employees should wash immediately with soap when skin is wet or contaminated. Provide emergency showers and eyewash.

Respirator Selection: *At any detectable concentration:* SCBAF: Pd,Pp (APF = 10,000) (any NIOSH/MSHA- or European Standard EN 149-approved self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode); or SaF: Pd,Pp: ASCBA (APF = 10,000) (any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary, self-contained breathing apparatus operated in a pressure-demand or other positive-pressure mode). *Escape:* 100 F (APF = 50) (any air-purifying, full facepiece respirator with an N100, R100, or P100 filter k-mounted organic vapor canister having a high-efficiency particulate filter); or SCBAE (any appropriate escape-type, self-contained breathing apparatus).

Storage: Color Code-Blue: Health Hazard/Poison. Store in a secure poison location. Prior to working with dichlobenil, you should be trained on its proper handling and storage. Store in tightly closed containers in a cool, well-ventilated area away from incompatible materials listed above, heat and water.

Shipping: This material may be classified as Environmentally hazardous substances, solid, n. o. s. It usually falls in Hazard Class 9.

Spill Handling: First remove all sources of ignition. Evacuate persons not wearing protective equipment from area of spill or leak until clean up is complete. Remove all ignition sources. Collect powdered material in the most convenient and safe manner and deposit in sealed containers. Ventilate area after clean up is complete. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable.

Fire Extinguishing: This chemical is a noncombustible solid. Use extinguishers suitable for surrounding fire. Hazardous decomposition includes oxides of nitrogen, hydrogen cyanide, hydrogen. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies. From a secure, explosion-proof location, use water spray to cool exposed containers. If cooling streams are ineffective (venting sound increases in volume and pitch, tank discolors, or shows any signs of deforming), withdraw immediately to a secure position. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode.

Disposal Method Suggested: Land disposal or incineration are disposal options. Containers must be disposed of properly by following package label directions or by contacting your local or federal environmental control agency, or by contacting your regional EPA office.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- New Jersey Department of Health and Senior Services, *Hazardous Substance Fact Sheet, Dichlobenil*, Trenton, NJ (October 2000). http://www.state.nj.us/health/eoh/rtkweb/0636.pdf
- USEPA, "Reregistration Eligibility Decision (RED), Dichlobenil" Office of Prevention, Pesticides and Toxic Substances, Washington DC (October 1998). http://www.epa.gov/REDs/0263red.pdf

- USEPA, Office of Pesticide Programs, Pesticide Residue Limits, "Dichlobenil", 40 CFR 180.231. http://www.epa.gov/pesticides/food/viewtols.htm

Dichlone D:0425

Use Type: Fungicide
CAS Number: 117-80-6
Formula: $C_{10}H_4Cl_2O_2$
Synonyms: 2,3-Dichloro-1,4-naphthalenedione; 2,3-Dichloro-1, 4-naphthoquinone; Dichloronaphthoquinone; 2,3-Dichloronaphthoquinone; 2.3-Dichloro-α-naphthoquinone; 2,3-Dichloronaphthoquinone-1,4; Diclone; ENT 3,776; 1,4-Napthalenedione, 2,3-dichloro-
Trade Names: ALGISTAT®; COMPOUND 604®; PHYGON®; PHYGON® PASTE; PHYGON® SEED PROTECTANT; PHYGON® XL; QUINTAR®; QUINTAR® 540 F; SANQUINON®; UNIROYAL® 604; USR® 604; U.S. RUBBER® 604
Chemical Class: Quinone
EPA/OPP PC Code: 029601
California DPR Chemical Code: 202
HSDB Number: 313
UN/NA & ERG Number: UN2902 (liquid)/151
RTECS® Number: QL7525000
EC Number: 204-210-5 [*Annex I Index No.:* 606-018-00-0]
Uses: Not currently registered in the U.S. Not approved for use in the EU. Dichlone is used as a fungicide for foliage and to control blue algae in ponds, swimming pools and lakes. As a substitute for copper and sulfur to control rot on fruit trees, vegetables, field crops, ornamentals, resident and commercial outdoor areas.
Human toxicity (long-term)[101]: Very low–560.00 ppb, Health Advisory
Fish toxicity (threshold)[101]: High–4.56263 ppb, MATC (Maximum Acceptable Toxicant Concentration)
Regulatory Authority and Advisory Information:
Poison (oral) Category: 2, WARNING
Clean Water Act: Section 311 Hazardous Substances/RQ (same as CERCLA)
EPCRA Section 304 RQ: CERCLA, 1 lb (0.454 kg)
European/International Regulations: Hazard Symbol: Xi, Xn, N; risk phrases: R/22; R36/38; R50/53; safety phrases: S2; S26; S60; S61 (see Appendix 1)
Description: Golden-yellow crystals, leaflets, or needles from alcohol. Usually dissolved in a liquid carrier. Molecular weight = 227.04; Boiling point = (sublimes) 275°C @ 2 mmHg; Freezing/Melting point = 193°C; Vapor density = 7.8; Vapor pressure = 8.2 mmHg @ 20°C. Practically insoluble in water; solubility = <0.1 mg/L @ 25°C.
Incompatibilities: May react with strong oxidizers such as chlorates, peroxides, nitrates, etc.
Determination in Water: EPA Method D3086. GC method with ECD for the determination of organochlorine pesticides in water and wastewater. Log K_{ow} = <2.5. Unlikely to bioaccumulate in marine organisms. The primary hazard of this fungicide is the threat to the environment. It can easily penetrate the soil and contaminate groundwater and nearby streams.
Routes of Entry: Dangerous through all routes of contact. Absorbed through intact skin.
Harmful Effects and Symptoms
Short Term Exposure: Central nervous system depressant. Irritating to eyes, skin, mucous membranes. Large doses can cause central nervous system depression, dizziness, weakness, headache, nausea, vomiting, and difficult breathing. Apprehension, anxiety, confusion, nervous excitation; dizziness; headache; numbness and weakness in limbs; muscle twitching, tremors; nausea and vomiting; slow, shallow respiration, bluish face; convulsions; loss of consciousness; breathing stops; death. At fire temperatures can produce coughing, choking, difficult breathing, and cyanosis. LD_{50} (oral, rat) = <500 mg/kg; LD_{50} (dermal, rabbit) = >300 mg/kg.
Long Term Exposure: Irritating to the skin; may cause dermatitis. May cause tumors.
Points of Attack: Skin, central nervous system.
Medical Surveillance: Medical observation is recommended for 24 to 48 hours after breathing overexposure, as pulmonary edema may be delayed. As first aid for pulmonary edema, consider administering a corticosteroid spray. Cigarette smoking may exacerbate pulmonary injury and should be discouraged for at least 72 hours following exposure.
First Aid: Speed in removing material from eyes and skin is of extreme importance. *Eyes:* Eye contact can cause dangerous amounts of these chemicals to be quickly absorbed through the mucous membrane into the bloodstream. Directly, irrigate with large amounts of plain, tepid water or saline for 20 minutes, occasionally lifting the lower and upper lids. During this time, remove contact lenses, if easily removable without additional trauma to the eye. Get medical aid immediately. Have physician check for possible delayed damage. *Skin:* Get medical aid. Dermal contact can cause dangerous amounts of these chemicals to be absorbed into the bloodstream. Wearing the appropriate PPE equipment and respirator for organochlorine pesticides, immediately flush exposed skin, hair, and under nails with plain, running, tepid water for 20 minutes, then wash twice with mild soap. Shampoo hair promptly if contaminated; protect eyes. Do not scrub skin or hair, since this can increase absorption through the skin. Rinse thoroughly with water. Victims who are able and cooperative may assist with their own decontamination. Remove and double-bag contaminated clothing and personal belongings. Leather absorbs many organochlorines; therefore, items such as leather shoes, gloves, and belts should be discarded. If the skin is swollen or inflamed, cool affected areas with cold compresses. *Ingestion:* Call poison control. Loosen all clothing. Never give anything by mouth to an unconscious person. Get medical aid. Do NOT induce vomiting. The patient is at risk of central nervous system depression or seizures, which may lead to pulmonary aspiration during vomiting. If the victim is conscious and

able to swallow, *administer an aqueous slurry of activated charcoal at 1 g/kg (usual adult dose 60–90 g, child dose 25–50 g). A soda can and straw may be of assistance when offering charcoal to a child. The efficacy of activated charcoal for some organochlorine poisoning (such as chlordane) is uncertain. If victim is *UNCONSCIOUS OR HAVING CONVULSIONS,* do nothing except keep victim warm. **In some cases you may be specifically instructed by poison control to induce vomiting by way of 2 tablespoons of syrup of ipecac (adult) washed down with a cup of water. Do NOT give activated charcoal* before or with *ipecac syrup. Inhalation:* Get medical aid. Do not contaminate yourself. Wearing the appropriate PPE equipment and respirator for organochlorine pesticides, immediately remove the victim from the contaminated area to fresh air. For inhalation exposures, monitor for respiratory distress. If the victim is not breathing, administer artificial respiration. Do not use mouth-to-mouth method if victim ingested or inhaled the substance; give artificial respiration with the aid of a pocket mask equipped with a one-way valve or other proper respiratory medical device. If cough or breathing difficulty develops, evaluate for respiratory tract irritation, bronchitis, or pneumonitis. If breathing is difficult, administer 100% humidified supplemental oxygen through bag/mask apparatus until medical help arrives. Do not leave victim unattended

Personal Protective Methods: Wear protective gloves and clothing to prevent any reasonable probability of dermal contact. Any barrier will prevent contamination from the dry chemical. Also, safety equipment suppliers/manufacturers can provide recommendations on the most protective glove/clothing material for your operation. All protective clothing (suits, gloves, footwear, headgear) should be clean, available each day, and put on before work. Contact lenses should not be worn when working with this chemical. Wear dust-proof chemical goggles and face shield unless full facepiece respiratory protection is worn. Employees should wash immediately with soap when skin is wet or contaminated. Provide emergency showers and eyewash.

Respirator Selection: NIOSH: *At any concentrations above the NIOSH REL, or where there is no REL, at any detectable concentration:* SCBAF: Pd, Pp (APF = 10,000) (any self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode); or SaF: Pd,Pp: ASCBA (APF = 10,000) (any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary self-contained breathing apparatus operated in a pressure-demand or other positive-pressure mode). *Escape:* GmFOv100 (APF = 50) [any air-purifying, full facepiece respirator (gas mask) with a chin-style, front- or back-mounted organic vapor canister having an N100, R100, or P100 filter]; or SCBAE (any appropriate escape-type, self-contained breathing apparatus).

Storage: Color Code-Blue: Health Hazard/Poison. Store in a secure poison location. Do not store in iron containers. Prior to working with DDT you should be trained on its proper handling and storage. Store in tightly closed containers in a cool, well-ventilated area away from strong oxidizers, strong bases, and heat. Should not be stored in iron containers. A regulated, marked area should be established where this chemical is handled, used, or stored in compliance with OSHA Standard 1910.1045.

Shipping: Pesticides liquid or solid, toxic, n.o.s. requires a shipping label of "poisonous materials" and falls in DOT Hazard Class 6.1. Technical name required.

Spill Handling: First remove all sources of ignition. Evacuate persons not wearing protective equipment from area of spill or leak until clean up is complete. Do not dry sweep. Use vacuum (use special HEPA vac, NOT a standard shop-vac) or a wet method to reduce dust during clean up. Collect powdered material in the most convenient and safe manner and deposit in sealed containers. Ventilate area after clean up is complete. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable.

Fire Extinguishing: Hazardous decomposition includes oxides of carbon and hydrogen chloride gas. *On a small fire:* use dry chemical, CO_2 or water spray. *On a large fire:* use water spray, fog or regular foam. Move containers from fire area if you can do it without risk. Dike fire-control water for later disposal; do not scatter the material. Use water spray or fog; do not use straight streams. *Fire involving tanks or car/trailer loads*: if tank, rail car or tank truck is involved in a fire, isolate for 800 meters/0.5 mile in all directions; also, consider initial evacuation for 800 meters/0.5 mile in all directions. Fight fire from maximum distance or use unmanned hose holders or monitor nozzles. Do not get water inside containers. Cool containers with flooding quantities of water until well after fire is out. Withdraw immediately in the case of rising sound from venting safety devices or discoloration of tank. ALWAYS stay away from tanks engulfed in fire. For massive fire, use unmanned hose holders or monitor nozzles; if this is impossible, withdraw from area and let fire burn. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies.

Disposal Method Suggested: If allowed, incineration with effluent gas scrubbing is recommended. Containers must be disposed of properly by following package label directions or by contacting your local or federal environmental control agency, or by contacting your regional EPA office. In accordance with 40CFR165, follow recommendations for the disposal of pesticides and pesticide containers.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- Pesticide Management Education Program, "Dichlone (Phygon, Quintar) Chemical Profile 2/85," Cornell University, Ithaca, NY (February 1985). http://pmep.cce.cornell.edu/profiles/fung-nemat/aceticacid-etridiazole/dichlone/fung-prof-dichlone.html
- New Jersey Department of Health and Senior Services, "Hazardous Substance Fact Sheet, Dichlone," Trenton, NJ (March 2001). http://www.state.nj.us/health/eoh/rtkweb/0637.pdf

Dichloran D:0427

Use Type: Fungicide

CAS Number: 99-30-9

Formula: $C_6H_4Cl_2N_2O_2$; $Cl_2C_6H_2(NO_2)NH_2$

Synonyms: AI3-08870; AI-50; Aniline, 2,6-dichloro-4-nitro-; Benzenamine, 2,6-dichloro-4-nitro-; Caswell No. 311; CDNA; CNA; DCNA; 2,6-Dichloro-4-nitroaniline; 2,6-Dichloro-4-nitrobenzenamine; Dicloran; 4-Nitroaniline, 2,6-dichloro-; 4-Nitro-2,6-dichloroaniline

Trade Names: AL-50®; ALLISAN®; BORTRAN®; BOTRAN®; DITRANIL®; FUMITE DICLORAN SMOKE ACARICIDE®; RESISAN®; RD-6584®; U-2069®

Chemical Class: Substituted benzene; Chlorophenyl

EPA/OPP PC Code: 031301

California DPR Chemical Code: 81

HSDB Number: 1570

UN/NA & ERG Number: UN2811/154; UN3077 (solid)/171

RTECS® Number: BX2975000

EC Number: 202-746-4

Uses: Used to control fungi on a variety of crops. The top crop usages in California are on celery, head lettuce, and grapes (table, wine and raisin). Not approved for use in EU countries[115]. Actively registered in the U.S. Sixty-five global suppliers[97].

U.S. Maximum Allowable Residue Levels for Dicloran (40 CFR 180.200): apricot, post-harvest 20 ppm; bean, snap, succulent 20 ppm; celery 15 ppm; cherry, sweet, post-harvest 20 ppm; cucumber 5 ppm; endive 10 ppm; garlic 5 ppm; grape 10 ppm; lettuce 10 ppm; nectarine, post-harvest 20 ppm; onion 10 ppm; peach, post-harvest 20 ppm; plum, fresh prune, post-harvest 15 ppm; potato 0.25 ppm; rhubarb 10 ppm; sweet potato, roots, post-harvest 10 ppm; tomato 5 ppm.

Regulatory Authority and Advisory Information:

Health Advisory: Mutagen, Developmental toxin (TRI)

Acute Oral Category: 3, CAUTION

Potential Ground Water Pollutant [California FAC Section 13145(d)/12811, active]

EPCRA Section 313 Form R *de minimus* concentration reporting level: 1.0%

European/International Regulations: Hazard Symbol: Xi; risk phrases: R36/R37/38; safety phrases: S26; S27/39 (see Appendix 1)

Description: Dicloran is a yellow crystalline solid or power. Odorless. Molecular weight = 207.01; Boiling point = (decomposes); Freezing/Melting point = 193–195°C. Hazard Identification (based on NFPA-704 M Rating System): Health 2, Flammability 0, Reactivity 0. Low solubility in water; solubility = 1 g/L @ 60°C.

Incompatibilities: Keep away from strong oxidizing agents, strong acids; acid anhydrides; acid chlorides; acetic anhydride; carbon dioxide.

Determination in Water: Log K_{ow} = 2.80. Values above 3.0 are likely to bioaccumulate in aquatic organisms.

Harmful Effects and Symptoms

Short Term Exposure: Contact with eyes or skin: may be fatal if absorbed through skin; may cause skin irritation. Inhalation should be avoided; may cause respiratory tract irritation. May be harmful and possibly fatal, if swallowed. LD_{50} (oral, rat) = >2000 mg/kg.

Routes of Entry: Inhalation, ingestion, skin absorption.

Long Term Exposure: May cause tumors, reproductive and fetal effects.

Points of Attack: Eyes, liver, blood, central nervous system, spleen, liver. Reproductive cells.

Medical Surveillance: In addition to comprehensive initial medical and work histories emphasizing reproductive experience and menstrual history, patient should have physical examination and testing of genito-urinary tract, sperm count, motility and morphology. If required, other tests, such as serum testosterone, serum follicle stimulating hormone (FSH), and serum lutenizing hormone (LH), may be indicated.

First Aid: If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least 15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately. If this chemical contacts the skin, remove contaminated clothing and wash immediately with soap and water. Seek medical attention immediately. If this chemical has been inhaled, remove from exposure, begin rescue breathing (using universal precautions) if breathing has stopped, and CPR if heart action has stopped. Transfer promptly to a medical facility. When this chemical has been swallowed, get medical attention. Give large quantities of water and induce vomiting. Do not make an unconscious person vomit. Do not induce vomiting when formulations containing petroleum solvents are ingested.

Storage: Color Code-Blue: Health Hazard/Poison. Store in a secure poison location. Prior to working with this chemical you should be trained on its proper handling and storage. Store in tightly closed containers in a cool, well-ventilated area away from strong oxidizers. Where possible, automatically transfer material from drums or other storage containers to process containers. Sources of ignition, such as smoking and open flames, are prohibited where this chemical is handled, used, or stored. Metal containers involving the transfer of this chemical should be grounded and bonded. Wherever this chemical is used, handled, manufactured, or stored, use explosion-proof electrical equipment and fittings.

Shipping: Toxic, solids, organic, n.o.s. require a label of "poisonous materials." This material falls in Hazard Class 6.1 and Packing Group III.

Spill Handling: First remove all sources of ignition. Evacuate persons not wearing protective equipment from area of spill or leak until clean up is complete. As an immediate precautionary measure, isolate spill or leak area in all directions for at least 50 meters/150 feet for liquids and at least 25 meters/75 feet for solids. Increase, in the downwind direction, as necessary, the isolation distance shown above. Eliminate all ignition sources (no smoking, flares, sparks or flames in immediate area). Do not touch damaged containers or spilled material unless wearing appropriate protective clothing. Stop leak if you can do it without risk. Prevent entry into waterways, sewers, basements or confined areas. Absorb or cover with dry earth, sand or other non-combustible material and transfer to containers. Do not get water inside containers. Soil Adsorption Index (K_{oc}) = 5000 (estimate).

Fire Extinguishing: Decomposes above 350°C emitting oxides of nitrogen and carbon and hydrogen chloride gas. *Fire involving storage or vehicular tanks:* isolate for 800 meters/0.5 mile in all directions; also, consider initial evacuation for 800 meters/0.5 mile in all directions. *Small fire:* dry chemical, carbon dioxide or water spray. *Large fire:* dry chemical, carbon dioxide, alcohol-resistant foam or water spray. Move containers from fire area if you can do it without risk. Dike fire-control water for later disposal; do not scatter the material. *Fire involving tanks or car/trailer loads:* fight fire from maximum distance or use unmanned hose holders or monitor nozzles. Do not get water inside containers. Cool containers with flooding quantities of water until well after fire is out. Withdraw immediately in the case of rising sound from venting safety devices or discoloration of tank. Always stay away from tanks engulfed in fire. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode.

Disposal Method Suggested: Consult with a licensed waste disposal service or environmental regulatory agencies for guidance on acceptable disposal practices. Dissolve or mix material with a combustible solvent and burn in a chemical incinerator equipped with an afterburner and scrubber.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- USEPA, Office of Pesticide Programs, Pesticide Residue Limits, "Dicloran", 40 CFR 180.200. http://www.epa.gov/pesticides/food/viewtols.htm

para-Dichlorobenzene D:0465

Use Type: Insecticide, Rodenticide, Fungicide
CAS Number: 106-46-7
Formula: $C_6H_4Cl_2$
Synonyms: *p-DCB:* 1,4-DCB: Benzene, 1,4-dichloro-; Benzene, *p*-dichloro-; *p*-Chlorophenyl chloride; PDCB; Dichloricide; 1,4-Diclorobenceno (Spanish); *p*-Diclorobenceno (Spanish); *p*-Dichlorobenzene; Paradichlorobenzene
Trade Names: DowTHERM®; EVOLA; PARACIDE®; PARA CRYSTALS®; PARADI®; PARADOW®; PARAMOTH®; PARANUGGETS®; PARAZENE®; PERSIA-PERAZOL®; SANTOCHLOR®; *Mixed isomers:* DILATIN DBI®; MOTTENSCHUTZMITTEL EVAU P®; MOTT-EX®; TOTAMOTT®
Chemical Class: Halogenated organic compound
EPA/OPP PC Code: 061501
California DPR Chemical Code: 455
HSDB Number: 523
UN/NA & ERG Number: UN3077 (solid)/171; IMO 6.1
RTECS® Number: CZ4550000
EC Number: 203-400-5 [*Annex I Index No.:* 602-035-00-2]

Uses: *p*-Dichlorbenzene is used primarily as an air deodorant, as moth balls, and in insecticides, which accounts for 90% of the total production of this isomer. Information is not available concerning the production and use of *m*-DCB. However, it may occur as a contaminant of *o*- or *p*-DCB formulations. Both *o*- and *p*-isomers are produced almost entirely as byproducts during the production of monochlorobenzene. The major uses of *o*-DCB are as a process solvent in the manufacturing of toluene diisocyanate and as an intermediate in the synthesis of dyestuffs, herbicides, and degreasers. The *para*-isomer of dichlorobenzene is the isomer most prominently used in agriculture. Not listed for use in EU countries[115].

Regulatory Authority and Advisory Information:

Carcinogenicity: EPA Group C, Possible human carcinogen; EU GHS Category 2: Suspected human carcinogen; ACGIH A3 Confirmed animal carcinogen with unknown relevance to humans
California Proposition 65 Chemical: Carcinogen (1/1/1989)
Health Advisory: Mutagen, Developmental/Reproductive Toxin, Skin irritant/sensitizer
Acute Oral Category: 3, CAUTION
List of priority pollutants (U.S. EPA)
Clean Air Act: Hazardous Air Pollutants (Title I, Part A, Section 112)
Clean Water Act: Section 311 Hazardous Substances/RQ 40CFR423, Appendix A, Priority Pollutants; Section 313 Water Priority Chemicals (57FR41331, 9/9/92); Toxic Pollutant (Section 401.15)
EPA Hazardous Waste Number (RCRA No.): U072; D027
RCRA Toxicity Characteristic (Section 261.24), Maximum Concentration of Contaminants, regulatory level, 7.5 mg/L
RCRA 40CFR268.48; 61FR15654, Universal Treatment Standards: Wastewater (mg/L), 0.090; Nonwastewater (mg/kg), 6.0

RCRA 40CFR264, Appendix 9; TSD Facilities Ground Water Monitoring List. Suggested test method(s) (PQL *u*g/L): 8010(2); 8020(5); 8120(15); 8270(10)

Safe Drinking Water Act: MCL, 0.075 mg/L; MCLG, 0.075 mg/L; Regulated chemical (47 FR 9352)

Superfund/EPCRA 40CFR302.4 RQ: CERCLA, 100 lb (45.4 kg)

EPCRA Section 313 Form R *de minimus* concentration reporting level: 0.1%

U.S. DOT Regulated Marine Pollutant (49CFR172.101, Appendix B)

European/International Regulations: Hazard Symbol: Xi, Xn, N; risk phrases: R36; R40; R50/53; safety phrases: S2; S36/37; S46; S60; S61 (see Appendix 1)

WGK (German Aquatic Hazard Class): 2-Hazard to waters.

Description: *p*-DCB is a colorless or white solid. Mothball-like odor. May be available commercially as a liquid. Odor threshold = 0.18 ppm. Molecular weight = 147; Specific gravity (H_2O:1) = 1.248 @ 55°C; Boiling point = 174°C; Freezing/Melting point = 53.1°C; Vapor pressure = 0.75 mmHg @ 8°C;. Flash point = 66°C. Explosive limits: LEL = 1.7%; UEL = 5.9%. Hazard Identification (based on NFPA-704 M Rating System): Health 2, Flammability 2, Reactivity 0. Soluble in water; solubility = 80 mg/L.

Incompatibilities: Strong oxidizers; although, incompatibilities for this chemical may also include other materials listed for *o*-DCB.

Permissible Exposure Limits in Air: NIOSH IDLH: [Ca] 150 ppm

OSHA PEL: 75 ppm/450 mg/m^3 TWA

NIOSH REL: Potential carcinogen. Limit exposure to lowest feasible level; See *NIOSH Pocket Guide*, Appendix A

ACGIH TLV®[1]: 10 ppm/60 mg/m^3 TWA; confirmed animal carcinogen with unknown relevance to humans.

Protective Action Criteria (PAC) Ver. 27[89]

PAC-1: 10 ppm
PAC-2: 10 ppm
PAC-3: 1000 ppm

DFG MAK: [skin] Carcinogen Category 2; Pregnancy Risk Group 3B; BAT suspended 2003

The Minimal Risk Level (MRL) for acute inhalation exposure to paradichlorobenzene has been set at 2 ppm.

Determination in Air: Charcoal adsorption followed by CS_2 workup and gas chromatographic analysis. See NIOSH Method 1003 for halogenated hydrocarbons[18].

Permissible Concentration in Water: EPA, Federal Drinking Water Guidelines: EPA 75 μg/L; State Drinking Water Standards: California 5 μg/L; Massachusetts 5 μg/L; State Drinking Water Guidelines: Arizona 75 μg/L; Maine 21 μg/L; Minnesota 10 μg/L.

Determination in Water: Gas chromatography (EPA Methods 601, 602, 612) or gas chromatography plus mass spectrometry (EPA Method 625). Gas-chromatographic methods have been developed for PDB with a sensitivity of 380 pg/cm peak high, and PDB concentrations as low as 1.0 ppb in water have been analyzed according to NAS/NRC. Log K_{ow} = 3.36–3.44. Values at or above 3.0 are likely to bioaccumulate in marine organisms.

Routes of Entry: Inhalation, ingestion, eye and dermal contact.

Harmful Effects and Symptoms

Human exposure to dichlorobenzene is reported to cause hemolytic anemia and liver necrosis, and 1,4-dichlorobenzene has been found in human adipose tissue. In addition, the dichlorobenzenes are toxic to nonhuman mammals, birds, and aquatic organisms and impart an offensive taste and odor to water. The dichlorobenzenes are metabolized by mammals, including humans, to various dichlorophenols, some of which are as toxic as the dichlorobenzenes. Exposure can damage blood cells. Contact can cause irritation of the skin and eyes. Prolonged contact can cause severe burns. It may damage the liver, kidneys and lungs. Exposure can cause headache, dizziness, swelling of the eyes, hands and feet, and nausea. Higher levels can cause severe liver damage and death. Persons with preexisting pathology (hepatic, renal, central nervous system, blood) or metabolic disorders, who are taking certain drugs (hormones or otherwise metabolically active), or who are otherwise exposed to DCBs or related (chemically or biologically) chemicals by such means as occupation, or domestic use or abuse (e. g., pica or "sniffing") of DCB products, might well be considered at increased risk from exposure to DCBs.

Short Term Exposure: *p*-DCB can be absorbed through the skin, thereby increasing exposure. Exposure can cause headache, dizziness, nausea, swelling of the hands and feet. Contact with the dust can irritate and burn the eyes and skin. Skin allergy may develop. LD_{50} (oral, rat) = >500 mg/kg; LD_{50} (dermal, rat) = >5 g/kg.

Long Term Exposure: *p*-DCB may be carcinogenic to humans; it causes kidney and liver cancer in animals. There is a suggested association between this chemical and leukemia. May cause tumors. There is evidence that *p*-DCB can damage the developing animal fetus. Repeated exposure can damage the nervous system, cause skin allergy and damage the lungs, liver, and kidneys. *p*-DCB may affect the blood and cause hemolytic anemia.

Points of Attack: Liver, respiratory system, eyes, kidneys, skin. Reproductive cells.

Medical Surveillance: This chemical is a suspected or known human carcinogen. Exposed persons should contact a physician for advice regarding the possible long term health effects and advice for medical monitoring. For those with frequent or potentially high exposure (half the TLV or greater, or significant dermal contact) the following are recommended before beginning work and at regular times after that: Liver, kidney and lung function tests. Complete blood count. If symptoms develop or overexposure is suspected, the following may be useful: Evaluation by a qualified allergist, including exposure history and testing, may help diagnose allergy.

First Aid: If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least 15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately. If this chemical contacts the skin, remove contaminated clothing and wash immediately with soap and water. Seek medical attention immediately. If this chemical has been inhaled, remove from exposure, begin rescue breathing (using universal precautions) if breathing has stopped, and CPR if heart action has stopped. Transfer promptly to a medical facility. When this chemical has been swallowed, get medical attention. Give large quantities of water and induce vomiting. Do not make an unconscious person vomit.

Personal Protective Methods: Wear protective gloves and clothing to prevent any reasonable probability of dermal contact. **4 hr** (At least 4 but <8 hours of resistance to breakthrough $>0.1\,\mu g/cm^2/min$): Viton™ gloves, suits; 4H™ and Silver Shield™ gloves. Safety equipment suppliers/manufacturers can provide recommendations on the most protective glove/clothing material for your operation. All protective clothing (suits, gloves, footwear, headgear) should be clean, available each day, and put on before work. Contact lenses should not be worn when working with this chemical. Wear dust-proof (*p*-DCB) chemical goggles and face shield unless full facepiece respiratory protection is worn. Employees should wash immediately with soap when skin is wet or contaminated. Provide emergency showers and eyewash.

Respirator Selection: *For p-DCB:* NIOSH: *At any detectable concentration:* SCBAF: Pd,Pp (APF = 10,000) (any NIOSH/MSHA- or European Standard EN 149-approved self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode); or SaF: Pd,Pp: ASCBA (APF = 10,000) (any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary, self-contained breathing apparatus operated in a pressure-demand or other positive-pressure mode). *Escape:* GmFOv (APF = 50) [any air-purifying, full facepiece respirator (gas mask) with a chin-style, front- or back-mounted organic vapor canister] or SCBAE (any appropriate escape-type, self-contained breathing apparatus).

Storage: A regulated, marked area should be established where *p*-DCB is handled, used, or stored in compliance with OSHA Standard 1910.1045. General storage may be used. Prior to working with any DCB you should be trained on its proper handling and storage. Before entering confined space where this chemical may be present, check to make sure that an explosive concentration does not exist. Dichlorobenzene must be stored to avoid contact with strong oxidizers, such as permanganates, nitrates, peroxides, chlorates, and perchlorates, hot aluminum or aluminum alloys, since violent reactions occur. Store in tightly closed containers in a cool well-ventilated area away from heat and direct light. Sources of ignition, such as smoking and open flames, are prohibited where dichlorobenzene is used, handled, or stored in a manner that could create a potential fire or explosion hazard.

Shipping: *p*-DCB: may be classified as an Environmentally hazardous substance, solid, n.o.s. This chemical requires a shipping label of "CLASS 9." It usually falls in Hazard Class 9.

Spill Handling: *p-DCB.* First remove all sources of ignition. Evacuate persons not wearing protective equipment from area of spill or leak until clean up is complete. Remove all ignition sources. Collect powdered material in the most convenient and safe manner and deposit in sealed containers. Ventilate area after clean up is complete. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable.

Fire Extinguishing: *p-DCB:* This chemical is a combustible solid. Use dry chemical, carbon dioxide; or foam extinguishers. Hazardous decomposition includes hydrogen chloride. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies. From a secure, explosion-proof location, use water spray to cool exposed containers. If cooling streams are ineffective (venting sound increases in volume and pitch, tank discolors, or shows any signs of deforming), withdraw immediately to a secure position. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode.

Disposal Method Suggested: Incineration, preferably after mixing with another combustible fuel. Care must be exercised to ensure complete combustion to prevent the formation of phosgene. An acid scrubber is necessary to remove the halo acids produced. Consult with environmental regulatory agencies for guidance on acceptable disposal practices. Generators of waste containing this contaminant (≥100 kg/mo) must conform with EPA regulations governing storage, transportation, treatment, and waste disposal.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- U.S. Environmental Protection Agency, Dichlorobenzene: Ambient Water Quality Criteria, Washington DC (1980)
- USEPA, 1,4-Dichlorobenzene, Health and Environmental Effects Profile No. 66, Washington DC, Office of Solid Waste (April 30, 1980)
- USEPA, Dichlorobenzenes, Health and Environmental Effects Profile No. 67, Washington DC, Office of Solid Waste (April 30, 1980)
- Sax, N. I., Ed., "Dangerous Properties of Industrial Materials Report," 4, No. 2, 45-48 (1984); (1,3-Dichlorobenzene); 4, No. 2, 49-52, and 6, No. 2, 50-57 (1986) (Mixed isomers)

- U.S. Public Health Service, "Toxicological Profile for 1,4-Dichlorobenzene," Atlanta, Georgia, Agency for Toxic
- Substances & Disease Registry (December 1987)
- New Jersey Department of Health, "Hazardous Substance Fact Sheet: 1,4-Dichlorobenzene," Trenton, NJ (June 1998)
- http://www.state.nj.us/health/eoh/rtkweb/0643.pdf
- New York State Department of Health, "Chemical Fact Sheet: *para*-Dichlorobenzene," Albany, NY, Bureau of Toxic Substance Assessment (April 1986)
- Gervais, J.; Luukinen, B.; Buhl, K.; Stone, D, *Paradichlorobenzene Technical Fact Sheet*; National Pesticide Information Center, Oregon State University Extension Services, Corvallis, OR (2010)

Dichloroisocyanuric acid D:0555

Use Type: Biocide, Water treatment chemical
CAS Number: 2782-57-2
Formula: $C_3H_2Cl_2N_3O_3$
Synonyms: Dichloroisocyanurate; Dichloroisocyanuric acid, dry or dichloroisocyanuric acid salts; Dichloro-*s*-triazinetrione; 1,3-Dichloro-*s*-triazine-2,4,6-(1*H*,3*H*,5*H*)-trione; Isocyanuric acid, dichloro-; Isocyanuric dichloride; *S*-Triazine-2,4,6-(1H,3H,5H)-trione, 1,3-dichloro-; 1,3,5-Triazine-2,4,6-(1H,3H,5H)-trione, 1,3-dichloro-
Trade Names: ACL 70®; CDB 60®; FI CLOR 71®; HILITE 60®; ORCED®; TROCLOSENE®
Chemical Class: Triazinetrione; Chlorinated isocyanurate
EPA/OPP PC Code: 081401
California DPR Chemical Code: 204
HSDB Number: 5897
UN/NA & ERG Number: UN2465/140 (Dichloroisocyanuric acid, dry, or its salts); UN2568
RTECS® Number: XZ1845000
EC Number: 220-487-5 [*Annex I Index No.*: 613-029-00-4
U.S. Maximum Allowable Residue Levels for Chlorinated isocyanurates [40 CFR 180.940 (c)]: Residues are exempted from the requirement of a tolerance when used in accordance with good manufacturing practice as ingredients in an antimicrobial pesticide formulation, provided that the substance is applied on a semi-permanent or permanent food-contact surface (other than being applied on food packaging) with adequate draining before contact with food. (c) The following chemical substances when used as ingredients in an antimicrobial pesticide formulation may be applied to: Food-processing equipment and utensils. 1,3,5-Triazine-2,4,6(1H,3H,5H)-trione, 1,3-dichloro- is included on this list. Limit: When ready for use, the end-use concentration of all di- or tri-chloroisocyanuric acid chemicals in the solution is not to exceed 100 ppm determined as total available chlorine.
Uses: Used in disinfectants and cleaning solution in domestic products and in food-processing plants. Registered because there are many products that contain this chemical.

Regulatory Authority and Advisory Information:
Clean Air Act: Hazardous Air Pollutants (Title I, Part A, Section 112)
Clean Water Act: Section 307 Priority Pollutants as cyanide, total; Toxic Pollutant (Section 401.15)
RCRA Universal Treatment Standards: Wastewater (mg/L), 1.2 (total); 0.86 (amenable); Nonwastewater (mg/kg), 590 (total); 30 (amenable)
RCRA Ground Water Monitoring List. Suggested test method(s) (PQL μg/L): 9010(40)
Safe Drinking Water Act: MCL, 0.2 mg/L; MCLG, 0.2 mg/L; Regulated chemical (47 FR 9352)
EPA Hazardous Waste Number (RCRA No.): D001 (40CFG261)
EPCRA Section 304 RQ: CERCLA, 10 lb (4.54 kg)
EPCRA Section 313 Form R *de minimis* concentration reporting level: 1.0%
European/International Regulations: Hazard Symbol: O, Xn, N; risk phrases: R8; R22; R31; R36/37; R50/53; safety phrases: S2; S8; S26; S41; S60; S61 (see Appendix 1)
Description: White, crystalline solid, powder, or granules. Chlorine odor. Molecular weight = 197.97; Freezing/Melting point = 227°C (decomposes); Vapor pressure = 2.0×10^{-9} mmHg @ 25°C. Moderately soluble in water; reaction may be violent, releasing chlorine gas.
Incompatibilities: A strong oxidizer and chlorinating compound. Violent reaction with organic and flammable materials. Contact with materials containing nitrogen, such as ammonia, ammonium salts, or urea, may be violent and form highly explosive nitrogen trichloride. Contact with water evolves extremely dense and noxious fumes of chlorides; chlorine gas. Triazine compounds are incompatible with oxidizers, acids, acid chlorides, acid halides, isocyanates, halogenated organics, peroxides, phenols (acidic), epoxides, anhydrides. Contact with strong reducing agents such as halides may generate explosive flammable gas.
Permissible Concentration in Water: The U.S. EPA[49] has determined a no-observed-adverse-effect level (NOAEL) of 10.8 mg/kg/day which yields a lifetime health advisory of 154 μg/L.
Determination in Water: Distillation followed by silver nitrate titration or colorimetric analysis using pyridine pyrazolone (or barbituric acid) Log K_{ow} = 1.3. Unlikely to bioaccumulate in marine organisms.
Routes of Entry: Inhalation, passing through the skin, ingestion.

Harmful Effects and Symptoms
Short Term Exposure: May cause skin and severe eye irritation. Moderately poisonous if ingested or inhaled. LD_{50} (oral, rat) = 150 mg/kg *as chlorinated isocyanurates*[83]; 1170 mg/kg[lit]
Long Term Exposure: May cause lung irritation and damage. May cause skin allergy. Contact with some triazine compounds may increase risks of tumors known to be associated with hormonal factors. These have been observed in both animals and human beings, and are consistent with the known effects on the hypothalamic pituitary gonadal axis. Repeated exposure may cause weight loss and reduced red blood cell count. A mutagen.

Points of Attack: Liver, lungs, skin. May cause reproductive and fetal effects.

Medical Surveillance: Before beginning employment and at regular times after that, for those with frequent or potentially high exposures, the following is recommended: Lung function tests. Consider chest x-ray following acute overexposure. Evaluation by a qualified allergist. Examination of the nervous system.

First Aid: If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least 15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately. If this chemical contacts the skin, remove contaminated clothing and wash immediately with soap and water. Seek medical attention immediately. If this chemical has been inhaled, remove from exposure, begin rescue breathing (using universal precautions) if breathing has stopped, and CPR if heart action has stopped. Transfer promptly to a medical facility. When this chemical has been swallowed, get medical attention. Give large quantities of water or milk and induce vomiting. Do not make an unconscious person vomit.

Personal Protective Methods: Applicators and other handlers must wear: Coveralls worn over long-sleeved shirt and long pants; Chemical-resistant gloves such as DuPont™ Tychem® suit fabrics, barrier laminate, or Viton®; Chemical-resistant footwear plus socks; Protective eye wear; Chemical-resistant headgear for overhead exposure; Chemical-resistant apron when cleaning equipment, mixing, or loading[83]. Agricultural Use/Engineering Controls: When handlers use closed systems, enclosed cabs, or aircraft in a manner that meets the requirements listed in the Worker Protection Standard (WPS) for agricultural pesticides, ***40 CFR 170.240(d)(4-6),*** the handler PPE requirements may be reduced or modified as specified in the Worker Protection Standard. Firefighters should wear NIOSH approved self-contained breathing apparatus and full protective clothing.

Respirator Selection: Wherever and whenever workplace conditions warrant respirator use, a respiratory protection program must be followed that meets one or more of the following requirements: OSHA's 29 CFR 1910.134, ANSI Z88.2, or European Standard EN 149.

Shipping: This chemical must carry an "OXIDIZING SUBSTANCES" label. It usually falls in Hazard Class 5.1 and Packing Group II. It is a marine pollutant and Environmentally hazardous substance.

Spill Handling: For solids, *small spill*, isolate spill or leak area in all directions for at least 25 meters/75 feet. Increase, in the downwind direction, as necessary. For a *large spill* evacuate downwind at least 100 meters/330 feet. Do not touch damaged containers or spilled material unless wearing appropriate protective clothing. Stop leak if you can do it without risk. Keep combustibles (wood, paper, oil, etc.) away from spilled material. Do not allow water to get inside containers. *Small dry spill*: with clean shovel place material into clean, dry container and cover loosely; move containers from spill area. *Large spill*: dike far ahead of liquid spill for later disposal. Following product recovery, flush area with water. Prevent entry into waterways, sewers, basements or confined areas. Cover with plastic sheet to prevent spreading. Absorb or cover with dry earth, sand or other non-combustible material and transfer to containers. Do not allow water to get inside containers.

Fire Extinguishing: Decomposition products include extremely dense and noxious fumes of chlorides, carbon monoxide, and other toxic gases. Move containers from fire area if you can do it without risk. *Fire involving storage or vehicular tanks:* isolate for 800 meters/0.5 mile in all directions; also, consider initial evacuation for 800 meters/0.5 mile in all directions. *On a small fire*: use water. Do not use dry chemicals or foams. Carbon dioxide or Halon® may provide limited control. *On a large fire:* flood fire area with water from a distance. Do not move cargo or vehicle if cargo has been exposed to heat. *Fire involving tanks or car/trailer loads*: fight fire from maximum distance or use unmanned hose holders or monitor nozzles. Do not allow water to get inside containers. Cool containers with flooding quantities of water until well after fire is out. Withdraw immediately in the case of rising sound from venting safety devices or discoloration of tank.

Disposal Method Suggested: Recycle any unused portion of the material for its approved use or return it to the manufacturer or supplier. Generators of waste containing this contaminant (≥100 kg/mo) must conform with EPA regulations governing storage, transportation, treatment, and waste disposal. Incineration with effluent gas scrubbing is recommended. Containers must be disposed of properly by following package label directions or by contacting your local or federal environmental control agency, or by contacting your regional EPA office. Ultimate disposal of the chemical must consider: the material's impact on air quality; potential migration in soil or water; effects on animal, aquatic, and plant life; and conformance with environmental and public health regulations.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- United States National Library of Medicine, ChemIDplus Advanced, Bethesda, MD. http://chem.sis.nlm.nih.gov/chemidplus/rn/2782-57-2

Dichlorophene D:0585

Use Type: Fungicide, Herbicide, Bactericide, Veterinary medicine

CAS Number: 97-23-4

Formula: $C_{13}H_{10}Cl_2O_2$

Synonyms: AI3-02370; Bis(5-chloro-2-hydroxyphenyl)methane; Bis(chlorohydroxyphenyl) methane; Bis(2-hydroxy-5-chlorophenyl)methane; Caswell No. 563; DDDM; DDM; 5,5'-Dichloro-2,2'-dihydroxydiphenylmethane; Dichlorofen;

Di(5-chloro-2-hydroxyphenyl)methane; 4,4'-Dichloro-2,2'-methylenediphenol; diclorofeno (Spanish); Dihydroxy dichlorodiphenylmethane; 2,2'-Dihydroxy-5,5'-dichloro diphenylmethane; [(Dihydroxydichloro)diphenyl]methane; GH; 2,2'-Methylenebis(4-chlorophenol); NSC 38642; Phenol, 2,2'-methylenebis(4-chloro-

Trade Names: ANTHIPHEN®; DIPHENTANE 70®; DICHLOROPHEN®; DICHLOROPHEN B®; DICHLOROPHENE 10®; DICHLORPHEN®; DIDROXANE®; DIPHENTHANE 70®; FUNGICIDE F®; FUNGICIDE GM®; FUNGICIDE M®; G 4®; GEFIR®; HYOSAN; KORIUM®; PLATH-LYSE®; PREVENTAL®; PREVENTOL®; PREVENTOL GD®; PREVENTOL GDC®; SUPER MOSSTOX®; TAENIATOL®; TENIATOL®; TENIATHANE®; TRIVEX®; VERMITHANA®; WESPURIL®

Chemical Class: Chlorinated phenol

EPA/OPP PC Code: 055001

California DPR Chemical Code: 206

HSDB Number: 6033

UN/NA & ERG Number: UN2020 (chlorophenols, solid)/153; UN2021 (chlorophenols, liquid)/153

RTECS® Number: SM0175000

EC Number: 202-567-1

Uses: Not currently registered in the U.S. Dichlorophene is a wide-spectrum, non-oxidizing biocide used against all types of algae and bacteria. Widely used to treat fungi, fleas and worm conditions in pet animals and livestock. See U.S. Food and Drug Administration 20 CFR 520.580 and 20 CFR 520.581

Regulatory Authority and Advisory Information:

California Proposition 65 Chemical: Developmental/Reproductive toxin (4/27/1999)

Health Advisory: Developmental toxin

EPCRA Section 313 Form R *de minimis* concentration reporting level: 1.0%

European/International Regulations: Hazard Symbol: Xi, Xn, N; risk phrases: R22; R36; R50/53; safety phrases: S2; S26; S60; S61 (see Appendix 1)

Description: White crystalline solid or tan, sand-like powder. Odorless when pure; weak phenol odor from contact with air. Molecular weight = 269.13; Freezing/Melting point = 177.22–177.78°C; Vapor pressure = 1×10^{-4} mmHg @ 100°C. Practically insoluble in water; solubility = <1 mg/mL @ 25°C[88].

Incompatibilities: React with oxidizers, boranes, alkalies, aliphatic amines, amides, strong bases, nitric acid, sulfuric acid. Flammable hydrogen gas may be generated, and the heat from reaction may ignite the gas. May generate heat on contact with bases. Heating may initiate dangerous polymerization.

Permissible Exposure Limits in Air: Protective Action Criteria (PAC) Ver. 27[89]

PAC-1: 4.5 mg/m^3
PAC-2: 50 mg/m^3
PAC-3: 300 mg/m^3

Determination in Water: Log K_{ow} = >3.5. Values above 3.0 are likely to bioaccumulate in aquatic organisms.

Routes of Entry: Dermal contact.

Harmful Effects and Symptoms

Short Term Exposure: Symptoms of exposure to this compound include sensitivity dermatitis, photosensitivity and stomatitis. Other symptoms include nausea, vomiting, gastrointestinal colic, diarrhea, urticarial rash and jaundice. Irritation of the skin, eyes, mucous membranes and upper respiratory tract may also occur. It can cause cramps. Symptoms of exposure to related compounds include necrosis of the mucous membranes, cerebral edema, degenerative changes in the liver and kidneys, bladder necrosis, collapse, coma, painless blanching or erythema, possible corrosion, profuse sweating, intense thirst, cyanosis from methemoglobinemia, hyperactivity, stupor, blood pressure fall, hyperpnea, abdominal pain, hemolysis, convulsions and pulmonary edema followed by pneumonia. If death from respiratory failure is not immediate, oliguria or anuria may occur[88]. LD_{50} (oral, rat) = >1500 mg/kg[83]; >2500 kg/mg.

Points of Attack: Liver, kidneys, spleen and central nervous system.

Medical Surveillance: Comprehensive physical examination with emphasis on the genito-urinary tract analysis to include sperm count, motility and morphology. Other tests, such as serum testosterone, serum follicle stimulating hormone (FSH), and serum lutenizing hormone (LH), may be carried out if, in the opinion of a physician, they are indicated.

First Aid: If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least 15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately. If this chemical contacts the skin, remove contaminated clothing and wash immediately with soap and water. Seek medical attention immediately. If this chemical has been inhaled, remove from exposure, begin rescue breathing (using universal precautions) if breathing has stopped, and CPR if heart action has stopped. Transfer promptly to a medical facility. When this chemical has been swallowed, get medical attention. Give large quantities of water and induce vomiting. Do not make an unconscious person vomit.

Personal Protective Methods: Applicators and other handlers must wear: Coveralls worn over long-sleeved shirt and long pants; Chemical-resistant gloves such as DuPont™ Tychem® suit fabrics, barrier laminate, or Viton®; Chemical-resistant footwear plus socks; Protective eye wear; Chemical-resistant headgear for overhead exposure; Chemical-resistant apron when cleaning equipment, mixing, or loading[83]. Agricultural Use/Engineering Controls: When handlers use closed systems, enclosed cabs, or aircraft in a manner that meets the requirements listed in the Worker Protection Standard (WPS) for agricultural pesticides, ***40 CFR 170.240(d)(4-6),*** the handler PPE requirements may be reduced or modified as specified in the Worker Protection Standard. Firefighters should wear NIOSH approved self-contained breathing apparatus and full protective clothing.

Respirator Selection: SCBA >5.5 mg/m^3. Wherever and whenever workplace conditions warrant respirator use, a respiratory protection program must be followed that meets one or more of the following government standards: OSHA's 29 CFR 1910.134, ANSI Z88.2, or European Standard EN 149.

Storage: Color Code-Blue: Health Hazard/Poison. Store in a tightly closed container in a dry, well-ventilated and secure poison location. Prior to working with this chemical you should be trained on its proper handling and storage. Where possible, automatically transfer material from other storage containers to process containers. Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: Chlorophenols, liquid or solid require a shipping label of "poisonous materials" and fall in Hazard Class 6.1.

Spill Handling: If a spill occurs, clean it up promptly. Wear protective clothing. Don't wash it away. Instead, sprinkle the spill with sawdust, vermiculite, or kitty litter. Sweep it into a plastic garbage bag, and dispose of it as directed on the pesticide product label. Clean up with dampened absorbent paper and transfer material to a suitable trash container. Seal the absorbent paper and your clothing in a vapor-tight plastic bag for eventual disposal. Wash all contaminated surfaces with a soap and water solution.

Fire Extinguishing: Hazardous decomposition includes oxides of carbon and extremely toxic hydrogen chloride fumes. As an immediate precautionary measure, isolate spill or leak area in all directions for at least 50 meters/150 feet for liquids and at least 25 meters/75 feet for solids. *Fire involving storage or vehicular tanks:* isolate for 800 meters/0.5 mile in all directions; also, consider initial evacuation for 800 meters/0.5 mile in all directions. *On a small fire:* use dry chemical, CO_2, water spray or regular foam. *On a large fire:* use water spray, fog or regular foam. Do not scatter spilled material with high-pressure streams of water. Move containers from fire area if you can do it without risk. Dike fire-control water for later disposal. *Fire involving tanks:* from a secure, explosion-proof location, use water spray to cool exposed containers. If cooling streams are ineffective (venting sound increases in volume and pitch, tank discolors, or shows any signs of deforming), withdraw immediately to a secure position. Always stay away from tanks engulfed in fire. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode.

Disposal Method Suggested: Do not discharge into drains or sewers. Dispose of waste material as hazardous waste using a licensed disposal contractor to an approved landfill. Consult with environmental regulatory agencies for guidance on acceptable disposal practices. Incineration with effluent gas scrubbing is recommended. Containers must be disposed of properly by following package label directions or by contacting your local or federal environmental control agency, or by contacting your regional EPA office.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- United States National Library of Medicine, ChemIDplus Advanced, Bethesda, MD. http://chem.sis.nlm.nih.gov/chemidplus/rn/97-23-4

1,3-Dichloropropene D:0660

Use Type: Soil fumigant, Nematicide

CAS Number: 542-75-6; 10061-01-5 (*cis*-); 10061-02-6 (*trans*-)

Formula: $C_3H_4Cl_2$; $CHCl = CHCH_2Cl$

Synonyms: β-Chloroallyl chloride; 3-Chloroallyl chloride; 3-Chloropropenyl chloride; 1,3-D; 1,3-Dichloro-2-propene; 1,3-Dicloropropeno (Spanish); α,β-Dichloropropylene; 1,3-Dichloropropylene; (*EZ*)-1,3-Dichloropropene; 1-Propene, 1,3-dichloro-; Propene, 1,3-dichloro-

Trade Names: DURHAM NEMATOCIDE®[C]; FUMAZONE®[C]; NEMAGON®[C]; NEMEX®; PRO-KILL NEMATOCIDE®[C]; TELONE®; TELONE II®; TELONE II-B®; TELONE® EC DRIP; VIDDEN D®; VORLEX®

Chemical Class: Halogenated hydrocarbon

EPA/OPP PC Code: 029001

California DPR Chemical Code: 573

HSDB Number: 1109

UN/NA & ERG Number: UN2047/129

RTECS® Number: UC8310000

EC Number: 208-826-5 [*Annex I Index No.:* 602-030-00-5]

Uses: This chemical is also used in combinations with dichloropropanes as a soil fumigant to kill nematodes, insects and fungus on cotton, potatoes, tobacco, sugar beets, vegetables, grain, citrus planting sites, deciduous fruit and nut-tree planting sites, and ornamental trees and floral sites. Top four applications in California are on sweet potatoes, carrots, wine grapes and outdoor propagation nurseries. It is used on a wide variety of crops. Not approved for use in EU countries[115]. Actively registered in the U.S.

Regulatory Authority and Advisory Information:

Carcinogenicity[83]: EPA Group B2, Probable human carcinogen; NTP: 12th Report on Carcinogens, 2011: Reasonably anticipated to be a human carcinogen; IARC: Group 2b, Possible human carcinogen; ACGIH, A3 Confirmed animal carcinogen with unknown relevance to humans

California Proposition 65 Chemical: Carcinogen (1/1/1989)

List of priority pollutants (U.S. EPA)

Health Advisory: Mutagen, Highly flammable

Clean Air Act: Hazardous Air Pollutants (Title I, Part A, Section 112)

Clean Water Act: Section 311 Hazardous Substances/RQ 40CFR117.3 (same as CERCLA, see below); 40CFR423, Appendix A, Priority Pollutants; Section 313 Water Priority Chemicals (57FR41331, 9/9/92)

EPA Hazardous Waste Number (RCRA No.): U084

Superfund/EPCRA 40CFR302.4 RQ: CERCLA, 100 lb (45.4 kg)

EPCRA Section 313 Form R *de minimus* concentration reporting level: 0.1%

U.S. DOT Regulated Marine Pollutant (49CFR172.101, Appendix B)

Mexico, drinking water, 0.09 mg/L

Hazard Symbol: T, N; risk phrases: R10; R20; R24/25; R36/37/38; R43; R65; R50/53; safety phrases: S1/2; S36/37; S45; S60; S61

WGK (German Aquatic Hazard Class): 3-Severe hazard to waters (542-75-6)

(*cis-isomer; 10061-01-5*)

European/International Regulations: Hazard Symbol: T, N; risk phrases: R10; R20; R24/25; R36/37/38; R43; R65; R50/53; safety phrases: S1/2; S36/37; S45; S60; S61

WGK (German Aquatic Hazard Class): 3-Severe hazard to waters (*10061-01-5*)

(trans-isomer; 10061-02-6)

RCRA 40CFR268.48; 61FR15654, Universal Treatment Standards: Wastewater (mg/L), 0.036; Nonwastewater (mg/kg), 18

RCRA 40CFR264, Appendix 9; TSD Facilities Ground Water Monitoring List. Suggested test method(s) (PQL *u*g/L): 8010(5); 8240(5)

EPCRA Section 313 Form R *de minimus* concentration reporting level: 0.1%

European/International Regulations (*Z; 10061-01-5*): Hazard Symbol: T, Xn, Xi, H, N; risk phrases: R10; R20; R24/25; R36/37/38; R43; R50/53; R65; safety phrases: S1/2; S36/37; S45; S60; S61

WGK (German Aquatic Hazard Class): No value assigned

Description: 1,3-Dichloropropene is a colorless to straw-colored liquid. Corrosive and flammable. It has a sharp, sweet, irritating, chloroform-like odor. Molecular weight = 110.97; Specific gravity (H_2O:1) = 1.2 @ 20°C; Boiling point = 103.89°C @ 760 mmHg; 77°C (mixed *cis*- and *trans*-isomers); Freezing/Melting point = –83.9°C; Vapor pressure = 28 mmHg @ 25°C; Flash point = 35°C. The explosive limits are: LEL = 5.3%; UEL = 14.5%. Hazard Identification (based on NFPA-704 M Rating System): Health 2, Flammability 3, Reactivity 0. Highly soluble in water; solubility = >2000 mg/L.

Incompatibilities: Forms explosive mixture with air. Violent reaction with strong oxidizers. May accumulate static electrical charges, and may cause ignition of its vapors. Incompatible with strong acids, oxidizers, aluminum or magnesium compounds, aliphatic amines, alkanolamines, alkaline matrials, halogens, or corrosives. *Note*: Epichlorohydrin may be added as a stabilizer.

Permissible Exposure Limits in Air: OSHA PEL: None

NIOSH REL: 1 ppm/5 mg/m^3 TWA [skin]; Potential occupational carcinogen; limit exposure to lowest feasible level. See *NIOSH Pocket Guide*, Appendix A

ACGIH TLV®[1]: 1 ppm/4.5 mg/m^3 TWA [skin]; confirmed animal carcinogen with unknown relevance to humans (2003)

Protective Action Criteria (PAC) Ver. 27[89]

dichloropropene, 1,3- (including *cis-* and *trans-* isomers)

PAC-1: 3 ppm
PAC-2: 19 ppm
PAC-3: 120 ppm

DFG MAK (*cis- and trans-isomers*): [skin] danger of skin sensitization; Carcinogen Category 2

Determination in Air: EPA Method 8240. Gas Chromatography/Mass Spectrometry for the determination of volatile organics. OSW Method 0031. Sampling Method for Volatile Organic Compounds. Sampling train. Incinerator. Target detection limit = 0.100 μg/m^3.

Permissible Concentration in Water: Federal Drinking Water Guidelines: 4 ppb[93]. State Drinking Water Standards: California 0.5 μg/L; State Drinking Water Guidelines: Florida 0.4 μg/L; Maine 4 μg/L; Massachusetts 0.4 μg/L; Minnesota 2 μg/L; New Hampshire 0.4 μg/L; Wisconsin 0.2 μg/L.

Determination in Water: Inert gas purge followed by gas chromatography with halide-specific detection (EPA Method 601) or gas chromatography plus mass spectrometry (EPA Method 624); Log K_{ow} = <2.5. Unlikely to bioaccumulate in marine organisms.

Routes of Entry: Inhalation, skin absorption, ingestion, skin and/or eye contact.

Harmful Effects and Symptoms

Short Term Exposure: This chemical can be absorbed through the skin, thereby increasing exposure. Exposure can cause headaches, chest pain, and dizziness. High levels can cause you to pass out. Contact can severely burn the eyes and skin, with permanent damage. High exposures can damage the kidneys, liver and lungs. A skin sensitizer. LD_{50} (oral, rat) = 50–500 mg/kg; LD_{50} (dermal, rat) = >300 mg/kg.

Long Term Exposure: There is evidence that 1,3-dichloropropene causes cancer in animals and humans. May be a liver and kidney toxin, causing damage to the kidneys and liver. May cause lung damage. May cause chronic headache, and personality changes. This chemical has mutagenic potential. May cause skin sensitization. May cause tumors.

Points of Attack: Eyes, skin, respiratory system, central nervous system, liver, kidneys. Cancer site in animals: cancer of the bladder, liver, lung and stomach.

Medical Surveillance: This chemical is a suspected or known human carcinogen. Exposed persons should contact a physician for advice regarding the possible long term health effects and advice for medical monitoring. In addition to comprehensive initial medical and work histories emphasizing reproductive experience and menstrual history, patient should have physical examination and testing of genito-urinary tract, sperm count, motility and morphology. If required, other tests, such as serum testosterone, serum follicle stimulating hormone (FSH), and serum lutenizing hormone (LH), may be indicated. Before beginning employment and at regular times after that, the following are recommended: Liver function tests. Lung function tests. Kidney function tests. Evaluation by a qualified allergist, including exposure history and testing, may help diagnose allergy.

First Aid: If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least 15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately. If this chemical contacts the skin, remove contaminated clothing and wash immediately with soap and water. Seek medical attention immediately. If this chemical has been inhaled, remove from exposure, begin rescue breathing (using universal precautions) if breathing has stopped, and CPR if heart action has stopped. Transfer promptly to a medical facility. When this chemical has been swallowed, get medical attention. Give large quantities of water and induce vomiting. Do not make an unconscious person vomit.

Personal Protective Methods: Wear protective gloves and clothing to prevent any reasonable probability of dermal and/or eye contact. NIOSH recommends: **8 hr** (more than 8 hours of resistance to breakthrough $>0.1 \mu g/cm^2/min$): polyvinyl alcohol gloves; Viton™ gloves, suits; Responder™ suits; **4 hr** (At least 4 but <8 hours of resistance to breakthrough $>0.1 \mu g/cm^2/min$): Teflon™ gloves, suits, boots. Safety equipment suppliers/manufacturers can provide recommendations on the most protective glove/clothing material for your operation. All protective clothing (suits, gloves, footwear, headgear) should be clean, available each day, and put on before work. Contact lenses should not be worn when working with this chemical. Wear splash-proof chemical goggles and face shield unless full facepiece respiratory protection is worn. Employees should wash immediately with soap when skin is wet or contaminated. Provide emergency showers and eyewash.

Respirator Selection: SCBA >3 ppm. *At any concentrations above the NIOSH REL, or where there is no REL, at any detectable concentration:* SCBAF: Pd,Pp (APF = 10,000) (any NIOSH/MSHA- or European Standard EN 149-approved self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode) or SaF: Pd,Pp: ASCBA (APF = 10,000) (any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary self-contained breathing apparatus operated in a pressure-demand or other positive-pressure mode). *Escape:* GmFOv (APF = 50) [any air-purifying, full facepiece respirator (gas mask) with a chin-style, front- or back-mounted organic vapor canister]; or SCBAE (any appropriate escape-type, self-contained breathing apparatus).

Storage: Color Code-Red: Flammability Hazard: Store in a flammable liquid storage area or approved cabinet away from ignition sources and corrosive and reactive materials. Prior to working with 1,3-dichloropropene you should be trained on its proper handling and storage. Before entering confined space where this chemical may be present, check to make sure that an explosive concentration does not exist. 1,3-Dichloropropene must be stored to avoid contact with aluminum or magnesium compounds, substances containing fluorine, chlorine, bromine or iodine, and alkaline or corrosive materials, since violent reactions occur. Store in tightly closed containers in a cool, well-ventilated area. Separate outside storage is preferred. If this material contains a flammable carrier, sources of ignition, such as smoking and open flames, are prohibited where 1,3-dichloropropene is handled, used, or stored. Metal containers involving the transfer of 5 gallons or more of 1,3-dichloropropene should be grounded and bonded. Drums must be equipped with self-closing valves, pressure vacuum bungs, and flame arresters. Use only non-sparking tools and equipment, especially when opening and closing containers of 1,3-dichloropropene. A regulated, marked area should be established where this chemical is handled, used, or stored in compliance with OSHA Standard 1910.1045. Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: Dichloropropene must be labeled "FLAMMABLE LIQUID." It falls in DOT Hazard Class 3.

Spill Handling: Evacuate and restrict persons not wearing protective equipment from area of spill or leak until clean up is complete. Stay upwind; keep out of low areas. Establish forced ventilation to keep levels below explosive limit. Absorb liquids in vermiculite, dry sand, earth, peat, carbon, or a similar material and deposit in sealed containers. Keep this chemical out of a confined space, such as a sewer, because of the possibility of an explosion, unless the sewer is designed to prevent the build-up of explosive concentrations. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable.

Fire Extinguishing: This chemical is a flammable liquid. Hazardous decomposition includes hydrogen chloride. Use dry chemical, carbon dioxide; or foam extinguishers. Vapors are heavier than air and will collect in low areas. Vapors may travel long distances to ignition sources and flashback. Vapors in confined areas may explode when exposed to fire. Containers may explode in fire. Storage containers and parts of containers may rocket great distances, in many directions. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies. From a secure, explosion-proof location, use water spray to cool exposed containers. If cooling streams are ineffective (venting sound increases in volume and pitch, tank discolors, or shows any signs of deforming), withdraw immediately to a secure position. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode.

Disposal Method Suggested: Incineration, preferably after mixing with another combustible fuel. Care must be exercised to ensure complete combustion to prevent the formation of phosgene. An acid scrubber is necessary to remove the halo acids produced. Containers must be disposed of properly by following package label directions or by contacting your local or federal environmental control agency, or by contacting your regional EPA office. Consult with environmental regulatory agencies for guidance on acceptable disposal practices. Generators of waste containing this contaminant (≥100 kg/mo) must conform with EPA regulations governing storage, transportation, treatment, and waste disposal.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- Agency for Toxic Substances and Disease Registry, “ToxFAQs for 1,3-Dichloropropene,” Atlanta, GA (September 1995). http://www.atsdr.cdc.gov/tfacts40.html
- Pesticide Management Education Program, “Chemical Fact Sheet 9/96: 1,3-Dichloropropene (Telon II),” Cornell University, Ithaca, NY (September 1986). http://pmep.cce.cornell.edu/profiles/fumigant/dichloropropene/fumi-prof-dichloropropene.html
- New Jersey Department of Health, “Hazardous Substance Fact Sheet: 1,3-Dichloropropene,” Trenton, NJ (April 1986, rev. December 1999). http://www.state.nj.us/health/eoh/rtkweb/0666.pdf
- USEPA, Dichloropropanes/Dichloropropenes: Ambient Water Quality Criteria, Washington DC (1980)/U.S. Environmental Protection Agency, 1,3-Dichloropropene, Health and Environmental Effects Profile No. 81, Washington DC, Office of Solid Waste (April 30, 1980)
- USEPA, Dichloropropanes/Dichloropropenes: Health and Environmental Effects Profile No. 79, Washington DC, Office of Solid Waste (April 30, 1980)
- USEPA, “Health Advisory: 1,3-Dichloropropene,” Washington DC, Office of Drinking Water (August 1987)
- Sax, N. I., Ed., “Dangerous Properties of Industrial Materials Report,” 6, No. 5, 88-93 (1986)

Dichlorvos D:0690

Use Type: Insecticide, Acaricide, Nematicide

CAS Number: 62-73-7

Formula: $C_4H_7Cl_2O_4P$

Synonyms: Chlorvinphos; Cyanophos; DDVF; DDVP (Insecticide); Dichlorman; 2,2-Dichloroethenol dimethyl phosphate; 2,2-Dichloroethenyl dimethyl phosphate; 2,2-Dichlorovinyl dimethyl phosphate; Dichlorovos; Dimethyl 2,2-dichloroethenyl phosphate; *O,O*-Dimethyl 2,2-dichlorovinyl phosphate; Dimethyl 2,2-dichlorovinyl phosphate; Dimethyl dichlorovinyl phosphate; ENT 20,738; Ethenol, 2,2-dichloro-, dimethyl phosphate; NCI-C00113; NSC-6738; Phosphoric acid, 2,2-dichloroethenyl dimethyl ester; Phosphoric acid, 2,2-dichlorovinyl dimethyl ester

Trade Names: ALCO® Dichlorvos; APAVAP®; ASTROBOT®; ATGARD®; BAY 19149®; BAYER 19149®; BENFOS®; BIBESOL®; BREVINYL®; BREVINYL E 50®; CANOGARD®; CEKUSAN®; CYPONA®; DEDEVAP®; DERRIBAN®; DERRIBANTE®; DES®; DEVIKOL®; DICLORCAL 50®; DIDIVANE; DIVIPAN®; DOOM®; DQUIGARD®; DUO-KILL®; DURAVOS®; ELASTREL®; EQUIGARD®[C]; EQUIGEL®[C]; ESTROSEL®; ESTROSOL®; FECAMA®; FEKAMA®; FLY-DIE®; FLY FIGHTER®; HERKOL®; INSECTIGAS D®; KRECALVIN®; LINDAN®; MAFU®; MARVEX®; MOPARI®; NEFRAFOS®; NERKOL®; NOGOS®; NO-PEST®; NOVOTOX®; NUVA®; NUVAN®; OKO®; OMS 14®; PANAPLATE®; PHOSVIT®; PRENTOX®; SD 1750®; SUCHLOR®; SZKLARNIAK®; TAP 9VP®; TASK®; TENAC®; TETRAVOS®; UNIFOS (PESTICIDE)®; UNITOX®; VAPONA® et al. [C]; VAPONITE®; VERDICAN®; VERDIPOR®; VERDISOL®; VINYLOFOS®; VINYLOPHOS®; WINYLOPHOS®

Chemical Class: Organophosphate

EPA/OPP PC Code: 084001 and 600020

California DPR Chemical Code: 187

HSDB Number: 319

UN/NA & ERG Number: UN2783 (solid)/152

RTECS® Number: TC0350000

EC Number: 200-547-7 [*Annex I Index No.:* 015-019-00-X]

Uses: Dichlorvos is used for insect control in food-storage areas, green-houses, and barns, and control of insects on livestock. It is not generally used on outdoor crops. Dichlorvos is sometimes used for insect control in workplaces and in the home. Dichlorvos used in pest control is diluted with other chemicals and used as a spray. It can also be incorporated into plastic that slowly releases the chemical. Veterinarians use it to control parasites on pets. Dichlorvos is effective against mushroom flies, aphids, spider mites, caterpillars, thrips, and white flies in greenhouse, outdoor fruit, and vegetable crops. It is used to treat a variety of parasitic worm infections in dogs, livestock, and humans. Dichlorvos can be fed to livestock to control botfly larvae in the manure. It acts against insects as both a contact and a stomach poison. It is used as a fumigant and has been used to make pet collars and pest strips. It is available as an aerosol and soluble concentrate. Not approved for use in EU countries[115]. A U.S. EPA restricted Use Pesticide (RUP). Dichlorvos also exists as a breakdown product.

U.S. Maximum Allowable Residue Levels for Dichlorvos [40 CFR 180.235 (a)]: Tolerances for residues of the insecticide 2,2-dichlorovinyl dimethyl phosphate are established as follows: cattle, fat 0.02 ppm (N); cattle, meat 0.02 ppm (N); cattle, meat, byproducts 0.02 ppm (N); egg 0.05 ppm (N); goat, fat 0.02 ppm (N); goat, meat 0.02 ppm (N); goat, meat byproducts 0.02 ppm (N); horse, fat 0.02 ppm (N); horse, meat 0.02 ppm (N); horse, meat byproducts 0.02 ppm (N); milk 0.02 ppm (N); mushroom (residues expressed as naled) 0.5 ppm; poultry, fat 0.05 ppm (N); poultry, meat 0.05 ppm (N); poultry, meat byproducts 0.05 ppm (N); raw agricultural commodities, nonperishable, bulk stored regardless of fat content, postharvest 0.5 ppm; raw agricultural commodities nonperishable, packaged or bagged, containing 6 percent fat or less, postharvest 0.5 ppm; raw agricultural commodities, nonperishable, packaged or bagged, containing more than 6 percent fat, postharvest 2 ppm; sheep, fat 0.02 ppm (N); sheep, meat 0.02 ppm (N); sheep, meat byproducts 0.02 ppm (N); and tomato, postharvest (residues expressed as naled) 0.05 ppm. ***[40 CFR 180.235(a)(2)]:*** The tolerance of 0.1 part per million prescribed by 21 CFR 556.180 for negligible residues of 2,2-dichlorovinyl dimethyl phosphate in the edible tissue of swine covers both its use as an anthelmintic in swine feed and as an insecticide applied directly to swine. ***[40 CFR 180.235(a)(3)]:*** a residue on packaged or bagged nonperishable processed food [see: 21 CFR 170.3(j)] 0.5 ppm. To ensure safe use of the insecticide, its label and labeling shall conform to the label and labeling registered by the U.S. EPA, and the usage employed shall conform with such label or labeling. ***[21 CFR 556.180]:*** negligible residues in the edible tissues of swine 0.1 ppm.

Human toxicity (long-term)[101]: Extra high–0.35 ppb, Health Advisory

Fish toxicity (threshold)[101]: High–7.24703 ppb, MATC (Maximum Acceptable Toxicant Concentration)

Regulatory Authority and Advisory Information:

Carcinogenicity[83]: IARC: Animal Sufficient Evidence; Human Inadequate Data, *possibly carcinogenic to humans*, Group 2b, 1991; EPA Group C, Possible human carcinogen

California Proposition 65 Chemical: Cancer (1/1/1989)

Health Advisory: Nerve Toxin, Mutagen, Developmental/Reproductive Toxin, Very toxic by Inhalation (EU)

Acute Oral Category: 1, DANGER–POISON

Clean Air Act: Hazardous Air Pollutants (Title I, Part A, Section 112)

Clean Water Act: Section 311 Hazardous Substances/RQ 40CFR117.3 (same as CERCLA, see below); Section 313 Water Priority Chemicals (57FR41331, 9/9/92)

Superfund/EPCRA 302 Extremely Hazardous Substances: TPQ = 1000 lb (454 kg)

CERCLA Reportable Quantity (RQ): 10 lb (4.54 kg)

EPCRA Section 313 Form R *de minimis* concentration reporting level: 1.0%

US DOT Regulated Marine Pollutant (49CFR172.101, appendix B), severe pollutant.

US DOT 49CFR172.101, Inhalation Hazardous Chemical as organophosphates

European/International Regulations: Hazard Symbol: T, T+, Xn, N; risk phrases: R24/25; R26; R43; R50; safety phrases: S1/2; S28; S36/37; S45; S61 (see Appendix 1)

WGK (German Aquatic Hazard Class): 3-Severe hazard to waters

Description: Dichlorvos is a colorless, pale yellow or amber liquid. Mild aromatic odor. Molecular weight = 220.98; Specific gravity (H_2O:1) = 1.415 @ 25°C; Boiling point = 140°C @ 25°C; Freezing/Melting point = <– 60°C; Vapor pressure = 1.6×10^{-2} mmHg @ 25°C; Flash point ≥79°C; LEL (Lower Explosive Limit) = 33,850 ppm. Hazard Identification (based on NFPA-704 M Rating System): Health 3, Flammability 1, Reactivity 0. Highly soluble in water; solubility = 10–50 mg/mL @ 20°C.

Incompatibilities: Mist or vapor may form explosive mixture with air. Corrosive in molten form. Strong acids, strong alkalis. In the presence of strong reducing agents such as hydrides, organophosphates form highly toxic and flammable phosphine gas. Contact with oxidizers can cause the release of toxic oxides of phosphorus. Corrosive to iron, mild steel, and some forms of plastics, rubber, and coatings.

Permissible Exposure Limits in Air: NIOSH IDLH: 100 mg/m^3

Conversion factor: 1 ppm = 9.04 mg/m^3 @ 25°C @ 1 atm

OSHA PEL: 1 mg/m^3 TWA [skin]

NIOSH REL: 1 mg/m^3 TWA [skin]

ACGIH TLV®[1]: 0.9 mg/m^3 TWA measured as inhalable fraction and vapor; [skin, sensitization]; not classifiable as a human carcinogen; BEI_A issued; Acetylcholinesterase inhibiting pesticides.

Protective Action Criteria (PAC) Ver. 27[89]

PAC-1: 1.8 mg/m^3

PAC-2: 20 mg/m^3

PAC-3: 200 mg/m^3

DFG MAK: 0.11 ppm/1 mg/m^3 TWA; Peak Limitation Category II(2) [skin], Pregnancy Risk Group C

Determination in Air: XAD-2® (tube); Toluene; Gas chromatography/Flame photometric detection for sulfur, nitrogen, or phosphorus; NIOSH II(5), P&CAM Method #295[18]

Permissible Concentration in Water: State Drinking Water Guidelines: Florida 0.1 μg/L.

Determination in Water: Log K_{ow} = <2.0. Unlikely to bioaccumulate in marine organisms.

Routes of Entry: Inhalation, skin absorption, ingestion, eye and/or dermal and/or eye contact.

Harmful Effects and Symptoms

Organophosphates are highly toxic. Symptoms may develop rapidly, or there may be a delay of several hours following exposure before they become noticeable. The delay tends to be longer in the case of some compounds that dissolve fats, lipids, oils and non-polar solvents such as toluene. Symptoms may increase in severity for more than a single day and last for several days. In severe cases of organophosphate intoxication, respiratory failure may occur.

Short Term Exposure: Dichlorvos irritates the eyes and skin. Symptoms include miosis, aching eyes; rhinorrhea (discharge of thin nasal mucous); headache; chest tightness, wheezing, laryngeal spasm, salivation; cyanosis;

anorexia, nausea, vomiting, diarrhea; sweating; muscle fasiculation, paralysis, giddiness, ataxia; convulsions; low blood pressure, cardiac irregular/irregularities. The substance may cause effects on the central nervous system. Acetyl cholinesterase inhibitor. High levels of exposure may result in death. Delayed pulmonary edema may occur after inhalation. Symptoms of exposure include sweating, twitching, contracted pupils, respiratory distress (tightness in the chest and wheezing), salivation (drooling), lacrimation (tearing), nausea, vomiting, abdominal cramps, diarrhea, involuntary defecation and urination, slurred speech, coma, apnea (cessation of breathing), and death. Toxic changes are typical of organophosphate insecticide poisoning with progression to respiratory distress, respiratory paralysis, and death if there is no clinical intervention. LD_{50} (oral, rat) = 17–80 mg/kg; LD_{50} (dermal, rat) = 75–120 mg/kg.

Long Term Exposure: May cause cancer. Repeated or prolonged contact with skin may cause skin sensitization and dermatitis. Cholinesterase inhibitor; cumulative effect is possible. Animal studies have also shown effects on the nervous system when animals drank water or ate food containing dichlorvos. Animal studies have not reported effects on reproduction or birth defects when animals were exposed to dichlorvos. May cause liver and kidney damage, tumors. A neurotoxin.

Points of Attack: Eyes, skin, liver, kidney respiratory system, cardiovascular system, central nervous system, blood acetylcholinesterase.

Medical Surveillance: This chemical is a suspected or known human carcinogen. Exposed persons should contact a physician for advice regarding the possible long term health effects and advice for medical monitoring. Medical observation is recommended for 24 to 48 hours following breathing overexposure, as pulmonary edema may be delayed. Routine biological monitoring of pesticide applicators and field workers includes testing of plasma and red blood cell acetylcholinesterase levels (for enzyme poisoned by this chemical). These tests are normally accurate only if done within about two hours of exposure. If exposure stops, plasma levels return to normal in 1–2 weeks while red blood cell levels may be reduced for 1–3 months. When acetylcholinesterase enzyme levels are reduced by 25% or more below preemployment levels, risk of poisoning is increased, even if results are in lower ranges of "normal." Reassignment to work not involving organophosphate pesticides is recommended until enzyme levels recover. Do not drink any alcoholic beverages before or during use as it promotes absorption of organophosphates. Also consider complete blood count and chest x-ray following acute overexposure.

First Aid: **Treatment for organophosphate poisoning consists of thorough decontamination, cardiorespiratory support, and administration of the antidotes atropine and pralidoxime. In cases of severe poisoning, diazepam, an anticonvulsant, should also be administered. Antidotes should be administered as prevention even if the diagnosis is in doubt**. Speed in removing material from eyes and skin is of extreme importance. *Eyes:* Eye contact can cause dangerous amounts of these chemicals to be quickly absorbed through the mucous membrane into the bloodstream. Immediately and gently flush eyes with plenty of warm or cold water (NO hot water) for at least 15 minutes, occasionally lifting the upper and lower eyelids. Get medical aid immediately. *Skin:* Get medical aid. Dermal contact can cause dangerous amounts of these chemicals to be absorbed into the bloodstream. Wearing the appropriate PPE equipment and respirator for organophosphate/carbamate pesticides, immediately flush skin with plenty of soap and water for at least 15 minutes while removing contaminated clothing and shoes. Shampoo hair promptly if contaminated. The removed, contaminated clothing and shoes should be double-bagged and left in Hot Zone for later disposal by hazardous materials experts. Skin may also be decontaminated with diluted hypochlorite solution. *Inhalation:* Get medical aid. Do not contaminate yourself. Wearing the appropriate PPE equipment and respirator for organophosphate pesticides, immediately remove the victim from the contaminated area to fresh air. If the victim is not breathing, administer artificial respiration. Do not use mouth-to-mouth method if victim ingested or inhaled the substance; give artificial respiration with the aid of a pocket mask equipped with a one-way valve or other proper respiratory medical device. If breathing is difficult, administer oxygen through bag/mask apparatus until medical help arrives. Do not leave victim unattended. *Ingestion:* Call poison control. Loosen all clothing. Never give anything by mouth to an unconscious person. If victim is *unconscious or having convulsions,* do nothing except keep victim warm. Get medical aid. Transfer promptly to a medical facility. In cases of ingestion, *do not induce vomiting*. If the victim is alert and asymptomatic, administer a slurry of activated charcoal at a dose of 1 g/kg (infant, child, and adult dose). A soda can and straw may be of assistance when offering charcoal to a child. *In some cases you may be specifically instructed by poison control to induce vomiting by way of 2 tablespoons of syrup of ipecac (adult) washed down with a cup of water*. Do NOT give activated charcoal before or with ipecac syrup. *Note to physician or authorized medical personnel:* Treat cases of respiratory compromise, coma, or excessive pulmonary secretions with respiratory support using protocols and techniques available and within the scope of training. Some cases may necessitate procedures such as endotracheal intubation or cricothyrotomy by properly trained and equipped personnel. When possible, atropine (see *Antidotes*, below) should be given under medical supervision. Patients who are comatose, hypotensive, or having seizures or cardiac arrhythmias should be treated according to advanced life support protocols. *Antidotes:* Two antidotes are administered to treat organophosphate poisoning. Atropine is a competitive antagonist of acetylcholine at muscarinic receptors and is used to control the excessive bronchial secretions which are often responsible for death. Pralidoxime relieves both the nicotinic and muscarine effects of organophosphate poisoning by regenerating acetylcholinesterase and can reduce both the bronchial secretions and the muscle weakness associated with poisoning. The initial intravenous dose of atropine in adults should be determined by the severity of symptoms: An initial adult dose of 1.0 to 2.0 mg or pediatric dose of 0.01 mg/kg (minimum 0.01 mg) should be administered intravenously. If intravenous access cannot be established, atropine may also be given intramuscularly, subcutaneously or via endotracheal tube. Doses should be repeated every 15 minutes until excessive secretions and sweating have been controlled. Once bronchial secretion has been controlled, atropine administration should be repeated whenever the secretions begin to recur. In seriously poisoned patients, very large doses may be required. Alterations of pulse rate and pupillary size should not be used as indicators of treatment adequacy. Pralidoxime should be administered as early in poisoning as possible as its efficacy may diminish when given more than 24 to 36 hours after exposure. Doses are as follows: adult 1.0 g; pediatric 25 to 50 mg/kg. The drug should be administered intravenously over 30 to 60 minutes, but in a life-threatening situation one-half of the total dose can be given per minute for a total administration time of 2 minutes. Treatment should begin to take effect within 40 minutes with a reduction in symptoms and the amount of atropine necessary to control bronchial secretion. The initial dose can be repeated in 1 hour and then every 8 to 12 hours until the patient is clinically well and no longer requires atropine. If intravenous access cannot be established, pralidoxime may also be given intramuscularly. Early administration of diazepam in addition to the combined atropine and pralidoxime treatment may help prevent the onset of seizures and potential brain and cardiac morphologic damage following high-level organophosphate poisoning.

Personal Protective Methods: Wear protective gloves and clothing to prevent any reasonable probability of dermal and/or eye contact. Safety equipment suppliers/manufacturers can provide recommendations on the most protective glove/clothing material for your operation. All protective clothing (suits, gloves, footwear, headgear) should be clean, available each day, and put on before work. Contact lenses should not be worn when working with this chemical. Wear splash-proof chemical goggles and face shield unless full facepiece respiratory protection is worn. Employees should wash immediately with soap when skin is wet or contaminated. Provide emergency showers and eyewash.

Respirator Selection: SCBA >1.8 mg/m^3 NIOSH: *10 mg/m^3*: Sa (APF = 10) (any supplied-air respirator). *25 mg/m^3*: Sa:Cf (APF = 25) (any supplied-air respirator operated in a continuous-flow mode). *50 mg/m^3*: SaT: Cf (APF = 50) (any supplied-air respirator that has a tight-fitting facepiece and is operated in a continuous-flow mode); or SCBAF (APF = 50) (any self-contained breathing apparatus with a full facepiece); or SaF (APF = 50) (any supplied-air respirator with a full facepiece). *100 mg/m^3*: Sa: Pd,Pp (APF = 1000) (any supplied-air respirator operated in a pressure-demand or other positive-pressure mode). *Emergency or planned entry into unknown concentrations or IDLH conditions*: SCBAF: Pd,Pp (APF = 10,000) (any self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode); or SaF: Pd,Pp: ASCBA (APF = 10,000) (any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary self-contained breathing apparatus operated in a pressure-demand or other positive-pressure mode). *Escape:* GmFOv100 (APF = 50) [any air-purifying, full facepiece respirator (gas mask) with a chin-style, front- or back-mounted organic vapor canister having an N100, R100, or P100 filter]; or SCBAE (any appropriate escape-type, self-contained breathing apparatus).

Storage: Color Code-Blue: Health Hazard/Poison. Store in a secure poison location. Prior to working with dichlorvos you should be trained on its proper handling and storage. Store in tightly closed containers in a cool, well-ventilated area away from strong acids; strong alkalis. Dichlorvos will attack some forms of mild iron, plastics, rubber and coatings. Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: Organophosphorus pesticides, liquid, toxic, n.o.s. require a "POISON, FLAMMABLE LIQUID" label. Dichlorvos falls in Hazard Class 6.1 and Packing Group II.

Spill Handling: Evacuate and restrict persons not wearing protective equipment from area of spill or leak until clean up is complete. Ventilate area of spill or leak. Remove and isolate contaminated clothing at the site. Do not touch spilled material; stop leaks if you can do it without risk. Reduce vapors with water spray. Take up *small spills* with sand or other noncombustible absorbent material for later disposal in canisters. Dike *large spills* far ahead of spill for later disposal. Keep this chemical out of a confined space, such as a sewer, because of the possibility of an explosion, unless the sewer is designed to prevent the build-up of explosive concentrations. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable.

Fire Extinguishing: Hazardous decomposition includes hydrogen chloride and oxides of phosphorus, sulfur, and nitrogen. This chemical is a flammable liquid. Use dry chemical, carbon dioxide; or foam extinguishers. Use self-contained breathing apparatus with a full facepiece operated on pressure-demand or other positive-pressure mode. Prevent dermal contact with protective clothing. Isolate area and deny entry. Fight fire from maximum distance. Dike fire control water for future disposal. Vapors are heavier than air and will collect in low areas. Vapors in confined areas may explode when exposed to fire. Containers may explode in fire. Storage containers and parts of containers may rocket great distances, in many directions. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies. From a secure, explosion-proof location, use water spray to cool exposed containers. If cooling streams are ineffective (venting sound increases in volume and pitch, tank discolors, or shows any signs of deforming), withdraw immediately to a secure position. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode.

Disposal Method Suggested: 50% hydrolysis is obtained in pure water in 25 minutes @ 70°C and in 61.5 days @ 20°C. A buffered solution yields 50% hydrolysis (37.5°C) in 301 minutes at pH 8, 462 minutes at pH 7, 620 minutes at pH 5.4. Hydrolysis yields no toxic residues. Incineration in a furnace equipped with an afterburner and alkaline scrubber is recommended as is alkaline hydrolysis followed by soil burial. Containers must be disposed of properly by following package label directions or by contacting your local or federal environmental control agency, or by contacting your regional EPA office.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- EXTOXNET, Extension Toxicology Network, "Pesticide Information Profile, Dichlorvos," Oregon State University, Corvallis, OR (June 1996). http://ace.ace.orst.edu/info/extoxnet/pips/dichlorv.htm
- USEPA, Investigation of Selected Potential Environmental Contaminants: Haloalkyl Phosphates, Report EPA-560/2076-007, Washington DC (August 1976)
- Sax, N. I., Ed., "Dangerous Properties of Industrial Materials Report," 1, No. 3, 57-59 (1981)
- USEPA, "Chemical Profile: Dichlorvos," Washington DC, Chemical Emergency Preparedness Program (November 30, 1987)
- Agency for Toxic Substances and Disease Registry, U.S. Department of Health and Human Services, Public Health Service, "Managing Hazardous Materials Incidents," Atlanta, GA (June 2003)
- New Jersey Department of Health, "Hazardous Substance Fact Sheet: Dichlorvos," Trenton, NJ (October 1996). http://www.state.nj.us/health/eoh/rtkweb/0674.pdf

Diclofop D:0694

Use Type: Herbicide
CAS Number: 40843-25-2
Formula: $C_{15}H_{12}Cl_2O_4$
Synonyms: Dichlorfop acid; 2-[4-(2,4-Dichlorophenoxy) phenoxy]-propanoic acid; (RS)-2-[4-(2,4-Dichlorophenoxy) phenoxy]-propanoic acid; Propanoic acid, 2-[4-(2,4-dichlorophenoxy)phenoxy]-
Trade names: HOE-021079
Chemical Class: Aryloxyphenoxypropionate acid; Chlorophenoxy
EPA/OPP PC Code: 110902
UN/NA & ERG Number: UN3077(solid)/171
RTECS® Number: UA2458880
Regulatory Authority and Advisory Information:
Acute Oral Category: 2, WARNING
WGK (German Aquatic Hazard Class): No value assigned

Description: A white to light yellow solid or powder. Molecular weight = 327.162; Specific gravity (H_2O:1) = 1.414 @ 20°C; Boiling point = (decomposes); Freezing/Melting point = 120°C; Vapor pressure = 4.03×10^{-8} mmHg @ 25°C; Henry's Law constant = 2.7×10^{-10} atm-m^3/mol @ 25°C (est)[83]. Hazard Identification (based on NFPA-704 M Rating System): Health 1, Flammability 0, Reactivity 0. High solubility in water; solubility = 453 mg/L.

Incompatibilities: Incompatible with oxidizers, chlorates, nitrates, peroxides, reducing agents, acids, and bases.

Permissible Concentration in Water: Canadian Drinking Water Standards: MAC 0.009 mg/L

Determination in Water: Toxicity to fish: LC_{50}: *Oncorhynchus mykiss*/rainbow trout = >100 mg/L/96 h. Log K_{ow} = 4.58[83]. Values above 3.0 are likely to bioaccumulate in aquatic organisms.

Routes of Entry: Inhalation, ingestion, dermal and/or eye contact.

Harmful Effects and Symptoms

Short Term Exposure: May cause eye, skin, and respiratory tract irritation. May be harmful if absorbed through the skin. Irritation of skin, eyes and respiratory tract. Inhalation may cause burning sensation in nasopharynx and chest, coughing, and/or dizziness. Headache, vomiting, diarrhea. Confusion, bizarre or aggressive behavior. Metabolic acidosis resulting in peculiar odor on breath. LD_{50} (oral, rat) = 523–563 mg/kg; LD_{50} (dermal, rat) = >5 g/kg.

Long Term Exposure: Workers exposed to chlorophenoxy compounds over a 5 to 10 year period at levels above 10 mg/m^3 complained of weakness, rapid fatigue, headache and vertigo. Liver damage, low blood pressure and slowed heartbeat were also found. Based on animal tests, may affect human reproduction. Liver and kidney toxin; may cause kidney failure and increased heart rate.

Points of Attack: Liver, kidneys.

Medical Surveillance: If symptoms develop or overexposure is suspected, the following may be useful: Liver and kidney function tests. Preliminary medical exam to detect chronic diseases of central nervous system, liver, heart, kidneys, lung and skin, as well as endocrinological or immunological disturbances, should protect susceptible individuals. Periodical medical exams of internal organs, skin and eyes are important to avoid chronic occupational intoxications.

They should include lab and patch tests when necessary[83].

First Aid: If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least 15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately. If this chemical contacts the skin, remove contaminated clothing and wash immediately with soap and water. Seek medical attention immediately. If this chemical has been inhaled, remove from exposure, begin rescue breathing (using universal precautions) if breathing has stopped, and CPR if heart action has stopped. Transfer promptly to a medical facility. When this chemical has been swallowed, get medical attention. *Do not induce vomiting when formulations containing petroleum solvents are ingested*. Otherwise, give large quantities of water and induce vomiting. Do not make an unconscious person vomit.

Personal Protective Methods: Wear protective gloves and clothing to prevent any reasonable probability of dermal and/or eye contact. Safety equipment suppliers/manufacturers can provide recommendations on the most protective glove/clothing material for your operation. All protective clothing (suits, gloves, footwear, headgear) should be clean, available each day, and put on before work. Contact lenses should not be worn when working with this chemical. Wear dust-proof chemical goggles and face shield unless full facepiece respiratory protection is worn. Employees should wash immediately with soap when skin is wet or contaminated. Provide emergency showers and eyewash.

Respirator Selection: Follow regulations in OSHA 29CFR1910.134 or European Standard EN149. Use a NIOSH/MSHA- or European Standard EN149-approved respirator; or use an approved supplied-air respirator with a full facepiece operated in the positive-pressure mode, or with a full facepiece, hood, or helmet in the continuous-flow mode; or use a NIOSH/MSHA- or European Standard EN149-approved self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive-pressure mode.

Storage: Color Code-Blue: Health Hazard/Poison. Store in a secure poison location. Prior to working with this chemical you should be trained on its proper handling and storage. Store in tightly closed containers in a cool, well-ventilated area away from strong oxidizers and bases. Metal containers involving the transfer of this chemical should be grounded and bonded. Where possible, automatically transfer material from drums or other storage containers to process containers. Drums must be equipped with self-closing valves, pressure vacuum bungs, and flame arresters. Use only non-sparking tools and equipment, especially when opening and closing containers of this chemical. If this material contains a flammable carrier, sources of ignition, such as smoking and open flames, are prohibited where this chemical is used, handled, or stored in a manner that could create a potential fire or explosion hazard. Wherever this chemical is used, handled, manufactured, or stored, use explosion-proof electrical equipment and fittings. Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: This material may be classified as Environmentally hazardous substances, solid, n. o. s. It usually falls in Hazard Class 9.

Spill Handling: *Solid material:* First remove all sources of ignition. Evacuate persons not wearing protective equipment from area of spill or leak until clean up is complete. Collect powdered material in the most convenient and safe manner and deposit in sealed containers. Ventilate area after clean up is complete. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable.

Liquid formulations containing organic solvents: Evacuate and restrict persons not wearing protective equipment from area of spill or leak until clean up is complete. Ventilate area of spill or leak. Absorb liquids in vermiculite, dry sand, earth, peat, carbon, or a similar material and deposit in sealed containers. Keep this chemical out of a confined space, such as a sewer, because of the possibility of an explosion, unless the sewer is designed to prevent the build-up of explosive concentrations. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable.

Fire Extinguishing: Hazardous decomposition includes chlorates, hydrogen chloride and carbon monoxide. As an immediate precautionary measure, isolate spill or leak area in all directions for at least 50 meters/150 feet for liquids and at least 25 meters/75 feet for solids. *Fire involving storage or vehicular tanks:* isolate for 800 meters/0.5 mile in all directions; also, consider initial evacuation for 800 meters/0.5 mile in all directions. *On a small fire:* use dry chemical, CO_2, water spray or regular foam. *On a large fire:* use water spray, fog or regular foam. Do not scatter spilled material with high-pressure streams of water. Move containers from fire area if you can do it without risk. Dike fire-control water for later disposal. *Fire involving tanks:* from a secure, explosion-proof location, use water spray to cool exposed containers. If cooling streams are ineffective (venting sound increases in volume and pitch, tank discolors, or shows any signs of deforming), withdraw immediately to a secure position. Always stay away from tanks engulfed in fire. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode.

Disposal Method Suggested: In accordance with 40CFR165, follow recommendations for the disposal of pesticides and pesticide containers. Containers must be disposed of properly by following package label directions or by contacting your local or federal environmental control agency, or by contacting your regional EPA office.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- United States National Library of Medicine, ChemIDplus Advanced, Bethesda, MD. http://chem.sis.nlm.nih.gov/chemidplus/rn/40843-25-2

Diclofop-methyl D:0695

Use Type: Herbicide

CAS Number: 51338-27-3

Formula: $C_{16}H_{14}Cl_2O_4$

Synonyms: Caswell No. 319A; Diclofop methyl ester; Dichlordiphenprop; Dichlorfop-methyl; 2-[4-(2,4-Dichlorophenoxy)phenoxy]-methyl-propionate; 2-[4-(2,4-Dichlorophenoxy)phenoxy]propanoic acid methyl ester; Methyl 2-[2-(2,4-dichlorophenoxy)phenoxy] propanoate; Methyl ester of 2-[4-(2,4-dichlorophenoxy) phenoxy] propanoic acid; Propanoic acid, 2-[4-(2,4-dichlorophenoxy) phenoxy]-, methyl ester

Trade Names: DICHLORDIPHENPROP®; HOELON®; HOELON® 3EC; HOE-GRASS®; HOEGRASS®; HOE® 23408; ILOXAN®; ILLOXAN®; ONE SHOT®[C]

Chemical Class: Chlorophenoxy; Aryloxyphenoxypropionate acid

EPA/OPP PC Code: 110902

California DPR Chemical Code: 2034 Not registered.

HSDB Number: 6607

UN/NA & ERG Number: UN3345 (solid)/153; UN3348 (liquid)/153

RTECS® Number: UF1180000

EC Number: 257-141-8 [*Annex I Index No.:* 607-165-00-3]

Uses: Some uses are classified as U.S. Restricted Use Pesticide (RUP). Diclofop-methyl is a selective post-emergence herbicide used to control wild oats and annual grassy weeds in grain and vegetable crops: alfalfa, carrots, celery, box, field and french beans, barley, wheat, brassicas, parsnips, peas, potatoes, rapeseed (canola), soy beans, oilseed rape, onions, sugar beets and lettuce.

U.S. Maximum Allowable Residue Levels for the combined residues of Diclofop-methyl and its metabolites, 2-(4-(2,4-dichlorophenoxy)phenoxy)propanoic acid and 2-(4-(2,4-dichloro-5-hydroxyphenoxy)phenoxy)propanoic acid (40 CFR 180.385): in or on the following raw agricultural commodities: barley, grain 0.1 ppm; barley, straw 0.1 ppm; flaxseed 0.1 ppm; lentils 0.1 ppm; pea seeds (dry) 0.1 ppm; soybeans 0.1 ppm; wheat, grain 0.1 ppm; and wheat, straw 0.1 ppm.

EPA Acceptable Daily Intake (ADI): 0.002 mg/kg.

Human toxicity (long-term)[101]: High–1.40 ppb, Health Advisory

Fish toxicity (threshold)[101]: Intermediate–10.60669 ppb, MATC (Maximum Acceptable Toxicant Concentration)

Regulatory Authority and Advisory Information:

Carcinogenicity[83]: EPA, Likely human carcinogen; IARC. Group 2b, possibly carcinogenic to humans.

California Proposition 65 Chemical: Listed: Cancer (4/6/2010)

Health Advisory: Developmental/Reproductive Toxin (TRI), Endocrine disruptor (?)

AB 2588-Air Toxics “Hot Spots” Chemicals (CAL) as chlorophenoxy pesticides

EPCRA Section 313 Form R *de minimis* concentration reporting level: 1.0%

European/International Regulations: Hazard Symbol: Xn, N; risk phrases: R22; R43; R50/53; safety phrases: S2; S24; S37; S60; S61 (see Appendix 1)

WGK (German Aquatic Hazard Class): 2-Hazard to waters.

Description: A white crystalline solid. Odorless. Can also be commercially available as a clear to dark brown liquid with a typical solvent odor. Molecular weight = 341.19; Specific gravity (H_2O:1) = 1.4; Boiling point = 173–175; Freezing/Melting point = 39–43.8°C; Vapor pressure = 2.5×10^{-2} mmHg @ 25°C; Flash point = 150°C; 63.1°C (cc) (liquid). Hazard Identification (based on NFPA-704 M Rating System): Health 2, Flammability 2, Reactivity 0. Slightly soluble in water (forms an emulsion); solubility = 3 mg/L. Physical and toxicological properties may be affected by carrier solvents in commercial formulations.

Incompatibilities: Incompatible with oxidizers, chlorates nitrates, peroxides, sulfuric acid, caustics, ammonia, aliphatic amines, alkanolamines, isocyanates, alkylene oxides, epichlorohydrin.

Permissible Concentration in Water: EU Drinking Water MAC: 0.006 μg/L. Runoff from spills or fire control may cause water pollution.

Determination in Water: Log K_{ow} = >4.5. Values above 3.0 are likely to bioaccumulate in aquatic organisms.

Routes of Entry: Inhalation, ingestion, absorbed through the skin.

Harmful Effects and Symptoms

Short Term Exposure: Poisonous; may be fatal if inhaled, swallowed, or absorbed through skin. Severely irritates eyes, skin and respiratory tract, with burning sensation, pain, redness and swelling. Metabolic stimulant. If inhaled, causes coughing, dilated pupils, headache, profuse perspiration, intense thirst, extreme fatigue, rapid pulse, high fever, clammy, flushed skin, rapid breathing, nausea, vomiting, cyanosis (bluish tint to skin and lips), anxiety and confusion, convulsions, risk of lung edema. If swallowed, face and lips turn bluish. Liver injury with associated jaundice, kidney failure, and cardiac arrhythmias are commonly noted. Nerve damage, which may be delayed, may include swelling of legs and feet, muscle twitch and stupor. Severe exposure can cause death from heart failure. Dust or liquid left in contact with the skin for several hours may be absorbed. This may result in severe delayed symptoms as listed above. These symptoms may last for months or years. May cause pulmonary edema or bronchopneumonia; symptoms may be delayed. LD_{50} (oral, rat) = >500 mg/kg.

Long Term Exposure: Workers exposed to chlorophenoxy compounds over a 5 to 10 year period at levels above 10 mg/m^3 complained of weakness, rapid fatigue, headache and vertigo. Liver damage, low blood pressure and slowed heartbeat were also found. Based on animal tests, may affect human reproduction

Points of Attack: Eyes, skin, lungs and respiratory system, central nervous system, cardiovascular system, liver, kidney. Liver and kidney toxin; skin sensitizer.

Medical Surveillance: Preliminary medical exam to detect chronic diseases of central nervous system, liver, heart, kidneys, lung and skin, as well as endocrinological or immunological disturbances, should protect susceptible individuals. Periodical medical exams of internal organs, skin and eyes are important to avoid chronic occupational intoxications. They should include lab and patch tests when necessary[83]. Medical observation is recommended for 24 to 48 hours following breathing overexposure, as pulmonary edema may be delayed. If symptoms develop or overexposure is suspected, the following may be useful: Liver and kidney function tests. Exam of the nervous system. Evaluation by a qualified allergist, including exposure history and testing, may help diagnose allergy.

First Aid: If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least 15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately. If this chemical contacts the skin, remove contaminated clothing and wash immediately with soap and water. Seek medical attention immediately. If this chemical has been inhaled, remove from exposure, begin rescue breathing (using universal precautions) if breathing has stopped, and CPR if heart action has stopped. Transfer promptly to a medical facility. When this chemical has been swallowed, get medical attention. *Do not induce vomiting when formulations containing petroleum solvents are ingested*. Otherwise, give large quantities of water and induce vomiting. Do not make an unconscious person vomit.

Personal Protective Methods: Wear protective gloves and clothing to prevent any reasonable probability of dermal and/or eye contact. Safety equipment suppliers/manufacturers can provide recommendations on the most protective glove/clothing material for your operation. All protective clothing (suits, gloves, footwear, headgear) should be clean, available each day, and put on before work. Contact lenses should not be worn when working with this chemical. Wear dust-proof chemical goggles and face shield unless full facepiece respiratory protection is worn. Employees should wash immediately with soap when skin is wet or contaminated. Provide emergency showers and eyewash.

Respirator Selection: Follow regulations in OSHA 29CFR1910.134 or European Standard EN149. Use a NIOSH/MSHA- or European Standard EN149-approved respirator; or use an approved supplied-air respirator with a full facepiece operated in the positive-pressure mode, or with a full facepiece, hood, or helmet in the continuous-flow mode; or use a NIOSH/MSHA- or European Standard EN149-approved self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive-pressure mode.

Storage: Color Code-Blue: Health Hazard/Poison. Store in a secure poison location. Prior to working with this chemical you should be trained on its proper handling and storage. Store in tightly closed containers in a cool, well-ventilated area away from strong oxidizers and bases. Metal containers involving the transfer of this chemical should be grounded and bonded. Where possible, automatically transfer material from drums or other storage containers to process containers. Drums must be equipped with self-closing valves, pressure vacuum bungs, and flame arresters. Use only non-sparking tools and equipment, especially when opening and closing containers of this chemical. If this material contains a flammable carrier, sources of ignition, such as smoking and open flames, are prohibited where this chemical is used, handled, or stored in a manner that could create a potential fire or explosion hazard. Wherever this chemical is used, handled, manufactured, or stored, use explosion-proof electrical equipment and fittings. Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: Phenoxyacetic acid derivative pesticide, solid or liquid, toxic require a shipping label of "poisonous materials" and fall in Hazard Class 6.1. Commercial product may also be a liquid in a flammable carrier.

Spill Handling: *Solid material:* first remove all sources of ignition. Evacuate persons not wearing protective equipment from area of spill or leak until clean up is complete. Collect powdered material in the most convenient and safe manner and deposit in sealed containers. Ventilate area after clean up is complete. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable.

Liquid formulations containing organic solvents: evacuate and restrict persons not wearing protective equipment from area of spill or leak until clean up is complete. Ventilate area of spill or leak. Absorb liquids in vermiculite, dry sand, earth, peat, carbon, or a similar material and deposit in sealed containers.

Fire Extinguishing: *Solid material: a* combustible solid. Hazardous decomposition includes hydrogen chloride gas, chlorates and oxides of carbon As an immediate precautionary measure, isolate spill or leak area in all directions for at least 50 meters/150 feet for liquids and at least 25 meters/75 feet for solids. *Fire involving storage or vehicular tanks:* isolate for 800 meters/0.5 mile in all directions; also, consider initial evacuation for 800 meters/0.5 mile in all directions. *On a small fire:* use dry chemical, CO_2, water spray or regular foam. *On a large fire:* use water spray, fog or regular foam. Do not scatter spilled material with high-pressure streams of water. Move containers from fire area if you can do it without risk. Dike fire-control water for later disposal. *Fire involving tanks:* from a secure, explosion-proof location, use water spray to cool exposed containers. If cooling streams are ineffective (venting sound increases in volume and pitch, tank discolors, or shows any signs of deforming), withdraw immediately to a secure position. Always stay away from tanks engulfed in fire. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode.

Disposal Method Suggested: In accordance with 40CFR165, follow recommendations for the disposal of pesticides and pesticide containers. Containers must be disposed of properly by following package label directions or by contacting your local or federal environmental control agency, or by contacting your regional EPA office.

References:

- EXTOXNET, Extension Toxicology Network, "Pesticide Information Profile, Diclofop-methyl," Oregon State University, Corvallis, OR (September 1995). http://extoxnet.orst.edu/pips/diclofop.htm
- USEPA, Office of Pesticide Programs, Pesticide Residue Limits, "Diclifop-methyl", 40 CFR 180.385. http://www.epa.gov/pesticides/food/viewtols.htm

Dicofol D:0700

Use Type: Insecticide, Acaricide

CAS Number: 115-32-2

Formula: $C_{14}H_9Cl_5$

Synonyms: Benzenemethanol, 4-chloro-α(-4-chlorophenyl) -α-(trichloromethyl)-; Benzhydrol, 4,4'-dichloro-*alpha*-(trichloromethyl)-; 1,1-Bis(*p*-chlorophenyl)-2,2,2-trichloro ethanol; 1,1-Bis(4-chlorophenyl)-2,2,2-trichloroethanol; 4-Chloro-α-(4-chlorophenyl)-α-(trichloromethyl)benzene methanol; CPCA; 4,4'-Dichloro-α-(trichloromethyl) benzhydrol; Dichlorokelthane; Di(*p*-chlorophenyl) trichloromethyl carbinol; DTMC; ENT 23,648; Ethanol, 2,2,2-trichloro-1,1-bis(4-chlorophenyl)-; NCI-C00486; 2,2,2-Trichloro-1,1-bis(4-chlorophenyl) ethanol; 2,2,2-Trichloro-1,1-bis(*p*-chlorophenyl)ethanoL; 2,2,2-Trichloro-1,1-di(4-chlorophenyl)ethanol

Trade Names: ACARIN®[C]; CALLIFOL®; CARBAX®; CEKUDIFOL®; DECOFOL®; DICOMITE®; DIFOL®; FERRIAMICIDE®; FUMITE DICOFOL®; FW 293®; HIFOL®; KELTANE®; KELTHANE®; P,P'-KELTHANE®; KELTHANETHANOL®; MILBOL®; MITIGAN®; TIKTOK®; VAPCOTHION®, dicofol

Chemical Class: Organochlorine

EPA/OPP PC Code: 010501

California DPR Chemical Code: 346

HSDB Number: 631

UN/NA & ERG Number: UN2761 (solid)/151; UN2996 (liquid)/151; UN3082 (liquid)/171

RTECS® Number: DC8400000

EC Number: 204-082-0 [*Annex I Index No.:* 603-044-00-4]

Uses: Not approved for use in EU countries[115]. Severely Restricted for use in EU (containing > 78% *p,p'*-dicofol or 1 g/kg of DDT and DDT-related compounds). Dicofol is an organochlorine miticide/pesticide used for foliar applications, mostly on cotton, apples, and citrus crops. Other crops include: strawberries, mint, beans, peppers, tomatoes, pecans, walnuts, stonefruit, cucurbits, and nonresidential lawns/ornamentals. Formulations registered for use on food/feed crops include emulsifiable concentrates, and wettable powder formulations. These formulations may be applied as concentrated or dilute sprays using aircraft, duster, groundboom, and sprayer. Dicofol is manufactured from DDT. In 1986, use of dicofol was temporarily canceled by the U.S. EPA because of concerns raised by high levels of DDT contamination. However, it was reinstated when it was shown that modern manufacturing processes can produce technical-grade dicofol which contains <0.1% DDT.

U.S. Maximum Allowable Residue Levels for Dicofol [40CFR180.163(a)(1)]: Apple, wet pomace 38.0 ppm; bean, dry, seed 0.5 ppm; bean, succulent 3.0 ppm; butternut 0.1 ppm; caneberry subgroup 13A, 5.0 ppm; chestnut 0.1 ppm; citrus, dried pulp 12.0 ppm; citrus oil 200.0 ppm; cotton, refined oil 0.5 ppm; cotton, undelinted seed 0.1 ppm; fruit, citrus, group 10, 6.0 ppm; fruit, pome, group 1, 1 ppm; 10.0 ppm; fruit, stone, group 12, 5.0 ppm; grape 5.0 ppm; grape, raisin 20.0 ppm; hazelnut 0.1 ppm; hop, dried cones 65.0 ppm; nut, hickory 0.1 ppm; nut, macadamia 0.1 ppm; pecan 0.1 ppm; peppermint, oil 30.0 ppm; peppermint, tops 25.0 ppm; spearmint, oil 30.0 ppm; spearmint, tops 25.0 ppm; strawberry 10.0 ppm; tea, dried 50.0 ppm; tea, plucked leaves 30.0 ppm; vegetable, cucurbit, group 9, 2.0 ppm; vegetable, fruiting, group 8, 2.0 ppm; walnut 0.1 ppm; **[*40CFR180.163(a)(2)*]** cattle, fat 50.0 ppm; cattle, liver 5.0 ppm; cattle, meat 3.0 ppm; cattle, meat byproducts, except liver 3.0 ppm; egg 0.05 ppm; goat, fat 50.0 ppm; goat, liver 5.0 ppm; goat, meat 3.0 ppm; goat, meat byproducts, except liver 3.0 ppm; hog, fat 50.0 ppm; hog, liver 5.0 ppm; hog, meat 3.0 ppm; hog, meat byproducts, except liver 3.0 ppm; horse, fat 50.0 ppm; horse, liver 5.0 ppm; horse, meat 3.0 ppm; horse, meat byproducts, except liver 3.0 ppm; milk, fat (reflecting 0.75 ppm; ppm in whole milk) 22.0 ppm; poultry, fat 0.1 ppm; poultry, meat 0.1 ppm; poultry, meat byproducts 0.1 ppm; sheep, fat 50.0 ppm; sheep, liver 5.0 ppm; sheep, meat 3.0 ppm; sheep, meat byproducts, except liver 3.0 ppm.

Human toxicity (long-term)[101]: Extra high–0.84 ppb, Health Advisory

Fish toxicity (threshold)[101]: High–5.89576 ppb, MATC (Maximum Acceptable Toxicant Concentration)

Regulatory Authority and Advisory Information:

Carcinogenicity[83]: EPA Group C, Possible human carcinogen, April 2006; IARC: Human, No Adequate Data, 1983; Animal, Limited Evidence, 1983*, not classifiable as carcinogenic to humans*, Group 3, 1987

Acute Oral Category: 2, WARNING

Health Advisory: Endocrine disruptor (S!), Mutagen, Developmental/Reproductive Toxin

Clean Water Act: Section 311 Hazardous Substances/RQ 40CFR117.3 (same as CERCLA, see below); Section 313 Water Priority Chemicals (57FR41331, 9/9/92)

CERCLA Reportable Quantity (RQ): 10 lb (4.54 kg)

EPCRA Section 313 Form R *de minimis* concentration reporting level: 1.0%

European/International Regulations: Hazard Symbol: Xn, N; risk phrases: R21/22; R38; R43; R50/53; safety phrases: S2; S36/37; 60; S61 (see Appendix 1)

Description: Dicofol is a white crystalline powder or white to brown waxy solid. The commercial product is often dissolved in a liquid carrier such as water. Molecular weight = 370.49; Specific gravity (H_2O:1) = 1.1; Boiling point = 180°C; 193°C; Freezing/Melting point = 77.5°C; Vapor pressure = 0.25 mmHg @ 25°C; Henry's Law constant = 2.4×10^{-7} atm-m^3/mol @ 25°C (est)[83]; Flash point = 120–230°C (depending on solvent). Hazard Identification (based on NFPA-704 M Rating System): Health 2, Flammability 1, Reactivity 0. Low solubility in water; solubility = about 1 mg/L. Physical and toxicological properties may be affected by by the carrier solvents (xylene is possible) used in commercial formulations.

Incompatibilities: Incompatible with alkaline pesticides, strong acids, acid fumes, aliphatic amines, isocyanates, steel. Slightly corrosive to metals, especially in the presence of moisture.

Permissible Concentration in Water: State Drinking Water Guidelines: Arizona 0.08 μg/L.

Determination in Water: EPA Method D3086. GC method with ECD for the determination of organochlorine pesticides in water and wastewater. Log K_{ow} = >4.0. Values at or above 3.0 are likely to bioaccumulate in marine organisms. The primary hazard of this pesticide is the threat to the environment. Immediate steps should be taken to limit its spread to the environment. Can easily penetrate the soil and contaminate groundwater and nearby streams.

Routes of Entry: Inhalation, passing through the skin, ingestion.

Harmful Effects and Symptoms

Short Term Exposure: Dicofol can be absorbed through the skin, thereby increasing exposure. It irritates the skin and the respiratory tract. Exposure can cause headache, nausea, vomiting and poor appetite. Dicofol may affect the central nervous system, causing numbness and weakness in the hands and feet, muscle twitching, seizures, unconsciousness and death. LD_{50} (oral, rat) = >500 mg/kg; LD_{50} (dermal, rat) = <200 mg/kg.

Long Term Exposure: May cause tumors. Organochlorine pesticides are highly toxic to mammals and will accumulate in the tissues of living organisms. May affect the liver and kidneys. May cause personality changes with depression, anxiety, and irritability. May decrease fertility in females. Prolonged or repeated dermal contact may cause dermatitis. There is limited evidence that dicofol causes liver cancer in animals. May cause skin sensitization.

Points of Attack: Skin, nervous system. liver, kidneys.

Medical Surveillance: This chemical is a suspected or known human carcinogen. Exposed persons should contact a physician for advice regarding the possible long term health effects and advice for medical monitoring. Liver and kidney function tests. Examination of the nervous system. Evaluation by a qualified allergist, including exposure history and testing, may help diagnose allergy.

First Aid: If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least 15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately. If this chemical contacts the skin, remove contaminated clothing and wash immediately with soap and water. Seek medical attention immediately. If this chemical has been inhaled, remove from exposure, begin rescue breathing (using universal precautions) if breathing has stopped, and CPR if heart action has stopped. Transfer promptly to a medical facility. When this chemical has been swallowed, get medical attention. Give large quantities of water and induce vomiting. Do not make an unconscious person vomit.

Personal Protective Methods: Wear protective gloves and clothing to prevent any reasonable probability of dermal and/or eye contact. Safety equipment suppliers/manufacturers can provide recommendations on the most protective glove/clothing material for your operation. All protective clothing (suits, gloves, footwear, headgear) should be clean, available each day, and put on before work. Contact lenses should not be worn when working with this chemical. Wear dust-proof chemical goggles and face shield unless full facepiece respiratory protection is worn. For liquid solutions containing dicofol wear indirect-vent, impact and splash-resistant goggles. Employees should wash immediately with soap when skin is wet or contaminated. Provide emergency showers and eyewash.

Respirator Selection: Follow regulations in OSHA 29CFR1910.134 or European Standard EN149. Use a NIOSH/MSHA- or European Standard EN149-approved respirator; or use an approved supplied-air respirator with a full facepiece operated in the positive-pressure mode, or with a full facepiece, hood, or helmet in the continuous-flow mode; or use a NIOSH/MSHA- or European Standard EN149-approved self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive-pressure mode.

Storage: Color Code-Blue: Health Hazard/Poison. Store in a secure poison location. Prior to working with dicofol you should be trained on its proper handling and storage. Store in tightly closed containers in a cool, well-ventilated area away from alkaline pesticides, strong acids, acid fumes, and steel. Where possible, automatically transfer material from drums or other storage containers to process containers. A regulated, marked area should be established where this chemical is handled, used, or stored in compliance with OSHA Standard 1910.1045. Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: Organochlorine pesticides, liquid or solid require a "poisonous materials" label. They fall in Hazard Class 6.1. STN: 4966940. It is also an environmental hazard: environmentally hazardous substances, solid or liquid, usually fall in Hazard Class 9.

Spill Handling: First remove all sources of ignition. Evacuate persons not wearing protective equipment from area of spill or leak until clean up is complete. Collect powdered material in the most convenient and safe manner and deposit in sealed containers. Ventilate area after clean up is complete. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable.

Fire Extinguishing: This chemical is a combustible solid. Use dry chemical, carbon dioxide; water spray; or alcohol foam extinguishers. Hazardous decomposition includes hydrogen chloride, hydrogen, and chlorides. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies. From a secure, explosion-proof location, use water spray to cool exposed containers. If cooling streams are ineffective (venting sound increases in volume and pitch, tank discolors, or shows any signs of deforming), withdraw immediately to a secure position. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode.

Disposal Method Suggested: Do not discharge into drains or sewers. Dispose of waste material as hazardous waste using a licensed disposal contractor to an approved landfill. Consult with environmental regulatory agencies for guidance on acceptable disposal practices. If allowed, incineration with effluent gas scrubbing is recommended. Containers must be disposed of properly by following package label directions or by contacting your local or federal environmental control agency, or by contacting your regional EPA office.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- USEPA, Office of Pesticide Programs, Reregistration Eligibility Decision (RED), "Dicofol," Washington DC (November 1998). http://www.epa.gov/oppsrrd1/REDs/factsheets/0021fact.pdf
- EXTOXNET, Extension Toxicology Network, "Pesticide Information Profile, Dicofol," Oregon State University, Corvallis, OR (June 1996). http://ace.orst.edu/info/extoxnet/pips/dicofol.htm
- USEPA, Office of Pesticide Programs, Pesticide Residue Limits, "Dicofol", 40 CFR 180.163. http://www.epa.gov/pesticides/food/viewtols.htm
- New Jersey Department of Health and Senior Services, "Hazardous Substance Fact Sheet, Dicofol," Trenton, NJ (October 1998). http://www.state.nj.us/health/eoh/rtkweb/0675.pdf

Dicrotophos D:0710

Use Type: Insecticide, Acaricide

CAS Number: 141-66-2

Formula: $C_8H_{16}NO_5P$

Synonyms: Crotonamide, 3-hydroxy-*N*-*N*,-dimethyl-, *cis*-, Dimethyl phosphate; Crotonamide, 3-hydroxy-*N*-*N*-dimethyl-, dimethylphosphate, *cis*-; Crotonamide, 3-hydroxy-*N*-*N*-dimethyl-, dimethylphosphate, (*E*)-; Dicroptophos; 3-(Dimethoxyphosphinyloxy)-*N,N*-dimethyl-(*E*)-crotonamide; 3-(Dimethoxyphosphinyloxy)-*N,N*-dimethyl-*cis*-crotonamide; 3-(Dimethoxyphosphinyloxy)-*N,N*-dimethylisocrotonamide; 3-(Dimethylamino)-1-methyl-3-oxo-1-propenyl dimethyl phosphate; *cis*-2-Dimethylcarbamoyl-1-methylvinyldimethylphosphate;*(E)*-2-Dimethylcarbamoyl-1-methylvinyl dimethylphosphate; *O,* *O,O*-Dimethylo-(*N,N*-dimethylcarbamoyl-1-methylvinyl) phosphate; *O,O*-Dimethyl-*O*-(1,4-dimethyl-3-oxo-4-azapent-1-enyl)phosphate; Dimethyl phosphate of 3-hydroxy-*N,N*-dimethyl-*cis*-crotonamide; Dimethyl phosphate ester with 3-hydroxy-*N,N*-dimethyl-*cis*-crotonamide; ENT 24,482; 3-Hydroxydimethyl crotonamide dimethyl phosphate; 3-Hydroxy-*N,N*-dimethyl-*cis*-crotonamide dimethyl phosphate; 3-Hydroxy-*N,N*-dimethyl-*(E)*-crotonamide dimethyl phosphate; Phosphoric acid, 3-(dimethylamino)-1-methyl-3-oxo-1-propenyl dimethyl ester, *(E)*-; Phosphoric acid, dimethyl ester with *cis*-3-hydroxy-*N,N*-dimethylcrotonamide; Phosphoric acid, dimethylester with *(E)*-3-hydroxy-*N,N*-dimethylcrotonamide

Trade Names: BIDIRL®; BIDRIN®; BIDRIN-R®[C]; BIDRIN®[C]; C-709®; C-709®; CARBICRIN®; CARBICRON®; CARBOMICRON®; CIBA 709®; DIAPADRIN®; DICRON®; DIDRIN®; EKTAFOS®; EKTOFOS®; KARBICRON®; SD 3562®; SHELL SD-3562®

Chemical Class: Organophosphate

EPA/OPP PC Code: 035201

California DPR Chemical Code: 72

HSDB Number: 1637

UN/NA & ERG Number: UN3018 (liquid)/152

RTECS® Number: TC3850000

EC Number: 205-494-3 [*Annex I Index No.:* 015-073-00-4]

Uses: EPA restricted Use Pesticide (RUP). Not approved for use in EU countries[115]. Dicrotophos was introduced in 1956 as a contact systemic pesticide with a wide range of applications. Today, dicrotophos is currently used mainly as an insecticide for apples and other fruit crops, and for cotton pests, mostly in the Mississippi Valley. It is acutely toxic to birds, especially those that follow their migratory corridors and feed in the farmlands that have been treated with this pesticide. Internationally, dicrotophos is used on rice, coffee and citrus. One of the major degradates of dicrotophos is monocrotophos. All uses of monocrotophos have been voluntarily cancelled in the United States due to its extreme toxicity to humans and wildlife.

U.S. Maximum Allowable Residue Levels for Dicrotophos (40 CFR 180.299): cotton, undelinted seed 0.05 ppm.

Human toxicity (long-term)[101]: Extra high–0.70 ppb, Health Advisory

Fish toxicity (threshold)[101]: Very low–953.39880 ppb, MATC (Maximum Acceptable Toxicant Concentration)

Regulatory Authority and Advisory Information:

Carcinogenicity[83]: EPA, Suggestive Evidence of Carcinogenicity, but Not Sufficient to Assess Human Carcinogenic Potential; ACGIH, A4 Not classifiable as a human carcinogen; EU GHS Category 2: Suspected human carcinogen.

Acute Oral Category: 1, DANGER–POISON

Health Advisory: Nerve Toxin, Mutagen, Developmental/Reproductive Toxin

Superfund/EPCRA 302 Extremely Hazardous Substances: TPQ = 100 lb (45.4 kg)

CERCLA Reportable Quantity (RQ): 100 lb (45.4 kg)

US DOT Regulated Marine Pollutant (49CFR172.101, appendix B)

US DOT 49CFR172.101, Inhalation Hazardous Chemical as organophosphates

European/International Regulations: Hazard Symbol: T+, N; risk phrases: R24; R28; R50/53; safety phrases: S1/2; S28; S36/37; S45; S60; S61 (see Appendix 1)

Description: Dicrotophos is a yellow or amber liquid. Mild ester odor. Molecular weight = 237.22; Specific gravity (H_2O:1) = 1.216 @ 15°C; Boiling point = 400°C (Decomposes below boiling point @ 75°C after storage for 31 days); Vapor pressure = 8.6×10^{-5} mmHg @ 20°C; Flash point ≥94°C; LEL (Lower Explosive Limit) = 41,000 ppm. Hazard Identification (based on NFPA-704 M Rating System): Health 3, Flammability 1, Reactivity 0. Highly soluble in water.

Incompatibilities: In the presence of strong reducing agents such as hydrides, organophosphates form highly toxic and flammable phosphine gas. Contact with oxidizers can cause the release of toxic oxides of phosphorus. Attacks some metals: corrosive to cast iron, mild steel, brass, and stainless steel 304. Decomposes after prolonged storage, but is stable when stored in glass or polyethylene containers with temperatures to 40°C. Forms highly toxic fumes of phosphorus and nitrogen oxides when heated to decomposition.

Permissible Exposure Limits in Air: Conversion factor: 1 ppm = 9.70 mg/m^3 @ 25°C @ 1 atm

OSHA PEL: None

NIOSH REL: 0.25 mg/m^3 TWA [skin]

ACGIH TLV®[1]: 0.05 mg/m^3 TWA measured as inhalable fraction and vapor [skin]; not classifiable as a human carcinogen; BEI: methemoglobin in blood; 1.5% of hemoglobin, during or end-of-shift as methemoglobin inducers.

Protective Action Criteria (PAC) Ver. 27[89]

PAC-1: 0.082 mg/m^3

PAC-2: 0.9 mg/m^3

PAC-3: 4 mg/m^3

Determination in Air: OSHA versatile sampler-2; Toluene/Acetone; Gas chromatography/Flame photometric detection for sulfur, nitrogen, or phosphorus; NIOSH IV, Method #5600, Organophosphorus pesticides[18]

Permissible Concentration in Water: State Drinking Water Guidelines: Florida 1.0 μg/L.

Determination in Water: Log K_{ow} = <– 0.9. Unlikely to bioaccumulate in marine organisms.

Routes of Entry: Inhalation, skin absorption, ingestion, skin and/or eye contact

Harmful Effects and Symptoms

Organophosphates are highly toxic. Symptoms may develop rapidly, or there may be a delay of several hours following exposure before they become noticeable. The delay tends to be longer in the case of some compounds that dissolve fats, lipids, oils and non-polar solvents such as toluene. Symptoms may increase in severity for more than a single day and last for several days. In severe cases of organophosphate intoxication, respiratory failure may occur.

Short Term Exposure: Dicrotophos may affect the nervous system, causing convulsions, respiratory failure. Dicrotophos is a cholinesterase inhibitor which can penetrate the skin. Effects may be cumulative. It is extremely toxic. Closely related in toxicity to azodrin. Acute exposure to dicrotophos may produce the following signs and symptoms; pinpoint pupils, blurred vision, headache, dizziness, muscle spasms, and profound weakness. Vomiting, diarrhea, abdominal pain, seizures, and coma may also occur. The heart rate may decrease following oral exposure or increase following dermal exposure. Hypotension (low blood pressure) is not uncommon. Respiratory symptoms include dyspnea (shortness of breath), respiratory depression, and respiratory paralysis. Psychosis may occur. The effects may be delayed. Delayed pulmonary edema may occur after inhalation. LD_{50} (oral, rat) = 191–225 mg/kg. Highly toxic.

Long Term Exposure: Dicrotophos is a cholinesterase inhibitor; cumulative effect is possible. May damage the nervous system, causing numbness, "pins and needles," sensation and/or weakness of the hands and feet. Repeated exposure may cause personality changes of depression, anxiety or irritability

Points of Attack: Respiratory system, lungs, central nervous system, cardiovascular system, skin, eyes, plasma and red blood cell cholinesterase.

Medical Surveillance: Medical observation is recommended for 24 to 48 hours following breathing overexposure, as pulmonary edema may be delayed. Routine biological monitoring of pesticide applicators and field workers includes testing of plasma and red blood cell acetylcholinesterase levels (for enzyme poisoned by this chemical). These tests are normally accurate only if done within about two hours of exposure. If exposure stops, plasma levels return to normal in 1–2 weeks while red blood cell levels may be reduced for 1–3 months. When acetylcholinesterase enzyme levels are reduced by 25% or more below preemployment levels, risk of poisoning is increased, even if results are in lower ranges of "normal." Reassignment to work not involving organophosphate pesticides is recommended until enzyme levels recover. Do not drink any alcoholic beverages before or during use as it promotes absorption of organophosphates.

First Aid: **Treatment for organophosphate poisoning consists of thorough decontamination, cardiorespiratory support, and administration of the antidotes atropine and pralidoxime. In cases of severe poisoning, diazepam, an anticonvulsant, should also be administered. Antidotes should be administered as prevention even if the diagnosis is in doubt**. *Eyes:* Speed in removing material from eyes and skin is of extreme importance. Eye contact can cause dangerous amounts of these chemicals to be quickly absorbed through the mucous membrane into the bloodstream. Immediately and gently flush eyes with plenty of warm or cold water (NO hot water) for at least 15 minutes, occasionally lifting the upper and lower eyelids. Get medical aid immediately. *Skin:* Get medical aid. Dermal contact can cause dangerous amounts of these chemicals to be absorbed into the bloodstream. Wearing the appropriate PPE equipment and respirator for organophosphate/carbamate pesticides, immediately flush skin with plenty of soap and water for at least 15 minutes while removing contaminated clothing and shoes. Shampoo hair promptly if contaminated. The removed, contaminated clothing and shoes should be double-bagged and left in Hot Zone for later disposal by hazardous materials experts. Skin may also be decontaminated with diluted hypochlorite solution. *Inhalation:* Get medical aid. Do not contaminate yourself. Wearing the appropriate PPE equipment and respirator for organophosphate pesticides, immediately remove the victim from the contaminated area to fresh air. If the victim is not breathing, administer artificial respiration. Do not use mouth-to-mouth method if victim ingested or inhaled the substance; give artificial respiration with the aid of a pocket mask equipped with a one-way valve or other proper respiratory medical device. If breathing is difficult, administer oxygen through bag/mask apparatus until medical help arrives. Do not leave victim unattended. *Ingestion:* Call poison control. Loosen all clothing. Never give anything by mouth to an unconscious person. If victim is *unconscious or having convulsions,* do nothing except keep victim warm. Get medical aid. Transfer promptly to a medical facility. In cases of ingestion, **do not induce vomiting**. If the victim is alert and asymptomatic, administer a slurry of activated charcoal at a dose of 1 g/kg (infant, child, and adult dose). A soda can and straw may be of assistance when offering charcoal to a child. *In some cases you may be specifically instructed by poison control to induce vomiting by way of 2 tablespoons of syrup of ipecac (adult) washed down with a cup of water*. Do NOT give activated charcoal before or with ipecac syrup. *Note to physician or authorized medical personnel:* Treat cases of respiratory compromise, coma, or excessive pulmonary secretions with respiratory support using protocols and techniques available and within the scope of training. Some cases may necessitate procedures such as endotracheal intubation or cricothyrotomy by properly trained and equipped personnel. When possible, atropine (see *Antidotes*, below) should be given under medical supervision. Patients who are comatose, hypotensive, or having seizures or cardiac arrhythmias should be treated according to advanced life support protocols. *Antidotes:* Two antidotes are administered to treat organophosphate poisoning. Atropine is a competitive antagonist of acetylcholine at muscarinic receptors and is used to control the excessive bronchial secretions which are often responsible for death. Pralidoxime relieves both the nicotinic and muscarine effects of organophosphate poisoning by regenerating acetylcholinesterase and can reduce both the bronchial secretions and the muscle weakness associated with poisoning. The initial intravenous dose of atropine in adults should be determined by the severity of symptoms: An initial adult dose of 1.0 to 2.0 mg or pediatric dose of 0.01 mg/kg (minimum 0.01 mg) should be administered intravenously. If intravenous access cannot be established, atropine may also be given intramuscularly, subcutaneously or via endotracheal tube. Doses should be repeated every 15 minutes until excessive secretions and sweating have been controlled. Once bronchial secretion has been controlled, atropine administration should be repeated whenever the secretions begin to recur. In seriously poisoned patients, very large doses may be required. Alterations of pulse rate and pupillary size should not be used as indicators of treatment adequacy. Pralidoxime should be administered as early in poisoning as possible as its efficacy may diminish when given more than 24 to 36 hours after exposure. Doses are as follows: adult 1.0 g; pediatric 25 to 50 mg/kg. The drug should be administered intravenously over 30 to 60 minutes, but in a life-threatening situation one-half of the total dose can be given per minute for a total administration time of 2 minutes. Treatment should begin to take effect within 40 minutes with a reduction in symptoms and the amount of atropine necessary to control bronchial secretion. The initial dose can be repeated in 1 hour and then every 8 to 12 hours until the patient is clinically well and no longer requires atropine. If intravenous access cannot be established, pralidoxime may also be given intramuscularly. Early administration of diazepam in addition to the combined atropine and pralidoxime treatment may help prevent the onset of seizures and potential brain and cardiac morphologic damage following high-level organophosphate poisoning.

Personal Protective Methods: Wear protective gloves and clothing to prevent any reasonable probability of dermal and/or eye contact. Safety equipment suppliers/manufacturers can provide recommendations on the most protective glove/clothing material for your operation. One recommendation is the use of DuPont™ Tychem® suit fabrics[88]. All protective clothing (suits, gloves, footwear, headgear) should be clean, available each day, and put on before work. Contact lenses should not be worn when working with this chemical. Wear splash-proof chemical goggles and face shield unless full facepiece respiratory protection is worn. Employees should wash immediately with soap when skin is wet or contaminated. Provide emergency showers and eyewash.

Respirator Selection: SCBA $>0.082\,\mathrm{mg/m^3}$. Engineering controls should be used wherever feasible to maintain airborne concentrations of this chemical below the prescribed exposure limit. Respirators and protective equipment are less effective than engineering controls, and should be used only in non-routine or emergency situations which may result in exposure concentrations in excess of the TWA environmental limit. *At any concentrations above the NIOSH REL, or where there is no REL, at any detectable concentration:* SCBAF: Pd,Pp (APF = 10,000) (any NIOSH/MSHA- or European Standard EN 149-approved self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode); or SaF: Pd,Pp: ASCBA (APF = 10,000) (any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary, self-contained breathing apparatus operated in a pressure-demand or other positive-pressure mode).

Storage: Color Code-Blue: Health Hazard/Poison. Store in a secure poison location. Prior to working with this chemical you should be trained on its proper handling and storage. Where possible, automatically transfer material from other storage containers to process containers. Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: Organophosphorus pesticides, solid or liquid (nonflammable), require a "poisonous materials" label. This chemical falls in Hazard Class 6.1.

Spill Handling: First remove all sources of ignition. Evacuate persons not wearing protective equipment from area of spill or leak until clean up is complete. Stay upwind; keep out of low areas. Ventilate area of spill or leak. Remove and isolate contaminated clothing at the site. Do not touch spilled material; stop leak if you can do so without risk. Use water spray to reduce vapors. *Small spills:* absorb with sand or other noncombustible absorbent material and place into containers for later disposal. *Large spills:* dike far ahead of spill for later disposal. Collect powdered material in the most convenient and safe manner and deposit in sealed containers. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable. Seek professional environmental engineering assistance from the U.S. EPA Environmental Response Team at (908) 548-8730 (24-hour response line).

Fire Extinguishing: Hazardous decomposition includes oxides of phosphorus, sulfur, and nitrogen. Hazardous decomposition includes oxides of carbon, nitrogen, sulfur and phosphorus. May be fatal if inhaled, ingested or absorbed through skin. Inhalation or contact with some of these materials will irritate or burn skin and eyes. Vapors may cause dizziness or suffocation. *Small fires:* dry chemical, carbon dioxide; water spray; or foam. *Large fires:* water spray, fog, or foam. Stay upwind; keep out of low areas. Ventilate closed spaces before entering them. Firefighting gear (including SCBA) may not provide adequate protection. If exposure occurs, remove and isolate gear immediately and thoroughly decontaminate personnel. Wear positive-pressure breathing apparatus and special protective clothing. Remove and isolate contaminated clothing at the site. Move container from fire area if you can do so without risk. Fight fire from maximum distance. Dike fire-control water for later disposal; do not scatter the material. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies. From a secure, explosion-proof location, use water spray to cool exposed containers. If cooling streams are ineffective (venting sound increases in volume and pitch, tank discolors, or shows any signs of deforming), withdraw immediately to a secure position. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode.

Disposal Method Suggested: Destruction by alkali hydrolysis or incineration. Containers must be disposed of properly by following package label directions or by contacting your local or federal environmental control agency, or by contacting your regional EPA office.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- EXTOXNET, Extension Toxicology Network, "Pesticide Information Profile, Dicrotophos," Oregon State University, Corvallis, OR (September 1995). http://ace.ace.orst.edu/info/extoxnet/pips/dicrotop.htm
- USEPA, Office of Pesticide Programs, Pesticide Residue Limits, "Dicrotophos," 40 CFR 180.299. http://www.epa.gov/pesticides/food/viewtols.htm
- New Jersey Department of Health and Senior Services, "Hazardous Substance Fact Sheet, Dicrotophos," Trenton, NJ (March 1989, revised October 1998). http://www.state.nj.us/health/eoh/rtkweb/0676.pdf
- Sax, N. I., Ed., "Dangerous Properties of Industrial Materials Report," 2, No. 5, 49-54 (1982)
- Agency for Toxic Substances and Disease Registry, U.S. Department of Health and Human Services, Public Health Service, "Managing Hazardous Materials Incidents," Atlanta, GA (June 2003)
- USEPA, "Chemical Profile: Dicrotophos," Washington DC, Chemical Emergency Preparedness Program (October 1998)

Didecyldimethylammonium chloride D:0745

Use Type: Biocide, Fungicide, Bactericide, Herbicide, Algaecide, Algaecide, Bacteriocide, Fungistat, Microbiocide, Microbiostat disinfectant, Viricide, Tuberculocide, Molluscide, Insecticide

CAS Number: 7173-51-5

Formula: $C_{22}H_{48}ClN$

Synonyms: 1-Decanaminium; *N*-Decyl-*N,N*-dimethyl-, chloride (1:1); *N*-Decyl-*N,N*-dimethyl-1-decanaminium chloride; Dimethyldidecylammonium chloride; Didecyl (dimethyl)azanium chloride;

Trade Names: ALIQUAT 203; BARDAC® 22; BARDAC® 2250, 2270, 2280

Chemical Class: Quaternary ammonium salt

EPA/OPP PC Code: 069149

HSDB Number: 7611

UN/NA & ERG Number: UN2811/154

RTECS® Number: BP6560000

EC Number: 230-525-2 [*Annex I Index No.:*612-131-00-6]

Uses: General purpose disinfectant used on hard, nonporous surfaces as a sanitizer; mildew preventative, wood preservative, and to kill algae, phytopathogenic fungi, phytopathogenic bacteria. An active ingredient in a large number of disinfectant products registered with USEPA and labeled with a claim to inactivate "avian influenza A" viruses on hard surfaces.

U.S. Maximum Allowable Residue Levels for residues of the pesticidal chemical 1-Decanaminium, N-decyl-N,N-dimethyl-, chloride [40 CFR 180.940 (c)]: is exempted from the requirement of a tolerance when used in accordance with good manufacturing practice as ingredients in an antimicrobial pesticide formulation, provided that the substance is applied on a semi-permanent or permanent food-contact surface (other than being applied on food packaging) with adequate draining before contact with food. This chemical in an antimicrobial pesticide formulation may be applied to: Food-processing equipment and utensils. Limit: When ready for use, the end-use concentration is not to exceed 200 ppm of active quaternary compound.

Regulatory Authority and Advisory Information:

Carcinogenicity[83]: EPA, Not likely to be carcinogenic to humans.

Health Advisory: Skin irritant/sensitizer

European/International Regulations: Hazard Symbol: Xn, C; risk phrases: R22; R34; safety phrases: S2; S26; S326/37/39; S45 (see Appendix 1)

WGK (German Aquatic Hazard Class): No value assigned.

Description: A clear crystalline solid, off-white, sticky powder, or yellow liquid. Ethanolic odor. Molecular weight = 362.09; Specific gravity (H_2O:1) = 0.9216 @ 25°C[83]; Boiling point = (decomposes); Freezing/Melting point = 228.81[83]; Vapor pressure = 2.3×10^{-11} mmHg @ 25°C; Flash point = 21–55°C. Henry's Law constant = 6.85×10^{-10} atm-m^3/mol @ 25°C (est)[83]. High solubility in water.

Incompatibilities: Dust forms explosive mixture with air. May react with strong oxidizers such as chlorates, peroxides, nitrates, etc. Corrosive material.

Determination in Water: Log K_{ow} = 4.66 (est)[83]. Values above 3.0 are likely to bioaccumulate in aquatic organisms.

Routes of Entry: Inhalation, ingestion, dermal and/or eye contact.

Harmful Effects and Symptoms

There have been nearly 2700 incidents reported to the Opp incident data system (ids) and the California Department of Pesticide Regulation from 1982 to 2004 associated with exposure to end-use products containing quaternary ammonium compounds: Most of the incidents are related to dermal, ocular and inhalation irritation. Allergic type reaction has also been reported in some incidents[83].

Short Term Exposure: Quaternary ammonium compounds can cause coughing and choking, shortness of breath, irritation to the mucous membrane, mouth, nose and respiratory tract; sore throat, possible chest pain, dizziness. Ingestion may cause abdominal pain, headache, dizziness and disorientation; burning irritation to mouth, nausea and vomiting. Eye irritation, burning and pain, conjunctivitis, swelling of both eye and eyelids. High levels of exposure may cause respiratory failure and/or cardiovascular collapse. Skin contact can result in irritation, burning sensation, itching, numbness, and itching; rash and blistering may result. May be a skin sensitizer. LD_{50} (oral, rat) = 150–238 mg/kg; LD_{50} (dermal, rat) = >4000 mg/kg.

Long Term Exposure: Repeated contact may cause skin problems.

Points of Attack: Skin, eyes, respiratory tract

Medical Surveillance: Evaluation by a qualified allergist, including exposure history and testing, may help diagnose allergy.

First Aid: Eyes: First check the victim for contact lenses and remove if present. Flush victim's eyes with water or normal saline solution for 20 to 30 minutes while simultaneously calling a hospital or poison control center. Do not put any ointments, oils, or medication in the victim's eyes without specific instructions from a physician. *Immediately* transport the victim after flushing eyes to a hospital even if no symptoms (such as redness or irritation) develop. Skin: *Immediately* flood affected skin with water while removing and isolating all contaminated clothing. Gently wash all affected skin areas thoroughly with soap and water. If symptoms such as redness or irritation develop, *immediately* call a physician and be prepared to transport the victim to a hospital for treatment. Inhalation: *Immediately* leave the contaminated area; take deep breaths of fresh air. If symptoms (such as wheezing, coughing, shortness of breath, or burning in the mouth, throat, or chest) develop, call a physician and be prepared to transport the victim to a hospital. Provide proper respiratory protection to rescuers entering an unknown atmosphere. Whenever possible, self-contained breathing apparatus (SCBA) should be used; if not available, use a level of protection greater than or equal to that advised under Protective Clothing. Ingestion: *Do not induce vomiting.* If the victim is conscious and not convulsing, give 1 or 2 glasses of water to dilute the chemical and *immediately* call a hospital or poison control center. Be prepared to transport the victim to a hospital if advised by a physician. If the victim is convulsing or unconscious, do not give anything by mouth, ensure that the victim's airway is open and lay the victim on his/her side with the head lower than the body. *Do not induce vomiting. Immediately* transport the victim to a hospital[88].

Personal Protective Methods: Smoking, eating, and drinking before washing should be absolutely prohibited when any pesticide is being handled or used. Applicators and other handlers must wear: Coveralls worn over long-sleeved shirt and long pants; Chemical-resistant gloves such as DuPont™ Tychem® suit fabrics, barrier laminate, or Viton®; Chemical-resistant footwear plus socks; Protective eye wear; Chemical-resistant headgear for overhead exposure; Chemical-resistant apron when cleaning equipment, mixing, or loading[83]. Agricultural Use/ Engineering Controls: When handlers use closed systems, enclosed cabs, or aircraft in a manner that meets the requirements listed in the Worker Protection Standard (WPS) for agricultural pesticides, ***40 CFR 170.240(d)(4-6),*** the handler PPE requirements may be reduced or modified as specified in the Worker Protection Standard.

Respirator Selection: Where the neat (undiluted) test chemical is weighed and diluted, wear a NIOSH-approved half face respirator equipped with an organic vapor/acid gas cartridge (specific for organic vapors, HCl, acid gas and SO_2) with a dust/mist filter[88].

Storage: Color Code-White: Corrosive or Contact Hazard; Store refrigerated and separately in a corrosion-resistant location. Prior to working with this chemical you should be trained on its proper handling and storage. Store in tightly closed containers in a cool, well-ventilated area away from incompatible materials listed above. Metal containers involving the transfer of this chemical should be grounded and bonded. Drums must be equipped with self-closing valves, pressure vacuum bungs, and flame arresters. Use only non-sparking tools and equipment, especially when opening and closing containers of this chemical. If this material contains a flammable carrier, sources of ignition, such as smoking and open flames, are prohibited where this chemical is used, handled, or stored in a manner that could create a potential fire or explosion hazard. Wherever this chemical is used, handled, manufactured, or stored, use explosion-proof electrical equipment and fittings. Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: Corrosive liquid, basic, organic, n.o.s. materials require a label of "CORROSIVE MATERIAL." It falls in Hazard Class 8 and Packing Group I, II or III, depending on concentration. Technical name required.

Spill Handling: As an immediate precautionary measure, isolate spill or leak area in all directions for at least 50 meters/150 feet for liquids and at least 25 meters/75 feet for solids. Increase, in the downwind direction, as necessary, the isolation distance shown above. Eliminate all ignition sources (no smoking, flares, sparks or flames in immediate area). Do not touch damaged containers or spilled material unless wearing appropriate protective clothing. Stop leak if you can do it without risk. Prevent entry into waterways, sewers, basements or confined areas. Absorb or cover with dry earth, sand or other non-combustible material and transfer to containers. Do not get water inside containers.

Fire Extinguishing: Hazardous decomposition includes fumes of amine, ammonia, hydrogen chloride, and organic chloride fumes. *Fire involving storage or vehicular tanks:* isolate for 800 meters/0.5 mile in all directions; also, consider initial evacuation for 800 meters/0.5 mile in all directions. *Small fire:* dry chemical, carbon dioxide or water spray. *Large fire:* dry chemical, carbon dioxide, alcohol-resistant foam or water spray. Move containers from fire area if you can do it without risk. Dike fire-control water for later disposal; do not scatter the material. *Fire involving tanks or car/trailer loads:* fight fire from maximum distance or use unmanned hose holders or monitor nozzles. Do not get water inside containers. Cool containers with flooding quantities of water until well after fire is out. Withdraw immediately in the case of rising sound from venting safety devices or discoloration of tank. Always stay away from tanks engulfed in fire. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode.

Disposal Method Suggested: High-temperature incineration. In accordance with 40CFR165, follow recommendations for the disposal of pesticides and pesticide containers. Containers must be disposed of properly by following package label directions or by contacting your local or federal environmental control agency, or by contacting your regional EPA office.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- United States National Library of Medicine, ChemIDplus Advanced, Bethesda, MD. http://chem.sis.nlm.nih.gov/chemidplus/rn/7173-51-5

Dieldrin D:0750

Use Type: Insecticide

CAS Number: 60-57-1

Formula: $C_{12}H_8Cl_6O$

Synonyms: Dieldrina (Spanish); 2,7:3, 6-Dimethanonaphtha[2,3B]oxirene,3,4,5,6,9,9-hexachloro-1a,2,2a,3,6,6a,7,7a-octahydro-(1a α,2. β,2A. α,3β,6. β,6Aα,7β,7Aα); 1,2,3,4,10,10-Hexachloro-6,7- epoxy-1,4,4a,5,6,7,8,8a-octahydro-1,4-*endo,exo*- 5,8-di-methanonaphthalene; 3,4,5,6,9,9 -Hexachloro-1a,2,2a,3,6,6a, 7,7a-octahydro-2,7:3,6-dimethano; ENT 16,225; HEOD; Hexachloroepoxyoctahydro- *endo,exo*-dimethanonaphthalene; 3,4,5,6,9,9-Hexachloro-1a, 2, 2a, 3, 6, 6a, 7, 7a-octahydro-2,7:3,6-dimethanonaphth(2,3-b)oxirene; NCI-C00124; (1R,4S,4AS,5R,6R,7S,8S,8AR) 1,2,3,4,10,10-Hexachloro-1,4,4a,5,6,7,8,8a-octahydro-6,7-epoxy-1,4:5,8-dimethanonaphthalene

Trade Names: ALVIT®; BELCO®[C]; COMPOUND 497®; D-31®; DIELDREX®; DIELDRITE®; ILLOXOL®; KILLGERM DETHLAC INSECTICIDAL LAQUER®; OCTALOX®; OXRALOX®; PANORAM®; PANORAM D-31®; PRENTOX®[C]; QUINTOX®; ROYAL BRAND®[C]; SD 3417®

Chemical Class: Organochlorine

EPA/OPP PC Code: 045001

California DPR Chemical Code: 210

HSDB Number: 322

UN/NA & ERG Number: UN2761 (solid)/151

RTECS® Number: IO1750000

EC Number: 200-484-5 [*Annex I Index No.:* 602-049-00-9]

Uses: Manufacture in the United States prohibited since 1974. In 1987, EPA banned all uses. Banned for use in EU (also for export) All uses of dieldrin (and Aldrin) were canceled in 1974, except for subsurface ground insertion for termite control, dipping of non-food roots and tops, and moth-proofing by manufacturing processes in a closed system (EPA 1974). In 1987, these final three uses were voluntarily canceled by the sole manufacturer. Currently there are more than 25 global suppliers[97].

Human toxicity (long-term)[101]: Extra high–0.02187 ppb, CHCL (Chronic Human Carcinogen Level)

Fish toxicity (threshold)[101]: Extra high–0.07710 ppb, MATC (Maximum Acceptable Toxicant Concentration)

Regulatory Authority and Advisory Information:

Carcinogenicity[83]: EPA Group B2, Probable human carcinogen; IARC: Human, Inadequate Data, 1974; Animal, Limited Evidence, 1974*, not classifiable as carcinogenic to humans*, Group 3, 1987; NIOSH: Potential occupational carcinogen, See *NIOSH Pocket Guide*, Appendix A; ACGIH, A4 Not classifiable as a human carcinogen.

California Proposition 65 Chemical: Carcinogen (7/1/1988)

Acute Oral Category: 1, DANGER–POISON

Health Advisory: Mutagen, Developmental/Reproductive Toxin, Endocrine disruptor (S!)

Clean Water Act: Section 311 Hazardous Substances/RQ 40CFR117.3 (same as CERCLA, see below); 40CFR423, appendix A, Priority Pollutants; Section 313 Water Priority Chemicals (57FR41331, 9/9/92); Toxic Pollutant (Section 401.15)

U.S. EPA Hazardous Waste Number (RCRA No.): P037

RCRA 40CFR268.48; 61FR15654, Universal Treatment Standards: Wastewater (mg/L), 0.017; Non-wastewater (mg/kg), 0.13

RCRA 40CFR264, appendix 9; TSD Facilities Ground Water Monitoring List. Suggested test method(s) (PQL μg/L): 8080 (0.05); 8270 (10)

CERCLA Reportable Quantity (RQ): 1 lb (0.454 kg)

US DOT Regulated Marine Pollutant (49CFR172.101, appendix B)

Mexico, Drinking Water Criteria, 0.0000007 mg/L

Rotterdam Convention Annex III [Chemicals Subject to the Prior Informed Consent Procedure (PIC)]

List of Stockholm Convention POPs: Annex A (Elimination), Dieldrin and Aldrin

Regulations: Hazard Symbol: T+, N; risk phrases: R25; R27; R40; R48/25; R50/53; safety phrases: S1/2; S21; S36/37; S45; S60; S61 (see Appendix 1)

WGK (German Aquatic Hazard Class): 3-Severe hazard to waters

Description: Dieldrin is a white to light tan crystalline solid. Mild chemical odor. Molecular weight = 380.93; Specific gravity (H_2O:1) = 1.75 @ 20°C; Boiling point = (decomposes); Freezing/Melting point = 178°C; Vapor pressure = 8×10^{-7} mmHg @ 25°C. Hazard Identification (based on NFPA-704 M Rating System): Health 3, Flammability 0, Reactivity 0. Practically insoluble in water; solubility = 0.02%. Physical and toxicological properties may be affected by carrier solvents in commercial formulations.

Potential Exposure: Dieldrin and aldrin were manufactured in the United States by Shell Chemical Co. until the U.S. EPA prohibited their manufacture in 1974 under the Federal Insecticide, Fungicide, and Rodenticide Act. The primary use of the chemicals in the past was for control of corn pests, although they were also used by the citrus industry. Dieldrin's persistence in the environment is due to its extremely low volatility (i.e., a vapor pressure of 1.78×10^{-7} mmHg @ 20°C), and low solubility in water (186 μg/L @ 25–29°C). In addition, dieldrin is extremely apolar, resulting in a high affinity for fat, which accounts for its retention in animal fats, plant waxes, and other such organic matter in the environment. The fat solubility of dieldrin results in the progressive accumulation in the food chain, which may result in a concentration in an organism which would exceed the lethal limit for a consumer.

Incompatibilities: Incompatible with strong acids: concentrated mineral acids, acid catalysts, phenols, strong oxidizers, phenols, active metals, like sodium, potassium, magnesium, and zinc. Keep away from copper, iron, and their salts. Corrosive to metals.

Permissible Exposure Limits in Air: OSHA PEL: 0.25 mg/m^3 TWA[skin]

NIOSH REL: 0.25 mg/m^3 TWA[skin]; Potential occupational carcinogen; limit exposure to lowest feasible level. See *NIOSH Pocket Guide*, Appendix A

ACGIH TLV®[1]: 0.25 mg/m^3 TWA measured as inhalable fraction and vapor [skin]; confirmed animal carcinogen with unknown relevance to humans.NIOSH IDLH: 50 mg/m^3

Protective Action Criteria (PAC) Ver. 27[89]

PAC-1: 0.3 mg/m^3
PAC-2: 2.5 mg/m^3
PAC-3: 450 mg/m^3

DFG MAK: 0.25 mg/m^3, measured as the, inhalable fraction; [skin] Peak Limitation Category II(8)

Determination in Air: Filter; Isooctane; Gas chromatography/Electrochemical detection; NIOSH II(3), Method #S283[18]

Permissible Concentration in Water: Federal Drinking Water Guidelines: 0.02 ppb[93]. State Drinking Water Standards: Illinois 1 μg/L; Florida 0.002 μg/L; California 0.002 μg/L; Connecticut 0.03 μg/L; Maine 0.02 μg/L; Minnesota 0.2 μg/L; New Hampshire 0.002 μg/L.

Determination in Water: Methylene chloride extraction followed by gas chromatography with electron capture or halogen-specific detection (EPA Method 608) or gas chromatography plus mass spectrometry (EPA Method 625). Log K_{ow} = >4.0. Values at or above 3.0 are likely to bioaccumulate in marine organisms. The Odor Threshold in water is 0.04 mg/L.

Routes of Entry: Inhalation, skin absorption, ingestion, eye and/or dermal contact.

Harmful Effects and Symptoms

During the past decade, considerable information has been generated concerning the toxicity and potential carcinogenicity of the two organochlorine pesticides, aldrin and dieldrin. These two pesticides are usually considered together since aldrin is readily epoxidized to dieldrin in the environment. Both are acutely toxic to most forms of life including arthropods, mollusks, invertebrates, amphibians, reptiles, fish, birds and mammals. Dieldrin is extremely persistent in the environment. By means of bioaccumulation it is concentrated many times as it moves up the food chain.

Short Term Exposure: *Inhalation:* May cause nausea, drowsiness, loss of appetite, visual disturbances and insomnia. Sprays of 1 to 21/2% have caused giddiness, headache, muscle twitching, convulsions and loss of consciousness. *Skin*: Can be absorbed to cause or increase the severity of symptoms as listed under ingestion. Contact may cause skin rash. *Eyes:* May cause irritation, redness, and affect vision. *Ingestion*: Can cause headache, nausea, irritability, insomnia, high blood pressure, vision problems, loss of coordination, profuse sweating, dizziness, frothing at the mouth, convulsions and loss of consciousness. Death may occur from as little as 1/20 ounce (1.4 gram). Some symptoms may be delayed up to 12 hours. Exposure to dieldrin may affect the central nervous system, resulting in convulsions. LD_{50} (oral, rat) = 46 mg/kg[86]. High toxicity.

Long Term Exposure: May cause tumors. Organochlorine pesticides are highly toxic to mammals and will accumulate in the tissues of living organisms. May cause liver damage. Dieldrin accumulates in the human body. Dieldrin has caused cancer in laboratory animals. It is considered a suspect occupational carcinogen. May damage the developing fetus. May reduce fertility in males and females. Dieldrin concentrates in breast milk, and therefore may be transferred to breast-feeding infants. Repeated higher exposure can cause tremors, muscle twitching and seizures (convulsions) and may lead to coma and death. Convulsions are somewhat delayed and may occur weeks or months following exposure. Repeated exposure may cause personality changes of depression, anxiety or irritability.

Points of Attack: Central nervous system, liver, kidneys, skin. Cancer site in animals: lung, liver, thyroid and adrenal gland tumors. Potential neurotoxin.

Medical Surveillance: This chemical is a suspected or known human carcinogen. Exposed persons should contact a physician for advice regarding the possible long term health effects and advice for medical monitoring. Before employment and at regular times after that, the following are recommended: Plasma and red blood cell cholinesterase levels (tests for the enzyme poisoned by this chemical). If exposure stops, plasma levels return to normal in 1–2 weeks while red blood cell levels may be reduced for 1–3 months. When acetylcholinesterase enzyme levels are reduced by 25% or more below pre-employment levels, risk of poisoning is increased, even if results are in lower ranges of "normal." Reassignment to work not involving organophosphate or carbamate pesticides is recommended until enzyme levels recover. If symptoms develop or overexposure occurs, repeat the above tests as soon as possible and get an exam of the nervous system. Also consider complete blood count and chest x-ray following acute overexposure. Blood dieldrin level. Examination of the nervous system. If symptoms develop or overexposure is suspected, the following may be useful: Liver function tests. EEG. Blood dieldrin levels (Normal = <1 mg/100 ml; level should not exceed 15 mg/100 ml). Examination of the nervous system

First Aid: If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least 15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately. If this chemical contacts the skin, remove contaminated clothing and wash immediately with soap and water. Seek medical attention immediately. If this chemical has been inhaled, remove from exposure, begin rescue breathing (using universal precautions) if breathing has stopped, and CPR if heart action has stopped. Transfer promptly to a medical facility. When this chemical has been swallowed, get medical attention. Give large quantities of water and induce vomiting. Do not make an unconscious person vomit. Medical observation is recommended for 12 hours after overexposure.

Personal Protective Methods: Wear protective gloves and clothing to prevent any reasonable probability of dermal and/or eye contact. Safety equipment suppliers/manufacturers can provide recommendations on the most protective glove/clothing material for your operation. All protective clothing (suits, gloves, footwear, headgear) should be clean, available each day, and put on before work. Contact lenses should not be worn when working with this chemical. Wear dust-proof chemical goggles and face shield unless full facepiece respiratory protection is worn. Employees should wash immediately with soap when skin is wet or contaminated. Provide emergency showers and eyewash.

Respirator Selection: SCBA >0.3 mg/m^3. NIOSH: At *any concentrations above the NIOSH REL, or where there is no REL, at any detectable concentration:* SCBAF: Pd,Pp (APF = 10,000) (any self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode); or SaF: Pd,Pp: ASCBA (APF = 10,000) (any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary self-contained breathing apparatus operated in a pressure-demand or other positive-pressure mode). *Escape:* GmFOv100 (APF = 50) [any air-purifying, full facepiece respirator (gas mask) with a chin-style, front- or back-mounted organic vapor canister having an N100, R100, or P100 filter]; or SCBAE (any appropriate escape-type, self-contained breathing apparatus).

Storage: Color Code-Blue: Health Hazard/Poison. Store in a secure poison location. Prior to working with dieldrin you should be trained on its proper handling and storage. Dieldrin must be stored to avoid contact with oxidizers (such as perchlorates, peroxides, permanganates, chlorates and nitrates); strong acids (such as hydrochloric, sulfuric and nitric); chemically active metals (such as potassium, sodium, magnesium and zinc), since violent reactions occur. A regulated, marked area should be established where this chemical is handled, used, or stored in compliance with OSHA Standard 1910.1045. Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: Dieldrin, an organochlorine pesticides, solid toxic, must carry a "poisonous materials" label. It usually falls in Hazard Class 6.1 and Packing Group II.

Spill Handling: Hazardous decomposition begins @~375°C releasing oxides of carbon and hydrogen chloride gas. First remove all sources of ignition. Evacuate persons not wearing protective equipment from area of spill or leak until clean up is complete. Collect powdered material in the most convenient and safe manner and deposit in sealed containers. Ventilate area after clean up is complete. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable.

Fire Extinguishing: Commercial solutions may contain flammable or combustible liquids. Use dry chemical, carbon dioxide; water spray, alcohol or polymer foam extinguishers. Hazardous decomposition includes hydrogen chloride and carbon monoxide. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies. Containers may explode in fire. From a secure, explosion-proof location, use water spray to cool exposed containers. If cooling streams are ineffective (venting sound increases in volume and pitch, tank discolors, or shows any signs of deforming), withdraw immediately to a secure position. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode.

Disposal Method Suggested: Incineration (816°C, 0.5 second minimum for primary combustion; 1760°C, 1.0 second for secondary combustion) with adequate scrubbing and ash-disposal facilities. Containers must be disposed of properly by following package label directions or by contacting your local or federal environmental control agency, or by contacting your regional EPA office. Consult with environmental regulatory agencies for guidance on acceptable disposal practices. Generators of waste containing this contaminant (≥100 kg/mo) must conform with EPA regulations governing storage, transportation, treatment, and waste disposal.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- U.S. Public Health Service, "ToxFAQs for Aldrin/Dieldrin," Atlanta, Georgia, Agency for Toxic Substances & Disease Registry (September 2002). http://www.atsdr.cdc.gov/tfacts1.html
- USEPA, Aldrin/Dieldrin: Ambient Water Quality Criteria, Washington DC (1980)
- USEPA, Dieldrin, Health and Environmental Effects Profile No. 82, Washington DC, Office of Solid Waste (April 30, 1980)
- Sax, N. I., Ed., "Dangerous Properties of Industrial Materials Report," 1, No. 4, 52-55 (1981) an 6, No. 1, 9-16 (1986)
- Adema, D. M. M., and G. J. Vink.1981. "A comparative study of the toxicity of 1,1,2- trichloroethane, dieldrin,

pentacholorophenol, and 3,4 dichloroaniline for marine and fresh water," *Chemosphere,* Pergamon Press, Elmsford NY

- USEPA, "Health Advisory: Dieldrin," Washington DC, Office of Drinking Water (August 1987)
- New Jersey Department of Health, "Hazardous Substance Fact Sheet: Dieldrin," Trenton, NJ (November 1998). http://www.state.nj.us/health/eoh/rtkweb/0683.pdf
- New York State Department of Health, "Chemical Fact Sheet: Dieldrin," Albany, NY, Bureau of Toxic Substance Assessment (January 1986 & Version 2)

Difenacoum D:0932

Use Type: Rodenticide

CAS Number: 56073-07-5

Formula: $C_{31}H_{24}O_3$

Synonyms: 3-(3,1,1'-Biphenyl-4-yl-1,2,3,4-tetrahydro-1-napthalenyl)-4-hydroxy-1(2*H*)-benzopyran-2-one

Trade Names: COMPO®; MATRAK®; NEOSOREXA® PELLETS; NEOSOREXA PP580®; RASTOP®; RATAK®; RATRICK®; SILO; SOREXA GEL; STORM

Chemical Class: Coumarin; Hydroxycoumarin

EPA/OPP PC Code: 119901

California DPR Chemical Code: 5973

HSDB Number: 6609

UN/NA & ERG Number: UN3027/151 Coumarin derivative pesticides, solid, toxic, n.o.s; Coumarin derivative pesticides, solid, toxic, n.o.s.

RTECS® Number: GN4934500

EC Number: 259-978-4 [*Annex I Index No.:* 607-157-00-X]

Uses: Difenacoum is an anticoagulant that is effective against rats and mice, including warfarin-resistant strains. It is used in agriculture and urban rodent control as ready-to-use baits.

Regulatory Authority and Advisory Information:

Acute Oral Category: 1, DANGER–POISON

Regulations: Hazard Symbol: T+, T, N; risk phrases: R28; R48/25; R50/53; safety phrases: S1/2; S36/37; S45; S60; S61 (see Appendix 1)

Description: Colorless to off-white crystalline solid or powder. Odorless. Some formulations may be combustible. Molecular weight = 444.6; Specific gravity (H_2O:1) = 1.27; Boiling point = (decomposes); Freezing/Melting point = 215–219°C; 230°C; Vapor pressure = 2×10^{-8} mmHg @ 25°C. Low solubility in water. Physical and toxicological properties may be affected by carrier solvents in commercial formulations.

Incompatibilities: A weak acid. Incompatible with oxidizers, chlorates nitrates, peroxides and alkaline materials.

Determination in Water: Log K_{ow} = >7.5. Values above 3.0 are likely to bioaccumulate in aquatic organisms.

Routes of Entry: Ingestion, dermal and/or eye contact. Persons who are taking anticoagulants or are suffering from bleeding disorders must be protected from exposure.

Harmful Effects and Symptoms

The onset of the symptoms of poisoning may be delayed for a few days following ingestion. Typical symptoms of poisoning include increased bleeding. Coagulation problems may be detected by laboratory analyses only. Large exposures may cause excessive bleeding from minor cuts or abrasions, bleeding from the gums and/or blood in feces. Massive internal bleeding may result in shock. A victim with anemia and/or liver disease may have more severe and persistent poisoning that may be extremely difficult to control.

Short Term Exposure: Vapor may cause dizziness; possible suffocation.May cause blood coagulation and hemorrhaging. Death may occur. LD_{50} (oral, rat) = 2 mg/kg or lower. Highly toxic.

Long Term Exposure: May accumulate in the liver.

Points of Attack: Blood, liver, kidneys

Medical Surveillance: Blood test for clotting time (PT, INR, or PTT). Stool and urine tests for blood. Liver and kidney function tests. Complete blood count. EEG. Plasma analysis for presence of coumarin in the liver. Gastric lavage and repeated administration of charcoal. Blood sample to measure hemoglobin level, prothrombin time, blood grouping and cross-matching.

First Aid: *Emergency Life-Support Procedures:* Acute exposure to difenacoum may require decontamination and life support for the victims. Emergency personnel should wear protective clothing appropriate to the type and degree of contamination. Air-purifying or supplied-air respiratory equipment should also be worn, as necessary. Rescue vehicles should carry supplies such as plastic sheeting and disposable plastic bags to assist in preventing spread of contamination. *Inhalation Exposure:* 1. Move victims to fresh air. Emergency personnel should avoid self-exposure to difenacoum. 2. Evaluate vital signs including pulse and respiratory rate, and note any trauma. If no pulse is detected, provide CPR. If not breathing, provide artificial respiration. If breathing is labored, administer oxygen or other respiratory support. 3. Obtain authorization and/or further instructions from the local hospital for administration of an antidote or performance of other invasive procedures. 4. RUSH to a health care facility. *Dermal/Eye Exposure:* 1. Remove victims from exposure. Emergency personnel should avoid self-exposure to difenacoum. 2. Evaluate vital signs including pulse and respiratory rate, and note any trauma. If no pulse is detected, provide CPR. If not breathing, provide artificial respiration. If breathing is labored, administer oxygen or other respiratory support. 3. Remove contaminated clothing as soon as possible. 4. If eye exposure has occurred, eyes must be flushed with lukewarm water for at least 15 minutes. 5. Wash exposed skin areas twice with soap and water. 6. Obtain authorization and/or further instructions from the local hospital for administration of an antidote or performance of other invasive procedures. 7. RUSH to a health care facility. *Ingestion Exposure:* 1. Evaluate vital signs including pulse and respiratory rate, and note any trauma. If no pulse is detected, provide CPR. If not breathing, provide artificial respiration. If breathing is labored, administer oxygen or other respiratory support. 2. Obtain authorization and/or further instructions from the local hospital for administration of an antidote or performance of other invasive procedures. 3. Vomiting may be induced with syrup of ipecac. If elapsed time since ingestion of difenacoum is unknown or suspected to be greater than 30 minutes, do not induce vomiting and RUSH to a health care facility. 4. ipecac should not be administered to children under 6 months of age. ***Warning:*** Syrup of ipecac should be administered only if victims are alert, have an active gag-reflex, and show no signs of impending seizure or coma. If ANY uncertainty exists, RUSH to a health care facility. 4. The following dosages of ipecac are recommended: children up to 1 year old, 10 mL (1/3 oz); children 1 to 12 years old, 15 mL (1/2 oz); adults, 30 mL (1 oz). Ambulate (walk) the victims and give large quantities of water. If vomiting has not occurred after 15 minutes, ipecac may be re-administered. Continue to ambulate and give water to the victims. If vomiting has not occurred within 15 minutes after second administration of ipecac, administer activated charcoal. 4. Activated charcoal may be administered if victims are conscious and alert. Use 15 to 30 g (1/2 to 1 oz) for children, 50 to 100 g (1-3/4 to 3-1/2 oz) for adults, with 125 to 250 mL (1/2 to 1 cup) of water. 5. Promote excretion by administering a saline cathartic or sorbitol to conscious and alert victims. Children require 15 to 30 g (1/2 to 1 oz) of cathartic; 50 to 100 g (1-3/4 to 3-1/2 oz) is recommended for adults. 6. RUSH to a health care facility[83].

Personal Protective Methods: Wear protective gloves and clothing to prevent any reasonable probability of dermal and/or eye contact. Safety equipment suppliers/manufacturers can provide recommendations on the most protective glove/clothing material for your operation. All protective clothing (suits, gloves, footwear, headgear) should be clean, available each day, and put on before work. Contact lenses should not be worn when working with this chemical. Wear splash-proof or dust-proof chemical goggles and face shield unless full facepiece respiratory protection is worn. Employees should wash immediately with soap when skin is wet or contaminated. Provide emergency showers and eyewash.

Respirator Selection: Specific respirator(s) have not been recommended by NIOSH. The following might be considered in an emergency: SCBAF: Pd,Pp (APF = 10,000) (any NIOSH/MSHA- or European Standard EN 149-approved self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode); or SaF: Pd,Pp: ASCBA (APF = 10,000) (any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary, self-contained breathing apparatus operated in a pressure-demand or other positive-pressure mode). *Escape:* 100F (APF = 50) (any air-purifying, full facepiece respirator with an N100, R100, or P100 filter); or SCBAE (any appropriate escape-type, self-contained breathing apparatus).

Storage: Color Code-Blue: Health Hazard/Poison. Store in a secure poison location. Prior to working with this chemical you should be trained on its proper handling and storage. Store in tightly closed containers in a cool, well-ventilated area away from oxidizers. Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: Coumarin derivative pesticides, solid, toxic, requires a shipping label of "poisonous materials." This material falls in the Hazard Class 6.1 and Product Group I.

Spill Handling: First remove all sources of ignition. Evacuate persons not wearing protective equipment from area of spill or leak until clean up is complete. Stay upwind; keep out of low areas. Ventilate closed spaces before entering them. Wear positive-pressure breathing apparatus and special protective clothing. Remove and isolate contaminated clothing at the site. Do not touch spilled material. Use water spray to reduce vapors. With clean shovel place material into clean, dry container and cover. Dike far ahead of *large spills* for later disposal. Collect powdered material in the most convenient and safe manner and deposit in sealed containers. Ventilate area after clean up is complete. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable.

Fire Extinguishing: Decomposition product includes toxic fumes of carbon. This chemical is a noncombustible solid. *Small fires:* dry chemical, carbon dioxide; water spray or foam. *Large fires:* water spray, fog or foam. Stay upwind, keep out of low areas. Wear positive-pressure breathing apparatus and special protective clothing. Fight fire from maximum distance. Dike fire-control water for later disposal. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies. From a secure, explosion-proof location, use water spray to cool exposed containers. If cooling streams are ineffective (venting sound increases in volume and pitch, tank discolors, or shows any signs of deforming), withdraw immediately to a secure position. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode.

Disposal Method Suggested: Dissolve in a solvent and burn in a furnace by spraying in the solution. Do not discharge into drains or sewers. Dispose of waste material as hazardous waste using a licensed disposal contractor to an approved landfill. Consult with environmental regulatory agencies for guidance on acceptable disposal practices. Incineration with effluent gas scrubbing is recommended. Containers must be disposed of properly by following package label directions or by contacting your local or federal environmental control agency, or by contacting your regional EPA office.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- International Programme on Chemical Safety (IPCS), "*Health and Safety Guide, Difenacoum*," Geneva, Switzerland (1995). http://www.inchem.org/documents/hsg/hsg/hsg095.htm
- The PiedPiper Northern Ltd, Stuart M. Bennett. http://www.The-piedpiper.co.uk/th15(c).htm

Difenoconazole D:0734

Use Type: Fungicide

CAS Number: 119446-68-3

Formula: $C_{19}H_{17}Cl_2N_3O_3$

Synonyms: CGA 169374; 1*H*-1,2,4-Triazole, 1-[(2-(2-chloro-4-(4-chlorophenoxy)phenyl)-4-methyl-1,3-dioxolan-2-yl)methyl]-

Trade Names: CGA 169374®; DIVIDEND®; DIVIDEND® EXTREME FUNGICIDE; HELIX®; SCORE®; TECHNICAL CGA-169374®

Chemical Class: Azole; Triazole

EPA/OPP PC Code: 128847

California DPR Chemical Code: 5024

UN/NA & ERG Number: UN 3077/171; UN3082 (liquid)/171

RTECS® Number: XZ4380000

Uses: For suppression of fungi diseases in crops and seeds.

Regulatory Authority and Advisory Information:

Acute Oral Category: 3, CAUTION

Health Advisory: Developmental/Reproductive Toxin

AB 2588-Air Toxics "Hot Spots" Chemicals (CAL) as chlorophenoxy pesticides

Marine pollutant.

Description: White crystalline solid. Commercial product may be an emulsifiable solid for adding to water or inorganic solvents for spraying. Molecular weight = 406.26; Specific gravity (H_2O:1) = 1.37; Boiling point = 102°C; Freezing/Melting point = 83.4 °C. Vapor pressure = 3×10^{-5} mmHg @ 25°C. Hazard Identification (based on NFPA-704 M Rating System): Health 2, Flammability 0, Reactivity 0. Low solubility in water.

Incompatibilities: A strong acid. Keep away from bases and alkalies.

Determination in Water: Log K_{ow} = >4.0. Values above 3.0 are likely to bioaccumulate in aquatic organisms.

Routes of Entry: Ingestion, dermal and/or eye contact.

Harmful Effects and Symptoms

Short Term Exposure: Poisonous; may be fatal if inhaled, swallowed, or absorbed through skin. Severely irritates eyes, skin and respiratory tract, with burning sensation, pain, redness and swelling. Metabolic stimulant. If inhaled, causes coughing, dilated pupils, headache, profuse perspiration, intense thirst, extreme fatigue, rapid pulse, high fever, clammy, flushed skin, rapid breathing, nausea, vomiting, cyanosis (bluish tint to skin and lips), anxiety and confusion, convulsions, risk of lung edema. If swallowed, face and lips turn bluish. Liver injury with associated jaundice, kidney failure, and cardiac arrhythmias are commonly noted. Nerve damage, which may be delayed, may include swelling of legs and feet, muscle twitch and stupor. Severe exposure can cause death from heart failure. Dust or liquid left in contact with the skin for several hours may be absorbed. This may result in severe delayed symptoms as listed above. These symptoms may last for months or years. LD_{50} (oral, rat) = >1000 mg/kg; LD_{50} (dermal, rat) = >2000 mg/kg.

Long Term Exposure: May cause reproductive and fetal effects. May cause chronic allergic reaction. May cause liver, kidney, thyroid and heart problems.

Points of Attack: Skin, eye, heart, liver, thyroid, kidney.

Medical Surveillance: If symptoms develop or overexposure is suspected, liver or kidney function tests may be useful. In addition to comprehensive initial medical and work histories emphasizing reproductive experience and menstrual history, patient should have physical examination and testing of genito-urinary tract, sperm count, motility and morphology. If required, other tests, such as serum testosterone, serum follicle stimulating hormone (FSH), and serum lutenizing hormone (LH), may be indicated.

First Aid: If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least 15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately. If this chemical contacts the skin, remove contaminated clothing and wash immediately with soap and water. Seek medical attention immediately. If this chemical has been inhaled, remove from exposure, begin rescue breathing (using universal precautions) if breathing has stopped, and CPR if heart action has stopped. Transfer promptly to a medical facility. When this chemical has been swallowed, get medical attention. Give large quantities of water and induce vomiting. Do not make an unconscious person drink or vomit. *Note to Physician:* If ingested, remove by lavage or vomiting. Use general supportive measures for central nervous system depression. Consider the use of quinidine for myotonia.

Personal Protective Methods: Wear positive-pressure self-contained breathing apparatus (SCBA). Wear chemical protective clothing that is specifically recommended by the manufacturer. DuPont™ Tychem® Suit Fabrics is recommended by one government source[88]. It may provide little or no thermal protection. Structural firefighters' protective clothing provides limited protection in fire situations ONLY; it is not effective in spill situations where direct contact with the substance is possible.

Respirator Selection: Where the neat (undiluted) test chemical is weighed and diluted, wear a NIOSH-approved half face respirator equipped with a combination filter cartridge, i.e. organic vapor/acid gas/HEPA (specific for organic vapors, HCl, acid gas, SO_2 and a high-efficiency particulate filter)[88]. Wherever and whenever workplace conditions warrant respirator use, a respiratory protection program must be followed that meets one or more of the following government standards: OSHA's 29 CFR 1910.134, ANSI Z88.2, or European Standard EN 149.

Storage: Color Code-Blue: Health Hazard/Poison. Store in a secure poison location. Refrigerate. Prior to working with this chemical you should be trained on its proper handling and storage. Store in tightly closed containers in a cool, well-ventilated area. If this material contains a flammable carrier, sources of ignition, such as smoking and open flames, are prohibited where this chemical is used, handled, or stored in a manner that could create a potential fire or explosion hazard. Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: This material may be classified as Environmentally hazardous substances, solid, n. o. s. It usually falls in Hazard Class 9.

Spill Handling: For solids, isolate spill or leak area in all directions for at least 25 meters/75 feet. Increase, in the downwind direction, as necessary. First remove all sources of ignition. Evacuate persons not wearing protective equipment from area of spill or leak until clean up is complete. Do not touch damaged containers or spilled material unless wearing appropriate protective clothing. Stop leak if you can do it without risk. Prevent entry into waterways, sewers, basements or confined areas. Cover with plastic sheet to prevent spreading. Absorb or cover with dry earth, sand or other non-combustible material and transfer to containers. If you spill this chemical, you should dampen the solid spill material with water, then transfer the dampened material to a suitable container. Use absorbent paper dampened with water to pick up any remaining material. Seal your contaminated clothing and the absorbent paper in a vapor-tight plastic bag for eventual disposal. Wash all contaminated surfaces with a soap and water solution. Do not reenter the contaminated area until the Safety Officer (or other responsible person) has verified that the area has been properly cleaned. Do not allow water to get inside containers. Ventilate area after clean up is complete. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable.

Fire Extinguishing: Hazardous decomposition includes toxic oxides of nitrogen and carbon and hydrogen chloride gas. As an immediate precautionary measure, isolate spill or leak area in all directions for at least 50 meters/150 feet for liquids and at least 25 meters/75 feet for solids. *Fire involving storage or vehicular tanks:* isolate for 800 meters/0.5 mile in all directions; also, consider initial evacuation for 800 meters/0.5 mile in all directions. *On a small fire:* use dry chemical, CO_2, water spray or regular foam. *On a large fire:* use water spray, fog or regular foam. Do not scatter spilled material with high-pressure streams of water. Move containers from fire area if you can do it without risk. Dike fire-control water for later disposal. *Fire involving tanks:* from a secure, explosion-proof location, use water spray to cool exposed containers. If cooling streams are ineffective (venting sound increases in volume and pitch, tank discolors, or shows any signs of deforming), withdraw immediately to a secure position. Always stay away from tanks engulfed in fire. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode.

Disposal Method Suggested: Consult with environmental regulatory agencies for guidance on acceptable disposal practices. Contact a licensed disposal facility about surplus and non-recyclable solutions. Burn in a chemical incinerator equipped with an afterburner and scrubber. Extra care must be exercised as the material in an organic solvent is highly flammable. In accordance with 40CFR165, follow recommendations for the disposal of pesticides and pesticide containers. Containers must be disposed of properly by following package label directions or by contacting your local or federal environmental control agency, or by contacting your regional EPA office. Incineration or permanganate oxidation.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- USEPA, Office of Pesticide Programs, Pesticide Residue Limits, "Difenoconazole", 40 CFR 180.475. http://www.epa.gov/pesticides/food/viewtols.htm

Difethialone D:0934

Use Type: Rodenticide, Pesticide

CAS Number: 104653-34-1

Formula: $C_{31}H_{23}BrO_2S$

Synonyms: 2*H*-1-Benzothiapyran-2-one,3-(3-(4'-bromo(1,1'-biphenyl)-4-yl)-1,2,3,4-tetrahydro-1-naphthalenyl)-4-hydroxy-; 2*H*-1-Benzothiopyran-2-one,3-(3-(4'bromo(1,1'biphenyl)-4-yl)-1,2,3,4-tetrahydro-1-naphthalenyl)-4-hydroxy-; 3-[3-(4-Bromo-(1,1'-biphenyl)-4-yl)-1,2,3,4-tetrahydro-1-naphthalenyl]-4-hydroxy-2*H*-benzothiopyran-2-one; 3-(1RS,3RS;1RS,3SR)-3-(4'-Bromobiphenyl-4-yl)-1,2,3,4-tetrahydro-1-naphthyl)-4-hydroxy-1-benzothi-in-2-one

Trade names: LM-2219®; PROTECTA RAT BAIT STATION®; VETERAN PELLET®; VETERAN WAX BLOCK®

Chemical Class: Coumarin derivative

EPA/OPP PC Code: 128967

California DPR Chemical Code: 4014

HSDB Number: 7119

UN/NA & ERG Number: UN2588 (Pesticide, solid, poisonous, n.o.s.)/151; UN2902 (Pesticide, liquid, poisonous, n.o.s.)/151

RTECS® Number: DM0013800

EC Number: Not found

Uses: Introduced in 1986, this second-generation anticoagulant rodenticide (member of the hydroxy-4-benzothiopyranone family) is used to control mice and rats, including those resistant to first-generation anticoagulants. Not approved for use in most EU countries[115]. Approved for use in the U.S.

Regulatory Authority and Advisory Information:

Reproductive Toxin

Acute Oral Category: 1, DANGER–POISON

Very toxic by inhalation, in contact with the skin and if swallowed.

Regulations: Hazard Symbol: T+, T, N; risk phrases: R26/27/28; R48/23/24/25; R50, R53; R61; safety phrases: S2; S45; S53; S60; S61 (see Appendix 1)

WGK (German Aquatic Hazard Class): No value assigned.

Description: A white to light yellow powder.

Molecular weight = 539.48; Specific gravity (H_2O:1) = 1.36 @ 20°C; Boiling point = (decomposes); Freezing/Melting point = 203–227°C; Vapor pressure = 6×10^{-7} mmHg @ 25°C.

Low solubility in water; solubility = <0.5 g/L @ 25°C.

Incompatibilities: Incompatible with oxidizers, chlorates nitrates, peroxides and alkaline materials.

Determination in Water: Log K_{ow} = >6.0. Values above 3.0 are likely to bioaccumulate in aquatic organisms.

Routes of Entry: Ingestion, dermal and/or eye contact.

Harmful Effects and Symptoms

The onset of the symptoms of poisoning may be delayed for a few days following ingestion. Typical symptoms of poisoning include increased bleeding. Coagulation problems may be detected by laboratory analyses only. Large exposures may cause excessive bleeding from minor cuts or abrasions, bleeding from the gums and/or blood in feces. Massive internal bleeding may result in shock. A victim with anemia and/or liver disease may have more severe and persistent poisoning that may be extremely difficult to control.

Short Term Exposure: Highly toxic. Ingestion may cause hemorrhaging and possible death. May be absorbed through the unbroken skin. LD_{50} (oral, rat) = 550 μg/kg; LD_{50} (dermal, rat) = 5.3–6.5 mg/kg.

Long Term Exposure: May affect the liver and kidneys. Repeated exposure may cause low white blood cell count and affect the brain. May accumulate in the liver.

Points of Attack: Blood, liver, kidneys.

Medical Surveillance: Blood test for clotting time (PT, INR, or PTT). Stool and urine tests for blood. Liver and kidney function tests. Complete blood count. EEG.

First Aid: *Emergency Life-Support Procedures:* Acute exposure RUSH to health care facility; may require decontamination and life support for the victims. Emergency personnel should wear protective clothing appropriate to the type and degree of contamination. Air-purifying or supplied-air respiratory equipment should also be worn, as necessary. Rescue vehicles should carry supplies such as plastic sheeting and disposable plastic bags to assist in preventing spread of contamination. *Inhalation Exposure:* 1. Move victims to fresh air. Emergency personnel should avoid self-exposure. 2. Evaluate vital signs including pulse and respiratory rate, and note any trauma. If no pulse is detected, provide CPR. If not breathing, provide artificial respiration. If breathing is labored, administer oxygen or other respiratory support. 3. Obtain authorization and/or further instructions from the local hospital for administration of an antidote or performance of other invasive procedures. 4. RUSH to a health care facility. *Dermal/Eye Exposure:* 1. Remove victims from exposure. Emergency personnel should avoid self- exposure. 2. Evaluate vital signs including pulse and respiratory rate, and note any trauma. If no pulse is detected, provide CPR. If not breathing, provide artificial respiration. If breathing is labored, administer oxygen or other respiratory support. 3. Remove contaminated clothing as soon as possible. 4. If eye exposure has occurred, eyes must be flushed with lukewarm water for at least 15 minutes. 5. Wash exposed skin areas twice with soap and water. 6. Obtain authorization and/or further instructions from the local hospital for administration of an antidote or performance of other invasive procedures. 7. RUSH to a health care facility. *Ingestion Exposure:* 1. Evaluate vital signs including pulse and respiratory rate, and note any trauma. If no pulse is detected, provide CPR. If not breathing, provide artificial respiration. If breathing is labored, administer oxygen or other respiratory support. 2. Obtain authorization and/or further instructions from the local hospital for administration of an antidote or performance of other invasive procedures. 3. Vomiting may be induced with syrup of ipecac. If elapsed time since ingestion of diphacinone is unknown or suspected to be greater than 30 minutes, do not induce vomiting and RUSH to a health care facility. 4. Ipecac should not be administered to children under 6 months of age. ***Warning:*** Syrup of ipecac should be administered only if victims are alert, have an active gag-reflex, and show no signs of impending seizure or coma. If ANY uncertainty exists, RUSH to a health care facility. 4. The following dosages of ipecac are recommended: children up to 1 year old, 10 mL (1/3 oz); children 1 to 12 years old, 15 mL (1/2 oz); adults, 30 mL (1 oz). Ambulate (walk) the victims and give large quantities of water. If vomiting has not occurred after 15 minutes, ipecac may be re-administered. Continue to ambulate and give water to the victims. If vomiting has not occurred within 15 minutes after second administration of ipecac, administer activated charcoal. 4. Activated charcoal may be administered if victims are conscious and alert. Use 15 to 30 g (1/2 to 1 oz) for children, 50 to 100 g (1-3/4 to 3-1/2 oz) for adults, with 125 to 250 mL (1/2 to 1 cup) of water. 5. Promote excretion by administering a saline cathartic or sorbitol to conscious and alert victims. Children require 15 to 30 g (1/2 to 1 oz) of cathartic; 50

to 100 g (1-3/4 to 3-1/2 oz) is recommended for adults. 6. RUSH to a health care facility[83].

Note to physician: A collection of published articles. from the literature has been submitted to support the use of Vitamin K as an antidote in treating diphacinone poisoning[83]. See record number 2788 for HSDB (Hazardous Substance Data Bank).

Personal Protective Methods: For emergency situations, wear a positive-pressure, pressure-demand, full facepiece self-contained breathing apparatus (SCBA) or pressure-demand supplied-air respirator with escape SCBA and a fully- encapsulating, chemical-resistant suit. Safety equipment suppliers/manufacturers can provide recommendations on the most protective glove/clothing material for your operation. All protective clothing (suits, gloves, footwear, headgear) should be clean, available each day, and put on before work. Contact lenses should not be worn when working with this chemical. Employees should wash immediately with soap when skin is wet or contaminated. Provide emergency showers and eyewash.

Respirator Selection: Where potential exists for exposure to diphacinone, use a NIOSH/MSHA- or European Standard EN149-approved supplied-air respirator with a full facepiece operated in the positive-pressure mode, or with a full facepiece, hood, or helmet in the continuous-flow mode; or use a NIOSH/MSHA- or European Standard EN149-approved self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive-pressure mode.

Storage: Color Code-Blue: Health Hazard/Poison. Store in a secure poison location. Prior to working with this chemical you should be trained on its proper handling and storage. Store in tightly closed containers in a cool, well-ventilated area. Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: Pesticides, solid, toxic/poisonous, n.o.s require a shipping label of "poisonous materials" and fall in Hazard Class 6.1. Technical name required.

Spill Handling: First remove all sources of ignition. Evacuate persons not wearing protective equipment from area of spill or leak until clean up is complete. Do not touch spilled material; stop leak if you can do it without risk. Use water spray to reduce vapors. *Small spills*: take up with sand or other noncombustible absorbent material and place into containers for later disposal. *Small dry spills:* with clean shovel place material into clean, dry container and cover; move containers from spill area. *Large spills*: dike far ahead of spill for later disposal. Ventilate area after clean up is complete. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable.

Fire Extinguishing: Hazardous decomposition includes oxides of bromine, sulfur, and carbon. *On a small fire:* use dry chemical, CO_2 or water spray. *On a large fire:* use water spray, fog or regular foam. Move containers from fire area if you can do it without risk. Dike fire-control water for later disposal; do not scatter the material. Use water spray or fog; do not use straight streams. *Fire involving storage or vehicular tanks:* isolate for 800 meters/0.5 mile in all directions; also, consider initial evacuation for 800 meters/0.5 mile in all directions. Fight fire from maximum distance or use unmanned hose holders or monitor nozzles. Do not get water inside containers. Cool containers with flooding quantities of water until well after fire is out. Withdraw immediately in the case of rising sound from venting safety devices or discoloration of tank. ALWAYS stay away from tanks engulfed in fire. For massive fire, use unmanned hose holders or monitor nozzles; if this is impossible, withdraw from area and let fire burn. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies.

Disposal Method Suggested: In accordance with 40CFR165, follow recommendations for the disposal of pesticides and pesticide containers. Containers must be disposed of properly by following package label directions or by contacting your local or federal environmental control agency, or by contacting your regional EPA office.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- Krieger, R. (ed.). Handbook of Pesticide Toxicology. Volume 2, 2nd ed. 2001. Academic Press, San Diego, CA., p. 1822

Diflubenzuron D:0938

Use Type: Insecticide, Larvicide

CAS Number: 35367-38-5

Formula: $C_{14}H_9ClF_2N_2O_2$

Synonyms: AI 329054; Benzamide, *N*-[((4-chlorophenyl) amino)carbonyl]-2,6-difluoro; *N*-[((4-Chlorophenyl)amino) carbonyl]-2,6-difluorobenzamide; 1-(4-Chlorophenyl)-3-(2,6-difluorobenzoyl)urea; ENT 29,054; Urea, 1-(*p*-chlorophenyl)-3-(2,6-difluorobenzoyl)-

Trade Names: ADEPT®; ASTONEX®; DIMILIN®; DIMILIN® FLO; DIMILIN® WG-80; DU-112307®; DUPHAR® PH 60-40; ODC-45®; DIFLURON®; DU 112307®; LARGON®; LARVAKIL®; MICROMITE®; OMS 1804®; PDD 60401®; PH 60-40®; PHILIPS-DUPHAR® PH 60-40; TH 60-40®;

THOMPSON-HAYWARD® 6040; VIGILANTE®

Chemical Class: Benzoyl urea

EPA/OPP PC Code: 108201

California DPR Chemical Code: 1992

HSDB Number: 6611

UN/NA & ERG Number: UN3077(solid)/171; UN3082 (liquid)/171

RTECS® Number: YS6200000

EC Number: 252-529-3

Uses: Diflubenzuron is used primarily on citrus, cattle feed, cotton, forestry, mushrooms, ornamentals, pastures, soybeans, standing water, sewage systems, and wide-area general outdoor treatment sites. The insecticide behaves as a chitin inhibitor to inhibit the growth of many leaf-eating larvae, mosquito larvae, aquatic midges, rust mite, boll weevil, and house- black-, and stable-flies. Diflubenzuron was first registered in the United States in 1979 for use as an insecticide.

Human toxicity (long-term)[101]: Very low–140.00 ppb, Health Advisory

Fish toxicity (threshold)[101]: Intermediate–20.00 ppb, MATC (Maximum Acceptable Toxicant Concentration)

U.S. Maximum Allowable Residue Levels for Diflubenzuron [40 CFR 180.377(a)(1)]: in or on the following food commodities: artichokes 6.0 ppm; cattle, fat 0.05 ppm; cattle, meat byproducts 0.05 ppm; cattle, meat 0.05 ppm; cottonseed 0.2 ppm; eggs 0.05 ppm; goats, fat 0.05 ppm; goats, meat byproducts 0.05 ppm; goats, meat 0.05 ppm; grapefruit 0.5 ppm; hogs, fat 0.05 ppm; hogs, meat byproducts 0.05 ppm; hogs, meat 0.05 ppm; horses, fat 0.05 ppm; horses, meat byproducts 0.05 ppm; horses, meat 0.05 ppm; milk 0.05 ppm; mushrooms 0.2 ppm; orange 0.5 ppm; poultry, fat 0.05 ppm; poultry, meat byproducts 0.05 ppm; poultry, meat 0.05 ppm; sheep, fat 0.05 ppm; sheep, meat byproducts 0.05 ppm; sheep, meat 0.05 ppm; soybeans 0.05 ppm; soybean hulls 0.5 ppm; tangerine 0.5 ppm; and walnuts 0.1 ppm. *Regional registration, as defined in section 180.1(n)* ***[40 CFR 180.377(c)]*** in or on the following raw agricultural commodities: grass, pasture: 1.0 ppm; grass, range: 3.0 ppm.

Regulatory Authority and Advisory Information:

Carcinogenicity[83]: EPA Group E, evidence of non-carcinogenicity for humans.

Acute Oral Category: 3, CAUTION

EPCRA Section 313 Form R *de minimis* concentration reporting level: 1.0%

Description: Colorless or white crystalline solid. Molecular weight = 310.70; Boiling point = 257°C, decomposes; Freezing/Melting point = 228°C; Vapor pressure = 9×10^{-10} mmHg @ 25°C. Practically insoluble in water; solubility = 2×10^{-5} mg/L @ 20°C.

Incompatibilities: Keep away from strong oxidizers and alkaline materials. Slowly hydrolyzes in water, releasing ammonia and forming acetate salts.

Permissible Concentration in Water: Benzoyl urea may cause groundwater contamination. Runoff from spills or fire control may cause water pollution.

Determination in Water: Log K_{ow} = >3.5. Values above 3.0 are likely to bioaccumulate in marine organisms.

Harmful Effects and Symptoms

Short Term Exposure: Contact with eyes or skin may cause irritation or burns. Inhalation should be avoided; use NIOSH- or CEN (UK)-approved air-purifying respirators for pesticides. May be harmful if swallowed. Dermal contact may cause allergic reaction. May be a methemoglobin inducer. LD_{50} (oral, rat) = >1500–4640 mg/kg; LD_{50} (dermal, rat) = >2 g/kg.

Long Term Exposure: Repeated or prolonged contact may cause skin and lung sensitization, resulting in allergies. May cause the severe blood disorder methemoglobinemia.

Points of Attack: Skin, respiratory tract.

Medical Surveillance: Evaluation by a qualified allergist, including exposure history and testing, may help diagnose allergy. Blood tests for methemoglobinemia.

First Aid: If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least 15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately. If this chemical contacts the skin, remove contaminated clothing and wash immediately with soap and water. Seek medical attention immediately. If this chemical has been inhaled, remove from exposure, begin rescue breathing (using universal precautions) if breathing has stopped, and CPR if heart action has stopped. Transfer promptly to a medical facility. When this chemical has been swallowed, get medical attention. Give large quantities of water and induce vomiting. Do not make an unconscious person vomit.

Personal Protective Methods: For emergency situations, wear a positive-pressure, pressure-demand, full facepiece self-contained breathing apparatus (SCBA) or pressure-demand supplied-air respirator with escape SCBA and a fully encapsulating, chemical resistant suit[83] such as DuPont™ Tychem® suit fabrics.

Respirator Selection: Wherever and whenever workplace conditions warrant respirator use, a respiratory protection program must be followed that meets one or more of the following government standards: OSHA's 29 CFR 1910.134, ANSI Z88.2, or European Standard EN 149.

Storage: Color Code-Blue: Health Hazard/Poison. Store in a tightly closed container in a dry, well-ventilated and secure poison location. Prior to working with this chemical you should be trained on its proper handling and storage. Where possible, automatically transfer material from other storage containers to process containers. Always store pesticides in their original containers, complete with labels that list ingredients, directions for use, and first aid steps in case of accidental poisoning. Never store pesticides in cabinets with or near food, animal feed, or medical supplies. Do not store pesticides in places where flooding is possible or where they might spill or leak into wells, drains, ground water, or surface water. Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid.

Shipping: This material may be classified as Environmentally hazardous substances, solid, n. o. s. It usually falls in Hazard Class 9.

Spill Handling: Dampen the spilled material with water.

Clean up with dampened absorbent paper and transfer material to a suitable trash container. Seal the absorbent paper and your clothing in a vapor-tight plastic bag for eventual disposal. Wash all contaminated surfaces with a soap and water solution. Do not re-enter the contaminated area until an expert verifies that the area has been properly cleaned.

Fire Extinguishing: Hazardous decomposition includes toxic fumes of chlorine, fluorine, oxides of nitrogen. As an immediate precautionary measure, isolate spill or leak area in all directions for at least 50 meters/150 feet for liquids and at least 25 meters/75 feet for solids. *Fire involving storage or vehicular tanks:* isolate for 800 meters/0.5 mile in all directions; also, consider initial evacuation for 800 meters/0.5 mile in all directions. *On a small fire:* use dry chemical, CO_2, water spray or regular foam. *On a large fire:* use water spray, fog or regular foam. Do not scatter spilled material with high-pressure streams of water. Move containers from fire area if you can do it without risk. Dike fire-control water for later disposal. *Fire involving tanks:* from a secure, explosion-proof location, use water spray to cool exposed containers. If cooling streams are ineffective (venting sound increases in volume and pitch, tank discolors, or shows any signs of deforming), withdraw immediately to a secure position. Always stay away from tanks engulfed in fire. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode.

Disposal Method Suggested: Do not discharge into drains or sewers. Dispose of waste material as hazardous waste using a licensed disposal contractor to an approved landfill. Consult with environmental regulatory agencies for guidance on acceptable disposal practices. Incineration with effluent gas scrubbing is recommended. Containers must be disposed of properly by following package label directions or by contacting your local or federal environmental control agency, or by contacting your regional EPA office.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- EXTOXNET, Extension Toxicology Network, "Pesticide Information Profile, Diflubenzuron," Oregon State University, Corvallis, OR (June 1996). http://extoxnet.orst.edu/pips/difluben.htm
- USEPA, "Reregistration Eligibility Decision (RED), Duflubenzuron" Office of Prevention, Pesticides and Toxic Substances, Washington DC (August 1997). http://www.epa.gov/REDs/0144red.pdf

Diflufenican D:0939

Use Type: Herbicide
CAS Number: 83164-33-4
Formula: $C_{19}H_{11}F_5N_2O_2$
Synonyms: *N*-(2,4-Difluorophenyl)-2-[3-(trifluoromethyl) phenoxy]-3-pyridinecarboxamide; 2',4'-Difluoro-2-(α-α-α-trifluoro-*m*-tolyloxy)nicotinanilide; DFF; 3-Pyridinecarboxamide, *N*-(2,4-difluorophenyl)-2-[3-(trifluoromethyl)phenoxy]-
Trade Names: ARDENT®; BACARA®; CAPTURE® Diflufenican; COUGAR®; CUB®; GRENADIER®; IONIZ®; JAVELIN®; JAVELIN® GOLD; KWARC®; MB-38183®; M&B 38544®; PANTHER®; QUARTZ®; SPEARHEAD®
Chemical Class: Anilide
EPA/OPP PC Code: Not assigned
UN/NA & ERG Number: UN3077(solid)/171; UN3082 (liquid)/171
RTECS® Number: US4898000
EC Number: Not assigned [*Annex I Index No.:* 616-032-00-9]
Uses: Pre- and post-emergence foliar absorbed herbicide for winter weed control in cereal crops; carotenoid biosynthesis inhibitor. Used on crops such as apples, apricot, barley, beans (dry), broad beans, cherry, grapefruit, lemon, lime, loquat, natsudaidai (whole), nectarine, orange, peach, pear, peas, persimon, plum,quince, rye, soybeans, unshu orange and wheat. Not currently registered in the U.S. Approved for use in EU countries[115].

Regulatory Authority and Advisory Information:
Health Advisory: Developmental/Reproductive Toxin
Acute Oral Category: 3, CAUTION
Dangerous to the Environment
European/International Regulations: Hazard Symbol: N; risk phrases: R52/53; safety phrases: S2; S61 (see Appendix 1)

Description: Light brown oily liquid suspension. Comercial product may be suspended in water or hydrocarbon solvent. Strong ester odor. Molecular weight = 394.29; Specific gravity (H_2O:1) = 1.438; Boiling point = 376°C @ 760 mmHg; Freezing/Melting point = 161–162°C; Vapor pressure = 1.9×10^{-7} mmHg @25°C; Flash point = 181°C. Low solubility in water. Physical and toxicological properties may be affected by carrier solvents in commercial formulations.

Incompatibilities: Slowly hydrolyzes in water, releasing ammonia and forming acetate salts.

Determination in Water: Log K_{ow} = >4.0. Values above 3.0 are likely to bioaccumulate in aquatic organisms.

Routes of Entry: Ingestion, eye, dermal and/or eye contact.

Harmful Effects and Symptoms

Short Term Exposure: May irritate mucous membranes in the mouth and nose. Possible eye irritation. LD_{50} (oral, rat) = 2 g/kg; LD_{50} (dermal, rat) = 2 g/kg.

Long Term Exposure: Fluorides may cause bone disease (pain and tenderness of the bones); mottled teeth in children. May cause reproductive and fetal effects.

Points of Attack: Reproductive cells, bones.

Medical Surveillance: Preliminary medical exam to detect chronic diseases of central nervous system, liver, heart, kidneys, lung and skin, as well as endocrinological or immunological disturbances, should protect susceptible individuals. Periodical medical exams of internal organs, skin and eyes are important to avoid chronic occupational intoxications. They should include lab and patch tests when necessary[83]. In addition to comprehensive initial medical and work histories emphasizing reproductive experience and menstrual history, patient should have physical examination and testing of genito-urinary tract, sperm count, motility and morphology. If required, other tests, such as serum testosterone, serum follicle stimulating hormone (FSH), and serum lutenizing hormone (LH), may be indicated.

First Aid: If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least 15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately. If this chemical contacts the skin, remove contaminated clothing and wash immediately with soap and water. Seek medical attention immediately. If this chemical has been inhaled, remove from exposure, begin rescue breathing (using universal precautions) if breathing has stopped, and CPR if heart action has stopped. Transfer promptly to a medical facility. When this chemical has been swallowed, get medical attention. Give large quantities of water and induce vomiting. Do not make an unconscious person vomit. Do not induce vomiting when formulations containing petroleum solvents are ingested

Personal Protective Methods: Wear protective gloves and clothing to prevent any reasonable probability of dermal and/or eye contact. Safety equipment suppliers/manufacturers can provide recommendations on the most protective glove/clothing material for your operation. Employees should wash immediately with soap when skin is wet or contaminated. Provide emergency showers and eyewash.

Respirator Selection: Engineering controls should be used wherever feasible to maintain airborne concentrations of this chemical below the prescribed exposure limit. Respirators and protective equipment are less effective than engineering controls, and should be used only in nonroutine or emergency situations which may result in exposure concentrations in excess of the TWA environmental limit. *At any concentrations above the NIOSH REL, or where there is no REL, at any detectable concentration:* SCBAF: Pd,Pp (APF = 10,000) (any NIOSH/MSHA- or European Standard EN 149-approved self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode); or SaF: Pd,Pp: ASCBA (APF = 10,000) (any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary, self-contained breathing apparatus operated in a pressure-demand or other positive-pressure mode).

Storage: Color Code-Blue: Health Hazard/Poison. Store in a secure poison location. Prior to working with diflufenican you should be trained on its proper handling and storage. Store in tightly closed containers in a cool, well-ventilated area. Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: This material may be classified as Environmentally hazardous substances, solid, n. o. s. It usually falls in Hazard Class 9.

Spill Handling: First remove all sources of ignition. Evacuate persons not wearing protective equipment from area of spill or leak until clean up is complete. Collect powdered material in the most convenient and safe manner and deposit in sealed containers. Ventilate area after clean up is complete. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable.

Fire Extinguishing: Hazardous decomposition includes oxides of nitrogen and carbon and hydrogen fluoride gas. As an immediate precautionary measure, isolate spill or leak area in all directions for at least 50 meters/150 feet for liquids and at least 25 meters/75 feet for solids. *Fire involving storage or vehicular tanks:* isolate for 800 meters/0.5 mile in all directions; also, consider initial evacuation for 800 meters/0.5 mile in all directions. *On a small fire:* use dry chemical, CO_2, water spray or regular foam. *On a large fire:* use water spray, fog or regular foam. Do not scatter spilled material with high-pressure streams of water. Move containers from fire area if you can do it without risk. Dike fire-control water for later disposal. *Fire involving tanks:* from a secure, explosion-proof location, use water spray to cool exposed containers. If cooling streams are ineffective (venting sound increases in volume and pitch, tank discolors, or shows any signs of deforming), withdraw immediately to a secure position. Always stay away from tanks engulfed in fire. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode.

Disposal Method Suggested: Do not discharge into drains or sewers. Dispose of waste material as hazardous waste using a licensed disposal contractor to an approved landfill. Consult with environmental regulatory agencies for guidance on acceptable disposal practices. If allowed, incineration with effluent gas scrubbing is recommended. Containers must be disposed of properly by following package label directions or by contacting your local or federal environmental control agency, or by contacting your regional EPA office.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- United States National Library of Medicine, ChemIDplus Advanced, Bethesda, MD. http://chem.sis.nlm.nih.gov/chemidplus/rn/83164-33-4

Dimethenamid D:1033

Use Type: Herbicide
CAS Number: 87674-68-8; 163515-14-8 (-P)
Formula: $C_{12}H_{18}ClNO_2S$
Synonyms: Acetamide, 2-chloro-*N*-(2,4-dimethyl-3-thienyl)-*N*-(2-methoxy-1-methylethyl)-; 2-Chloro-*N*-(2,4-dimethyl-3-thienyl)-*N*-(2-methoxy-1-methylethyl) acetamide; 2-Chloro-*N*-[(1-methyl-2-methoxy)-ethyl]-*N*-(2,4-dimethyl-thien-3-yl)acetamide
Trade Names: DETAIL®; DPX-PM082® (formulation containing dimethenamid, chlorimuron-ethyl, and sodium sulforicinol); FRONTIER®; GUARDSMAN®; LEADOFF® (atrazine + dimethenamid), DuPont™ Crop Protection; PURSUIT®; OPTILL®; SAN-582H®
Chemical Class: Amide Herbicide
EPA/OPP PC Code: 129051 as dimethenamid-P
California DPR Chemical Code: 5112
HSDB Number: 7935 as dimethenamid-P
UN/NA & ERG Number: UN3082 (liquid)/171
RTECS® Number: AB54442000
Uses: A U.S. EPA restricted Use Pesticide (RUP) as Dimethenamide-P. Not approved for use in EU countries[115].
U.S. Maximum Allowable Residue Levels for Dimethenamid [40 CFR 180.464(a)]: Bean, dry, seed 0.01 ppm; beet, garden, roots 0.01 ppm; beet, garden, tops 0.01 ppm; beet, sugar, dried pulp 0.01 ppm; beet, sugar, molasses 0.01 ppm; beet, sugar, roots 0.01 ppm; beet, sugar, tops 0.01 ppm; corn, field, forage 0.01 ppm; corn, field, grain 0.01 ppm; corn, field, stover 0.01 ppm; corn, pop, forage 0.01 ppm; corn, pop, grain 0.01 ppm; corn, pop, stover 0.01 ppm; corn, sweet, forage 0.01 ppm; corn, sweet, kernel plus cob with husks removed 0.01 ppm; corn, sweet, stover 0.01 ppm; garlic 0.01 ppm; grass, forage 0.15 ppm; grass, hay 2.5 ppm; grass, seed screenings 0.01 ppm; grass, straw 0.01 ppm; hop, dried cones 0.05 ppm; horseradish 0.01 ppm; leek 0.01 ppm; onion, bulb 0.01 ppm; onion, green 0.01 ppm; onion, Welsh 0.01 ppm; peanut 0.01 ppm; peanut, hay 0.01 ppm; radish, roots 0.01 ppm; radish, tops 0.01 ppm; rutabaga, roots 0.01 ppm; rutabaga, tops 0.1 ppm; shallot, bulb 0.01 ppm; shallot, fresh leaves 0.01 ppm; sorghum, grain, forage 0.01 ppm; sorghum, grain, grain 0.01 ppm; sorghum, grain, stover 0.01 ppm; soybean, seed 0.01 ppm; turnip, greens 0.1 ppm; turnip, roots 0.01 ppm; turnip, tops 0.1 ppm; vegetable, tuberous and corm, subgroup 1C, 0.01 ppm. ***Dimethenamid applied as either the 90: 10 or 50: 50 S: R isomers [40CFR180.464(c)]:*** in or on Pumpkin 0.01 ppm; Squash, winter 0.01 ppm.
Human toxicity (long-term) [101]***:*** Intermediate–35.00 ppb, Health Advisory
Fish toxicity (threshold) [101]***:*** Low–169.70710 ppb, MATC (Maximum Acceptable Toxicant Concentration)
Regulatory Authority and Advisory Information:
Potential Ground Water Pollutant [California FAC Section 13145(d)/12811, active] (-P)
Acute Oral Category: 2, WARNING
Description: Dark yellow-brown viscous liquid. Aromatic odor; Molecular weight = 275.79; 123 (P-); Specific gravity (H_2O:1) = 1.195; Boiling point = 383; 127–130°C (-P); Flash point = 285°C; 90°C (-P); Autoignition temperature (-P) = >400°C. Soluble in water; solubility = 1165 ppm.
Incompatibilities: Slowly hydrolyzes in water, releasing ammonia and forming acetate salts.
Determination in Water: Log K_{ow} = <2.0. Unlikely to bioaccumulate in marine organisms.
Routes of Entry: Skin, eyes, inhalation.
Harmful Effects and Symptoms
Short Term Exposure: Contact with eyes or skin may cause irritation or injury. Inhalation should be avoided; use. May be harmful if swallowed. Skin sensitization. LD_{50} (oral, rat) = 380 mg/kg; >5 g/kg (-P).
Long Term Exposure: May cause skin problems.
Points of Attack: skin sensitization.
Medical Surveillance: Preliminary medical exam to detect chronic diseases of central nervous system, liver, heart, kidneys, lung and skin, as well as endocrinological or immunological disturbances, should protect susceptible individuals. Periodical medical exams of internal organs, skin and eyes are important to avoid chronic occupational intoxications. They should include lab and patch tests when necessary[83]. Evaluation by a qualified allergist, including exposure history and testing, may help diagnose allergy.
First Aid: If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least 15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately. If this chemical contacts the skin, remove contaminated clothing and wash immediately with soap and water. Seek medical attention immediately. If this chemical has been inhaled, remove from exposure, begin rescue breathing (using universal precautions) if breathing has stopped, and CPR if heart action has stopped. Transfer promptly to a medical facility. When this chemical has been swallowed, get medical attention. Give large quantities of water and induce vomiting. Do not make an unconscious person vomit.
Personal Protective Methods: Applicators and other handlers must wear: Coveralls worn over long-sleeved shirt and long pants; Chemical-resistant gloves such as DuPont™ Tychem® suit fabrics, barrier laminate, or Viton®; Chemical-resistant footwear plus socks; Protective eye wear; Chemical-resistant headgear for overhead exposure; Chemical-resistant apron when cleaning equipment, mixing, or loading[83]. Agricultural Use/Engineering Controls: When handlers use closed systems, enclosed cabs, or

aircraft in a manner that meets the requirements listed in the Worker Protection Standard (WPS) for agricultural pesticides, ***40 CFR 170.240(d)(4-6),*** the handler PPE requirements may be reduced or modified as specified in the Worker Protection Standard. Firefighters should wear NIOSH approved self-contained breathing apparatus and full protective clothing.

Respirator Selection: Wherever and whenever workplace conditions warrant respirator use, a respiratory protection program must be followed that meets one or more of the following government standards: OSHA's 29 CFR 1910.134, ANSI Z88.2, or European Standard EN 149.

Storage: Color Code-Blue: Health Hazard/Poison. Store in a secure poison location. Prior to working with this chemical you should be trained on its proper handling and storage. Store in tightly closed containers in a cool, well-ventilated area. If this material contains a flammable carrier, sources of ignition, such as smoking and open flames, are prohibited where this chemical is used, handled, or stored in a manner that could create a potential fire or explosion hazard. Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: This material may be classified as Environmentally hazardous substances, solid, n. o. s. It usually falls in Hazard Class 9.

Spill Handling: For liquids, isolate spill or leak area in all directions for at least 50 meters /150 feet. Increase, in the downwind direction, as necessary. Do not touch damaged containers or spilled material unless wearing appropriate protective clothing. Stop leak if you can do it without risk. Prevent entry into waterways, sewers, basements or confined areas. Cover with plastic sheet to prevent spreading. Absorb or cover with dry earth, sand or other non-combustible material and transfer to containers. Do not allow water to get inside containers.

Fire Extinguishing: Hazardous decomposition includes oxides of nitrogen, sulfur and carbon and hydrogen chloride gas. As an immediate precautionary measure, isolate spill or leak area in all directions for at least 50 meters/150 feet for liquids and at least 25 meters/75 feet for solids. *Fire involving storage or vehicular tanks:* isolate for 800 meters/0.5 mile in all directions; also, consider initial evacuation for 800 meters/0.5 mile in all directions. *On a small fire:* use dry chemical, CO_2, water spray or regular foam. *On a large fire:* use water spray, fog or regular foam. Do not scatter spilled material with high-pressure streams of water. Move containers from fire area if you can do it without risk. Dike fire-control water for later disposal. *Fire involving tanks:* from a secure, explosion-proof location, use water spray to cool exposed containers. If cooling streams are ineffective (venting sound increases in volume and pitch, tank discolors, or shows any signs of deforming), withdraw immediately to a secure position. Always stay away from tanks engulfed in fire. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode.

Disposal Method Suggested: Do not discharge into drains or sewers. Dispose of waste material as hazardous waste using a licensed disposal contractor to an approved landfill. Consult with environmental regulatory agencies for guidance on acceptable disposal practices. If allowed, incineration with effluent gas scrubbing is recommended. Containers must be disposed of properly by following package label directions or by contacting your local or federal environmental control agency, or by contacting your regional EPA office.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- USEPA, Office of Pesticide Programs, Pesticide Residue Limits, "Dimethenamid", 40 CFR 180.464. http://www.epa.gov/pesticides/food/viewtols.htm

Dimethipin D:1036

Use Type: Plant growth regulator, Defoliant

CAS Number: 55290-64-7

Formula: $C_6H_{10}O_4S_2$

Synonyms: Caswell No. 472AA; 2,3-Dehydro-2,3-dimethyl-tetroxide; 2,3-dihydro-5,6-dimethyl-1,4-dithiin 1,1,4,4-tetraoxide; 2,3,-Dihydro-5,6-dimethyl-1,4-dithiin 1,1,4,4-tetraoxide; 2,3-Dihydro-5,6-dimethyl-1,4-dithiin 1,1,4,4-tetraoxide; *p*-Dithiane, dimethipin [2,3,-dihydro-5,6-dimethyl-1,4-dithiin-1,1,4,4-tetraoxide]; 2,3-*p*-Dithiane, 2,3-dehydro-2,3-dimethyl-, tetroxide; 1,4-Dithiin, 2,3-dihydro-5,6-dimethyl-,1,1,4,4-tetraoxide; Oxidimethiin; Oxydimethiin

Trade Names: HARVADE®; HARVADE-25F®; LEAFLESS® Dimethipin; N 252®; TETRATHIIN®; UBI-N 252®

Chemical Class: Unclassified

EPA/OPP PC Code: 118901; (210600 old EPA code number)

California DPR Chemical Code: 2159

HSDB Number: 6615

UN/NA & ERG Number: UN2811/154

RTECS® Number: JO5090000

EC Number: 259-572-7

Uses: Plant and harvest growth regulant. Defoliant used on cotton crops, beans (dry), vines, plants, and trees. Desiccant for canola seeds, flax, maize, rice, oilseed rape, and sunflowers. Not approved for use in the U.S. or EU countries[115]. There are 17 global suppliers[97].

U.S. Maximum Allowable Residue Levels for Dimethipin [40 CFR 180.406]: in or on cottonseed 0.5 ppm; cattle, fat 0.02 ppm; cattle, meat 0.02 ppm; cattle, meat byproducts 0.02 ppm; goats, fat 0.02 ppm; goats, meat 0.02 ppm; goats, meat byproducts 0.02 ppm; hogs, fat 0.02 ppm; hogs, meat 0.02 ppm; hogs, meat byproducts 0.02 ppm; horses, fat 0.02 ppm; horses, meat 0.02 ppm; horses, meat byproducts 0.02 ppm; sheep, fat 0.02 ppm; sheep, meat 0.02 ppm; and sheep, meat byproducts 0.02 ppm. ***[40 CFR 186.2050]:*** in or on the following processed feeds when present therein as a result of application to the growing crops: cottonseed hulls 0.7 ppm. (1996)

Regulatory Authority and Advisory Information: Carcinogenicity[83]: EPA Group C, Possible human carcinogen
Acute Oral Category: 2, WARNING
EPCRA Section 313 Form R *de minimis* concentration reporting level: 1.0%

Description: White crystalline solid or needles. Commercial product may be a concentrated liquid suspension. Molecular weight = 210.28; Specific gravity (H_2O:1) = 1.59; Freezing/Melting point = 168°C; Vapor pressure = 4×10^{-7} mmHg @ 25°C. Henry's Law constant = 1.7 x10^{-8} Pa-m^3/mole @ 25°C[83,USDA]. Highly soluble in water; decomposes. Physical and toxicological properties may be affected by carrier solvents in commercial formulations.

Incompatibilities: Slowly decomposes in water. Keep away from strong oxidizers and nitrates.

Determination in Water: Log K_{ow} = <– 1. Unlikely to bioaccumulate in marine organisms.

Routes of Entry: Inhalation of dust particles, dermal and/or eye contact.

Harmful Effects and Symptoms

Short Term Exposure: Irritates the eyes, skin and respiratory tract. Poisonous if ingested; LD_{50} (dermal, rat) = 400–1000 mg/kg; LD_{50} (dermal, rabbit) = >7500 mg/kg.

Long Term Exposure: May result in skin sensitization.

Points of Attack: Skin sensitizer.

Medical Surveillance: This chemical is a suspected or known human carcinogen. Exposed persons should contact a physician for advice regarding the possible long term health effects and advice for medical monitoring. Evaluation by a qualified allergist, including exposure history and testing, may help diagnose allergy.

First Aid: If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least 15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately. If this chemical contacts the skin, remove contaminated clothing and wash immediately with soap and water. Seek medical attention immediately. If this chemical has been inhaled, remove from exposure, begin rescue breathing (using universal precautions) if breathing has stopped, and CPR if heart action has stopped. Transfer promptly to a medical facility. When this chemical has been swallowed, get medical attention. Give large quantities of water and induce vomiting. Do not make an unconscious person vomit.

Personal Protective Methods: Wear protective gloves and clothing to prevent any reasonable probability of dermal and/or eye contact. Safety equipment suppliers/manufacturers can provide recommendations on the most protective glove/clothing material for your operation. One recommendation is the use of DuPont™ Tychem® suit fabrics[88] All protective clothing (suits, gloves, footwear, headgear) should be clean, available each day, and put on before work. Contact lenses should not be worn when working with this chemical. Wear splash-proof chemical goggles and face shield unless full facepiece respiratory protection is worn. Employees should wash immediately with soap when skin is wet or contaminated. Provide emergency showers and eyewash.

Respirator Selection: Wherever and whenever workplace conditions warrant respirator use, a respiratory protection program must be followed that meets one or more of the following government standards: OSHA's 29 CFR 1910.134, ANSI Z88.2, or European Standard EN 149.

Storage: Color Code-Blue: Health Hazard/Poison. Store in a secure poison location. Prior to working with this chemical you should be trained on its proper handling and storage. Store in tightly closed containers in a cool, well-ventilated area. Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: Toxic, solids, organic, n.o.s. require a label of "poisonous materials." This material falls in Hazard Class 6.1 and Packing Group III.

Spill Handling: First remove all sources of ignition. Evacuate persons not wearing protective equipment from area of spill or leak until clean up is complete. Ventilate area of spill or leak. Use water spray to reduce vapor. Absorb liquids in vermiculite, dry sand, earth, or a similar material and deposit in sealed containers. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable.

Fire Extinguishing: Hazardous decompositon includes oxides of carbon and sulfur. *Fire involving storage or vehicular tanks:* isolate for 800 meters/0.5 mile in all directions; also, consider initial evacuation for 800 meters/0.5 mile in all directions. *Small fire:* dry chemical, carbon dioxide or water spray. *Large fire:* dry chemical, carbon dioxide, alcohol-resistant foam or water spray. Move containers from fire area if you can do it without risk. Dike fire-control water for later disposal; do not scatter the material. *Fire involving tanks or car/trailer loads:* fight fire from maximum distance or use unmanned hose holders or monitor nozzles. Do not get water inside containers. Cool containers with flooding quantities of water until well after fire is out. Withdraw immediately in the case of rising sound from venting safety devices or discoloration of tank. Always stay away from tanks engulfed in fire. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode.

Disposal Method Suggested: Do not discharge into drains or sewers. Dispose of waste material as hazardous waste using a licensed disposal contractor to an approved landfill. Consult with environmental regulatory agencies for guidance on acceptable disposal practices. If allowed, incineration with effluent gas scrubbing is recommended. Containers must be disposed of properly by following package label directions or by contacting your local or federal environmental control agency, or by contacting your regional EPA office.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- USEPA, Office of Pesticide Programs, Pesticide Residue Limits, "Dimethenamid", 40 CFR 180.464. http://www.epa.gov/pesticides/food/viewtols.htm

Dimethoate D:1040

Use Type: Insecticide, Miticide

CAS Number: 60-51-5

Formula: $C_5H_{12}NO_3PS_2$; $H_3COP(S)(OCH_3)SCH_2CONHCH_3$

Synonyms: Acetic acid, *O,O*-dimethyldithiophosphoryl-, *N*-monomethylamide Salt; *O,O*-Dimethyl *S*-(*N*-methylcarbamoylmethyl)dithiophosphate; Phosphorodithioic acid, *O,O*-dimethyl *S*-[2-(methylamino)-2-oxoethyl] ester; Phosphamide

Trade Names: REBELATE®; CEKUTHOATE®; CHIMIGOR 40®; CYGON 400®[C]; DEFEND®; DAPHENE®; DANADIM®; DANADIM® PROGRESS; DE-FEND®; DEMOS NF®; DEVIGON®; DICAP®; DIMATE 267®; DIMET®; DIMETHOATE 40; DIMETHOPGAN®; FERKETHION®; FOSTION MM®; KENLOGO®; NUGOR®; PERFEKTION®; ROGODAN®; ROGODIAL®; ROGOR®; ROXION®; SEVIGOR®

Chemical Class: Organophosphate

EPA/OPP PC Code: 035001

California DPR Chemical Code: 216

HSDB Number: 1586

UN/NA & ERG Number: UN2783 (solid)/152; UN3018 (liquid)/152

RTECS® Number: TE1750000

EC Number: 200-480-3 [*Annex I Index No.:* 015-051-00-4]

Uses: Dimethoate is used to kill mites and insects systemically and on contact. It is used against a wide range of insects, including aphids, thrips, planthoppers, and whiteflies on ornamental plants, alfalfa, apples, corn, cotton, grapefruit, grapes, lemons, melons, oranges, pears, pecans, safflower, sorghum, soybeans, tangerines, tobacco, tomatoes, watermelons, wheat, and other vegetables. It is also used as a residual wall spray in farm buildings for house flies. Dimethoate has been administered to livestock for control of botflies. Dimethoate is available in aerosol spray, dust, emulsifiable concentrate, and ULV concentrate formulations.

U.S. Maximum Allowable Residue Levels for Dimethoate including its oxygen analog [O,O-dimethyl S-(N-methylcarbamoylmethyl) phosphorothioate] [40CFR 180.204(a)]: Alfala 2 ppm; apple 2 ppm; bean, dry, seed 2 ppm; bean, lima 2 ppm; bean, snap, succulent 2 ppm; broccoli 2 ppm; cabbage 2 ppm; cattle, meat byproducts 0.02 ppm; cauliflower 2 ppm; celery 2 ppm; citrus, dried pulp 5 ppm; collards 2 ppm; corn, forage 1 ppm; corn, grain 0.1 ppm; corn, stover 1 ppm; cotton, undelinted seed 0.1 ppm; egg 0.02 ppm; endive (escarole) 2 ppm; goat, meat byproducts 0.02 ppm; grapefruit 2 ppm; grape 1 ppm; hog, meat byproducts 0.02 ppm; horse, meat byproducts 0.02 ppm; kale 2 ppm; lemon 2 ppm; lentil, seed 2.0 lettuce 2 ppm; melon 1 ppm; milk 0.002 ppm; mustard greens 2 ppm; orange, sweet 2 ppm; pear 2 ppm; pea 2 ppm; pecans 0.1 ppm; pepper 2 ppm; potato 0.2 ppm; poultry, meat byproducts 0.02 ppm; safflower, seed 0.1 ppm; sheep, meat byproducts 0.02 ppm; sorghum, forage 0.2 ppm; sorghum, grain 0.1 ppm; soybean 0.05 ppm; soybean, forage 2 ppm; soybean, hay 2 ppm; spinach 2 ppm; Swiss chard 2 ppm; tangerine 2 ppm; tomato 2 ppm; turnip, greens 2 ppm; turnip, roots 2 ppm; wheat, grain 0.04 ppm; wheat, hay 2 ppm; wheat, straw 2 ppm. [*40CFR 180.204 ppm(c)*]: asparagus 0.15 ppm; Brussels sprouts 5 ppm; cherry 2 ppm.

Human toxicity (long-term) [101]***:*** Extra high–0.35 ppb, Health Advisory

Fish toxicity (threshold) [101]***:*** Very low–600.99381 ppb, MATC (Maximum Acceptable Toxicant Concentration)

Regulatory Authority and Advisory Information:

Carcinogenicity[83]: EPA Group C, Possible human carcinogen

Acute Oral Category: 2, WARNING

Health Advisory: Nerve Toxin, Mutagen, Developmental/Reproductive Toxin, Developmental toxin (TRI)

Potential Ground Water Pollutant [California FAC Section 13145(d)/12811, active]

U.S. EPA Hazardous Waste Number (RCRA No.): P044

RCRA 40CFR264, appendix 9; TSD Facilities Ground Water Monitoring List. Suggested test method(s) (PQL μg/L): 8270 (10)

Superfund/EPCRA 302 Extremely Hazardous Substances: TPQ = 500/10,000 lb (227/4540 kg)

CERCLA Reportable Quantity (RQ): 10 lb (4.54 kg)

EPCRA Section 313 Form R *de minimis* concentration reporting level: 1.0%

US DOT 49CFR172.101, Inhalation Hazardous Chemical as organophosphates

US DOT Regulated Marine Pollutant (49CFR172.101, appendix B)

European/International Regulations: Hazard Symbol: Xn; risk phrases: R21/22; safety phrases: S2; S36/37 (see Appendix 1)

Description: Dimethoate is a white crystalline solid with a camphor-like odor. Molecular weight = 229.27; Specific gravity (H_2O:1) = 1.277 @ 65°C; Boiling point = (decomposes) 117°C; Freezing/Melting point = 52°C; flash point – 106.7. Hazard Identification (based on NFPA-704 M Rating System): Health 3, Flammability 2, Reactivity 0. Readily soluble in water; solubility = >4000 mg/L.

Incompatibilities: Unstable in strong bases (alkalis). In the presence of strong reducing agents such as hydrides, organophosphates form highly toxic and flammable phosphine gas. Contact with oxidizers can cause the release of toxic oxides of phosphorus.

Permissible Exposure Limits in Air: Protective Action Criteria (PAC) Ver. 27[89]

PAC-1: 2.7 mg/m^3
PAC-2: 30 mg/m^3
PAC-3: 30 mg/m^3

Determination in Air: OSHA versatile sampler-2; Toluene/Acetone; Gas chromatography/Flame photometric detection for sulfur, nitrogen, or phosphorus; NIOSH Method IV Method #5600, Organophosphorus pesticides[18].

Permissible Concentration in Water: State Drinking Water Guidelines: Arizona 1.2 μg/L; Florida 5 μg/L; California 1 μg/L; Wisconsin 2 μg/L. Canadian Drinking Water Standards: IMAC 0.02 mg/L.

Determination in Water: NIOSH Method 1657. The determination of organophosphorus pesticides in municipal and industrial wastewater by gas chromatography. Detection limit = 6.0 ng/L. Log K_{ow} = <1.0. Unlikely to bioaccumulate in marine organisms.

Routes of Entry: Inhalation, skin absorption, eyes and ingestion.

Harmful Effects and Symptoms

Organophosphates are highly toxic. Symptoms may develop rapidly, or there may be a delay of several hours following exposure before they become noticeable. The delay tends to be longer in the case of some compounds that dissolve fats, lipids, oils and non-polar solvents such as toluene. Symptoms may increase in severity for more than a single day and last for several days. In severe cases of organophosphate intoxication, respiratory failure may occur.

Short Term Exposure: Acute exposure to dimethoate may produce the following signs and symptoms: pinpoint pupils, blurred vision, headache, dizziness, muscle spasms, and profound weakness. Vomiting, diarrhea, abdominal pain, seizures, and coma may also occur. The heart rate may decrease following oral exposure or increase following dermal exposure. Low blood pressure and chest pain may be noted. High blood pressure is not uncommon. Respiratory effects may include dyspnea (shortness of breath), respiratory depression, and respiratory paralysis. Psychosis may occur. Dimethoate is a cholinesterase inhibitor, meaning it affects the central nervous system. Death is due to respiratory arrest arising from failure of respiratory center, paralysis of respiratory muscles, intense bronchoconstriction or all three, Dimethoate is a mutagen. Mutagens may have a cancer risk. All contact with this chemical should be reduced to the lowest possible level. Delayed pulmonary edema may occur after inhalation. LD_{50} (oral, rat) = 60 mg/kg; LD_{50} (dermal, rat) = <400 mg/kg.

Long Term Exposure: May cause tumors. Repeated or prolonged contact with skin may cause dermatitis. Cholinesterase inhibitor; cumulative effect is possible. A nerve toxin; this chemical may damage the nervous system with repeated exposure, resulting in convulsions, respiratory failure. May cause liver damage. Animal tests indicate that this chemical possibly causes toxic effects upon human reproduction. May cause reproductive and fetal effects.

Points of Attack: Respiratory system, lungs, central nervous system, cardiovascular system, skin, eyes, plasma and red blood cell cholinesterase. Reproduction system.

Medical Surveillance: This chemical is a suspected or known human carcinogen. Exposed persons should contact a physician for advice regarding the possible long term health effects and advice for medical monitoring. Medical observation is recommended for 24 to 48 hours following breathing overexposure, as pulmonary edema may be delayed. Routine biological monitoring of pesticide applicators and field workers includes testing of plasma and red blood cell acetylcholinesterase levels (for enzyme poisoned by this chemical). These tests are normally accurate only if done within about two hours of exposure. If exposure stops, plasma levels return to normal in 1–2 weeks while red blood cell levels may be reduced for 1–3 months. When acetylcholinesterase enzyme levels are reduced by 25% or more below preemployment levels, risk of poisoning is increased, even if results are in lower ranges of "normal." Reassignment to work not involving organophosphate pesticides is recommended until enzyme levels recover. Do not drink any alcoholic beverages before or during use as it promotes absorption of organophosphates. In addition to comprehensive initial medical and work histories emphasizing reproductive experience and menstrual history, patient should have physical examination and testing of genito-urinary tract, sperm count, motility and morphology. If required, other tests, such as serum testosterone, serum follicle stimulating hormone (FSH), and serum lutenizing hormone (LH), may be indicated.

First Aid: **Treatment for organophosphate poisoning consists of thorough decontamination, cardiorespiratory support, and administration of the antidotes atropine and pralidoxime. In cases of severe poisoning, diazepam, an anticonvulsant, should also be administered. Antidotes should be administered as prevention even if the diagnosis is in doubt**. Speed in removing material from eyes and skin is of extreme importance. *Eyes:* Eye contact can cause dangerous amounts of these chemicals to be quickly absorbed through the mucous membrane into the bloodstream. Immediately and gently flush eyes with plenty of warm or cold water (NO hot water) for at least 15 minutes, occasionally lifting the upper and lower eyelids. Get medical aid immediately. *Skin:* Get medical aid. Dermal contact can cause dangerous amounts of these chemicals to be absorbed into the bloodstream. Wearing the appropriate PPE equipment and respirator for organophosphate/carbamate pesticides, immediately flush skin with plenty of soap and water for at least 15 minutes while removing contaminated clothing and shoes. Shampoo hair promptly if contaminated. The removed, contaminated clothing and shoes should be double-bagged and left in Hot Zone for later disposal by hazardous materials experts. Skin may also be decontaminated with diluted hypochlorite solution. *Inhalation:* Get medical aid. Do not contaminate yourself. Wearing the appropriate PPE equipment and respirator for organophosphate pesticides, immediately remove the victim from the contaminated area to fresh air. If the victim is not breathing, administer artificial respiration. Do not use mouth-to-mouth method if victim ingested or inhaled the substance; give artificial respiration with the aid of a pocket mask equipped with a one-way valve or other proper respiratory medical device. If breathing is difficult, administer oxygen through bag/mask apparatus until medical help arrives. Do not leave victim unattended. *Ingestion:* Call poison control. Loosen all clothing. Never give anything by mouth to an unconscious person. If victim is *unconscious or having convulsions,* do nothing except keep victim warm. Get medical aid. Transfer promptly to a medical facility. In cases of ingestion, **do not induce vomiting**. If the victim is alert and asymptomatic, administer a slurry of activated charcoal at a dose of 1 g/kg (infant, child, and adult dose). A soda can and straw may be of assistance when offering charcoal to a child. *In some cases you may be specifically instructed by poison control to induce vomiting by way of 2 tablespoons of syrup of ipecac (adult) washed down with a cup of water*. Do NOT give activated charcoal before or with ipecac syrup. *Note to physician or authorized medical personnel:* Treat cases of respiratory compromise, coma, or excessive pulmonary secretions with respiratory support using protocols and techniques available and within the scope of training. Some cases may necessitate procedures such as endotracheal intubation or cricothyrotomy by properly trained and equipped personnel. When possible, atropine (see *Antidotes*, below) should be given under medical supervision. Patients who are comatose, hypotensive, or having seizures or cardiac arrhythmias should be treated according to advanced life support protocols. *Antidotes:* Two antidotes are administered to treat organophosphate poisoning. Atropine is a competitive antagonist of acetylcholine at muscarinic receptors and is used to control the excessive bronchial secretions which are often responsible for death. Pralidoxime relieves both the nicotinic and muscarine effects of organophosphate poisoning by regenerating acetylcholinesterase and can reduce both the bronchial secretions and the muscle weakness associated with poisoning. The initial intravenous dose of atropine in adults should be determined by the severity of symptoms: An initial adult dose of 1.0 to 2.0 mg or pediatric dose of 0.01 mg/kg (minimum 0.01 mg) should be administered intravenously. If intravenous access cannot be established, atropine may also be given intramuscularly, subcutaneously or via endotracheal tube. Doses should be repeated every 15 minutes until excessive secretions and sweating have been controlled. Once bronchial secretion has been controlled, atropine administration should be repeated whenever the secretions begin to recur. In seriously poisoned patients, very large doses may be required. Alterations of pulse rate and pupillary size should not be used as indicators of treatment adequacy. Pralidoxime should be administered as early in poisoning as possible as its efficacy may diminish when given more than 24 to 36 hours after exposure. Doses are as follows: adult 1.0 g; pediatric 25 to 50 mg/kg. The drug should be administered intravenously over 30 to 60 minutes, but in a life-threatening situation one-half of the total dose can be given per minute for a total administration time of 2 minutes. Treatment should begin to take effect within 40 minutes with a reduction in symptoms and the amount of atropine necessary to control bronchial secretion. The initial dose can be repeated in 1 hour and then every 8 to 12 hours until the patient is clinically well and no longer requires atropine. If intravenous access cannot be established, pralidoxime may also be given intramuscularly. Early administration of diazepam in addition to the combined atropine and pralidoxime treatment may help prevent the onset of seizures and potential brain and cardiac morphologic damage following high-level organophosphate poisoning.

Respirator Selection: SCBA >2.7 mg/m^3. Wherever and whenever workplace conditions warrant respirator use, a respiratory protection program must be followed that meets one or more of the following government standards: OSHA's 29 CFR 1910.134, ANSI Z88.2, or European Standard EN 149.

Storage: Color Code-Blue: Health Hazard/Poison. Store in a secure poison location. Do not store solid above 25–30°C. Liquid solutions must be stored above 7°C. Prior to working with this chemical you should be trained on its proper handling and storage. Where possible, automatically transfer material from other storage containers to process containers. Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: Organophosphorous pesticides, solid or liquid (nonflammable), require a "poisonous materials" label. This chemical falls in Hazard Class 6.1.

Spill Handling: First remove all sources of ignition. Evacuate persons not wearing protective equipment from area of spill or leak until clean up is complete. Stay upwind; keep out of low areas. Ventilate area of spill or leak. Remove and isolate contaminated clothing at the site. Do not touch spilled material; stop leak if you can do so without risk. Use water spray to reduce vapors. *Small spills:* absorb with sand or other noncombustible absorbent material and place into containers for later disposal. *Large spills:* dike far ahead of spill for later disposal. Collect powdered material in the most convenient and safe manner and deposit in sealed containers. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable. Seek professional environmental engineering assistance from the U.S. EPA Environmental Response Team at (908) 548-8730 (24-hour response line).

Fire Extinguishing: Hazardous decomposition includes oxides of phosphorus, sulfur, and nitrogen. May be fatal if inhaled, ingested or absorbed through skin. Inhalation or contact with some of these materials will irritate or burn skin and eyes. Vapors may cause dizziness or suffocation. *Small fires:* dry chemical, carbon dioxide; water spray; or foam. *Large fires:* water spray, fog, or foam. Stay upwind; keep out of low areas. Ventilate closed spaces before entering them. Firefighting gear (including SCBA) may not provide adequate protection. If exposure occurs, remove and isolate gear immediately and thoroughly decontaminate personnel. Wear positive-pressure breathing apparatus and special protective clothing. Remove and isolate contaminated clothing at the site. Move container from fire area if you can do so without risk. Fight fire from maximum distance. Dike fire control water for later disposal; do not scatter the material. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies. From a secure, explosion-proof location, use water spray to cool exposed containers. If cooling streams are ineffective (venting sound increases in volume and pitch, tank discolors, or shows any signs of deforming), withdraw immediately to a secure position. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode.

Disposal Method Suggested: Generators of waste containing this contaminant (≥100 kg/mo) must conform with EPA regulations governing storage, transportation, treatment, and waste disposal. Destruction by alkali hydrolysis or incineration. Containers must be disposed of properly by following package label directions or by contacting your local or federal environmental control agency, or by contacting your regional EPA office.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- EXTOXNET, Extension Toxicology Network, "Pesticide Information Profile, Dimethoate," Oregon State University, Corvallis, OR (June 1996). http://ace.orst.edu/info/extoxnet/pips/dimethoa.htm
- USEPA, Office of Pesticide Programs, Pesticide Residue Limits, "Dimethoate", 40 CFR 180.204. http://www.epa.gov/pesticides/food/viewtols.htm
- USEPA, "Chemical Profile: Dimethoate," Washington DC, Chemical Emergency Preparedness Program (November 30, 1987)
- Agency for Toxic Substances and Disease Registry, U.S. Department of Health and Human Services, Public Health Service, "Managing Hazardous Materials Incidents," Atlanta, GA (June 2003)
- New Jersey Department of Health, "Hazardous Substance Fact Sheet: Dimethoate," Trenton, NJ (February 1999). http://www.state.nj.us/health/eoh/rtkweb/0733.pdf

Dimethomorph D:1045

Use Type: Fungicide

CAS Number: 110488-70-5

Formula: $C_{21}H_{22}ClNO_4$

Synonyms: (*E,Z*)-4-[3-(4-Chlorophenyl)-3-(3,4-dimethoxyphenyl)acryloyl]morpholine; 4-[3-(4-Chlorophenyl)-3-(3,4-dimethoxyphenyl)-1-*oxo*-2-propenyl]morpholine; 3-(4-Chlorophenyl)-3-(3,4-dimethyphenyl)acrylic acid morpholide; Morpholine, 3-[3-(4-chlorophenyl)-3-(3,4-dimethoxyphenyl)-1-oxo-2-propenyl]-

Trade Names: ACROBAT® WP; FORUM DC®, [mancozeb+dimethomorph]; CME 151®; STATURE®

Chemical Class: Morpholine

EPA/OPP PC Code: 268800

California DPR Chemical Code: 4003

HSDB Number: 6915

UN/NA & ERG Number: UN3077(solid)/171

RTECS® Number: QE0478300

EC Number: 404-200-2 [*Annex I Index No.:* 613-102-00-0]

Uses: A systemic fungicide that protects crops from mold. It also kills mold and prevents their spread; controls late blight on tomatoes; and is used as a wood preservative to control downey mildew.

U.S. Maximum Allowable Residue Levels for Dimethomorph (40 CFR 180.493): A tolerance is established for the residues of the fungicide dimethomorph in or on potatoes at 0.05 ppm. All other tolerances have expired.

Human toxicity (long-term)[101]: Very low–700.00 ppb, Health Advisory

Fish toxicity (threshold)[101]: Intermediate–34.00 ppb, MATC (Maximum Acceptable Toxicant Concentration)

Regulatory Authority and Advisory Information: Carcinogenicity[83]: EPA, Not likely to be carcinogenic in humans.

European/International Regulations: Hazard Symbol: N; risk phrases: R51/53; safety phrases: S2; S61 (see Appendix 1)

Description: Colorless or gray crystalline solid. The commercial/technical product may be yellowish to red-brown.

Odorless. Commercial product is a mixture of *cis*- and *trans*-isomers. Molecular weight = 387.86; Specific gravity (H_2O:1) = 1.32; Boiling point = 584.9°C; Freezing/Melting point = 137°C; Flash point = 305°C. Practically insoluble in water; solubility = <0.005 ppm. Physical and toxicological properties may be affected by carrier solvents in commercial formulations.

Incompatibilities: Dust may form explosive mixture with air. This material is a strong acid. Keep away from bases and alkaline materials.

Determination in Water: Log K_{ow} = >2.5–<3.0. Values above 3.0 are likely to bioaccumulate in aquatic organisms.

Harmful Effects and Symptoms

Short Term Exposure: Contact with eyes, skin, or respiratory tract may cause irritation or injury. May be harmful if swallowed. LD_{50} (oral, rat) = 3900 mg/kg; LD_{50} (dermal, rat) = >2 g/kg.

First Aid: If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least 15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately. If this chemical contacts the skin, remove contaminated clothing and wash immediately with soap and water. Seek medical attention immediately. If this chemical has been inhaled, remove from exposure, begin rescue breathing (using universal precautions) if breathing has stopped, and CPR if heart action has stopped. Transfer promptly to a medical facility. When this chemical has been swallowed, get medical attention. Give large quantities of water and induce vomiting. Do not make an unconscious person vomit.

Personal Protective Methods: Applicators and other handlers must wear: Coveralls worn over long-sleeved shirt and long pants; Chemical-resistant gloves such as DuPont™ Tychem® suit fabrics, barrier laminate, or Viton®; Chemical-resistant footwear plus socks; Protective eye wear; Chemical-resistant headgear for overhead exposure; Chemical-resistant apron when cleaning equipment, mixing, or loading[83]. Agricultural Use/Engineering Controls: When handlers use closed systems, enclosed cabs, or aircraft in a manner that meets the requirements listed in the Worker Protection Standard (WPS) for agricultural pesticides, ***40 CFR 170.240(d)(4-6),*** the handler PPE requirements may be reduced or modified as specified in the Worker Protection Standard. Firefighters should wear NIOSH approved self-contained breathing apparatus and full protective clothing.

Respirator Selection: Wherever and whenever workplace conditions warrant respirator use, a respiratory protection program must be followed that meets one or more of the following government standards: OSHA's 29 CFR 1910.134, ANSI Z88.2, or European Standard EN 149.

Storage: Color Code-Blue: Health Hazard/Poison. Store in a secure poison location. Prior to working with this chemical you should be trained on its proper handling and storage. Store in tightly closed containers in a cool, well- ventilated area. Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: This material may be classified as Environmentally hazardous substances, solid, n. o. s. It usually falls in Hazard Class 9.

Spill Handling: First remove all sources of ignition. Evacuate persons not wearing protective equipment from area of spill or leak until clean up is complete. Ventilate area of spill or leak. Use water spray to reduce vapor. Absorb liquids in vermiculite, dry sand, earth, or a similar material and deposit in sealed containers. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable.

Fire Extinguishing: Hazardous decomposition includes toxic oxides of nitrogen and carbon and corrosive hydrogen chloride gas. As an immediate precautionary measure, isolate spill or leak area in all directions for at least 50 meters/150 feet for liquids and at least 25 meters/75 feet for solids. *Fire involving storage or vehicular tanks:* isolate for 800 meters/0.5 mile in all directions; also, consider initial evacuation for 800 meters/0.5 mile in all directions. *On a small fire:* use dry chemical, CO_2, water spray or regular foam. *On a large fire:* use water spray, fog or regular foam. Do not scatter spilled material with high-pressure streams of water. Move containers from fire area if you can do it without risk. Dike fire-control water for later disposal. *Fire involving tanks:* from a secure, explosion-proof location, use water spray to cool exposed containers. If cooling streams are ineffective (venting sound increases in volume and pitch, tank discolors, or shows any signs of deforming), withdraw immediately to a secure position. Always stay away from tanks engulfed in fire. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode.

Disposal Method Suggested: Do not discharge into drains or sewers. Dispose of waste material as hazardous waste using a licensed disposal contractor to an approved landfill. Consult with environmental regulatory agencies for guidance on acceptable disposal practices. If allowed, incineration with effluent gas scrubbing is recommended. Containers must be disposed of properly by following package label directions or by contacting your local or federal environmental control agency, or by contacting your regional EPA office.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov

- USEPA, Office of Pesticide Programs, Pesticide Residue Limits, "Dimethomorph," 40 CFR 180.493. http://ecfr.gpoaccess.gov/cgi/t/text/text-idx?c=ecfr&sid=8c864e-7c447828dfa4ba332edba93ad6&rgn=div8&view=text&node=40:21.0.1.1.27.3.27.264&idno=40
- EXTOXNET, Extension Toxicology Network, "Pesticide Information Profile, Dimethomorph," Oregon State University, Corvallis, OR (September 1995). http://extoxnet.orst.edu/pips/dimetomo.htm

Dimetilan D:1300

Use Type: Insecticide
CAS Number: 644-64-4
Formula: $C_{10}H_{16}N_4O_3$
Synonyms: Carbamic acid, dimethyl-, 1-[(dimethylamino)carbonyl]-5-methyl-1*H*-pyrazol-2-yl ester; Carbamic acid, dimethyl-, ester with 3-hydroxy-*N,N*-5-trimethylpyrazole-1-carboxamide; Dimethyl carbamate ester of 3-hydroxy-*N,N*-5-trimethylpyrazole-1-carboxamide; Dimethylcarbamic acid-1-[(dimethylamino)carbonyl]-5-methyl-1*H*-pyrazol-3-yl ester; Dimethylcarbamic acidester with 3-hydroxy-*N,N*,5-trimethylpyrazole-1-carboxamide; Dimethylcarbamic acid-5-methyl-1*H*-carboxamine; Dimethylcarbamic acid-5-methyl-1*H*-pyrazol-3-yl ester; 2-Dimethylcarbamoyl-3-methylpyrazolyl-(5)-*N,N*-dimethylcarbamat; Dimethylcarbamoyl-3-methyl-5-pyrazolyldimethylcarbamate; 1-Dimethylcarbamoyl-5-methylpyrazol-3-yl dimethylcarbamate; Dimetilane; ENT 25,595-X; ENT 25,922; 3-Hydroxy-*N,N*,5-trimethylpyrazole-1-carboxamidedimethylcarbamate (ester); 5-Methyl-1*H*-pyrazol-3-yl dimethylcarbamate
Trade Names: FLYBANDS®[C]; GEIGY 22870®[C]; GEIGY GS-13332®[C]; SNIP®[C]; SNIP FLY®[C].
Chemical Class: Carbamate
EPA/OPP PC Code: 090101
HSDB Number: 1726
UN/NA & ERG Number: UN2757 (solid)/151
RTECS® Number: EZ9084000
EC Number: 211-420-0 [*Annex I Index No.:* 623-047-2]
Uses: An insecticide formerly used for insect control on livestock, especially housefly control. Not registered for use in the U.S. or in EU countries[115]. There are 10 global suppliers[97].
Regulatory Authority and Advisory Information: Health Advisory: Nerve Toxin (S!)
Superfund/EPCRA [40CFR 302 and 355, F R: 8/16/06, Vol 71, No. 158] Reportable Quantity (RQ): 1 lb (0.454 kg)
U.S. EPA Hazardous Waste Number (RCRA No.): P191
RCRA 40CFR268.48; 61FR15654, Universal Treatment Standards: Wastewater (mg/L), 0.056; Non-wastewater (mg/kg), 1.4
Superfund/EPCRA 302 Extremely Hazardous Substances: TPQ = 500/10,000 lb (227/4540 kg)
CERCLA Reportable Quantity (RQ): 1 lb (0.454 kg)
European/International Regulations: Hazard Symbol: T, N; risk phrases: R21; R25; R50/53; safety phrases: S1/2; S36/37; S45; S60; S61 (see Appendix 1)

Description: Dimetilan is a yellow to reddish-brown solid. My be commercially available as a aqueous liquid or emulsifiable concentrate. Molecular weight = 240.26; Boiling point = 210°C; Freezing/Melting point = 68–71°C (technical grade 55–65°C); Vapor pressure = 0.00097 mmHg @ 20°C; Henry's Law constant = 4.14×10^{-11} atm-m^3/mol @ 25°C (est)[83]. Hazard Identification (based on NFPA-704 M Rating System): Health 3, Flammability 1, Reactivity 1. Soluble in water; solubility = 24% @ 25°C. Physical and toxicological properties may be affected by carrier solvents in commercial formulations.
Incompatibilities: Carbamates are incompatible with reducing agents, strong acids, oxidizing acids, peroxides, and bases. Contact with active metals or nitrides causes the release of flammable, and potentially explosive, hydrogen gas. May react violently with strong oxidizers, bromine, 90% hydrogen peroxide, phosphorus trichloride, silver powders or dust. Incompatible with silver compounds. Mixture with some silver compounds forms explosive salts of silver oxalate. Hydrolyzed by acids and alkalis.
Permissible Exposure Limits in Air: Protective Action Criteria (PAC) Ver. 27[89]
PAC-1: 2.3 mg/m^3
PAC-2: 25 mg/m^3
PAC-3: 25 mg/m^3
Permissible Concentration in Water: Runoff from spills or fire control may cause water pollution.
Determination in Water: Log K_{ow} = 0.27[83]. Unlikely to bioaccumulate in marine organisms.
Routes of Entry: Dermal contact, inhalation
Harmful Effects and Symptoms
Short Term Exposure: Dimetilan is highly toxic by ingestion and moderately toxic by contact with the skin. Death is primarily due to respiratory arrest of central origin, paralysis of the respiratory muscles, intense bronchoconstriction, or all three. This compound is an acetylcholinesterase inhibitor. Symptoms are similar to carbaryl poisoning: nausea, vomiting, abdominal cramps, diarrhea, pinpoint pupils, excessive salivation, and sweating are common symptoms. Running nose and tightness in chest are common in inhalation exposures. Difficulty in breathing, raspy breathing, and loss of muscle coordination may also be seen. Exposure may also result in random jerky movements, incontinence, convulsions, and coma and death. LD_{50} (oral, rat) = 25–70 mg/kg; LD_{50} (dermal, rat) = 600 mg/kg.
Long Term Exposure: Many carbamates affect the central nervous system
Points of Attack: Attacks the central nervous system.
Medical Surveillance: Routine biological monitoring of pesticide applicators and field workers includes testing of plasma and red blood cell acetylcholinesterase levels (for enzyme poisoned by this chemical). These tests are normally accurate only if done within about two hours of exposure. If exposure stops, plasma levels return to normal in 1–2 weeks while red blood cell levels may be reduced for 1–3 months. When acetylcholinesterase enzyme levels

are reduced by 25% or more below preemployment levels, risk of poisoning is increased, even if results are in lower ranges of "normal." Reassignment to work not involving carbamate pesticides is recommended until enzyme levels recover. Also consider complete blood count and chest x-ray following acute overexposure. Do not drink any alcoholic beverages before or during use.

First Aid: Speed in removing material from eyes and skin is of extreme importance. *Eyes:* Eye contact can cause dangerous amounts of these chemicals to be quickly absorbed through the mucous membrane into the bloodstream. Immediately and gently flush eyes with plenty of warm or cold water (NO hot water) for at least 15 minutes, occasionally lifting the upper and lower eyelids. Get medical aid immediately. *Skin:* Get medical aid. Dermal contact can cause dangerous amounts of these chemicals to be absorbed into the bloodstream. Wearing the appropriate PPE equipment and respirator for carbamate pesticides, immediately flush skin with plenty of soap and water for at least 15 minutes while removing contaminated clothing and shoes. Shampoo hair promptly if contaminated; protect eyes. *Ingestion:* Call poison control. Loosen all clothing. Never give anything by mouth to an unconscious person. Get medical aid. Do NOT induce vomiting. * If conscious, alert, and able to swallow, rinse mouth and have victim drink 4 to 8 ounces of water. Check to see if poison control instructs you to use ipecac syrup, otherwise administer slurry of activated charcoal (2 oz in 8 oz of water). If victim is *UNCONSCIOUS OR HAVING CONVULSIONS,* do nothing except keep victim warm. **In some cases you may be specifically instructed by poison control to induce vomiting by way of 2 tablespoons of syrup of ipecac (adult) washed down with a cup of water.* Do NOT give activated charcoal before or with ipecac syrup. *Inhalation:* Get medical aid. Do not contaminate yourself. Wearing the appropriate PPE equipment and respirator for carbamate pesticides, immediately remove the victim from the contaminated area to fresh air. If the victim is not breathing, administer artificial respiration. Do not use mouth-to-mouth method if victim ingested or inhaled the substance; give artificial respiration with the aid of a pocket mask equipped with a one-way valve or other proper respiratory medical device. If breathing is difficult, administer oxygen through bag/mask apparatus until medical help arrives. Do not leave victim unattended. *Note to physician or authorized medical personnel.* Administer atropine, 2 mg (1/30 gr) intramuscularly or intravenously as soon as any local or systemic signs or symptoms of an intoxication are noted; repeat the administration of atropine every 3 to 8 minutes until signs of atropinization (mydriasis, dry mouth, rapid pulse, hot and dry skin) occur; initiate treatment in children with 0.05 mg mg/kg of atropine; repeat at 5 to 10 minute intervals. Watch respiration, and remove bronchial secretions if they appear to be obstructing the airway; intubate if necessary

Medical note: 2-PAMCI may be contraindicated in the case of some carbamate poisonings.

Personal Protective Methods: Wear protective gloves and clothing to prevent any reasonable probability of dermal and/or eye contact. Safety equipment suppliers/manufacturers can provide recommendations on the most protective glove/clothing material for your operation. DuPont™ Tychem® suit fabrics[88] All protective clothing (suits, gloves, footwear, headgear) should be clean, available each day, and put on before work. Contact lenses should not be worn when working with this chemical. Wear dust-proof chemical goggles and face shield unless full facepiece respiratory protection is worn. Employees should wash immediately with soap when skin is wet or contaminated. Provide emergency showers and eyewash.

Respirator Selection: SCBA >2.3 mg/m^3. Wherever and whenever workplace conditions warrant respirator use, a respiratory protection program must be followed that meets one or more of the following government standards: OSHA's 29 CFR 1910.134, ANSI Z88.2, or European Standard EN 149. *At concentrations above the NIOSH REL, or where there is no REL, at any detectable concentration:* SCBAF:Pd,Pp (APF = 10,000): (any self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode); or SaF:Pd,Pp:ASCBA (APF = 10,000) (any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary self-contained positive-pressure breathing apparatus). *Escape*: GmFOv100 (APF = 50) [any air-purifying, full facepiece respirator (gas mask) with a chin-style, front- or back-mounted organic vapor canister having an N100, R100, or P100 filter]; or SCBAE (any appropriate escape-type, self-contained breathing apparatus).

Storage: Color Code-Blue: Health Hazard/Poison. Store in a secure poison location. Prior to working with this chemical you should be trained on its proper handling and storage. Store in tightly closed containers in a cool, well-ventilated area. Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: Carbamate pesticides, solid, toxic, n.o.s. require a "poisonous materials" label. They are usually in Hazard Class 6.1 and Packing Group II.

Spill Handling: First remove all sources of ignition. Evacuate persons not wearing protective equipment from area of spill or leak until clean up is complete. Collect powdered material in the most convenient and safe manner and deposit in sealed containers. Ventilate area after clean up is complete. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable.

Fire Extinguishing: Hazardous decomposition includes oxides of nitrogen and carbon. *On a small fire:* use dry chemical powder, carbon dioxide, water spray, or foam. *On a large fire:* use water spray, fog or alcohol-resistant foam. Do not scatter material using straight water jet streams. Dike fire-control water for later disposal; do not scatter the material. Move containers from fire area if you can do it without risk. *Fire involving storage or vehicular tanks:* isolate for 800 meters/0.5 mile in all directions; also, consider initial evacuation for 800 meters/0.5 mile in all directions. Fight fire from maximum distance or use unmanned hose holders or monitor nozzles. Do not allow water to get inside containers. Cool containers with flooding quantities of water until well after fire is out. Withdraw immediately in the case of rising sound from venting safety devices or discoloration of tank. *Always* stay away from tanks engulfed in fire. For massive fire, use unmanned hose holders or monitor nozzles; if this is impossible, withdraw from area and let fire burn.

Disposal Method Suggested: Generators of waste containing this contaminant (≥100 kg/mo) must conform with EPA regulations governing storage, transportation, treatment, and waste disposal. Alkali treatment followed by soil burial. Large amounts should be incinerated in a unit equipped with efficient gas scrubbing. In accordance with 40CFR165, follow recommendations for the disposal of pesticides and pesticide containers. Containers must be disposed of properly by following package label directions or by contacting your local or federal environmental control agency, or by contacting your regional EPA office.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- USEPA, "Chemical Profile: Dimetilan," Washington DC, Chemical Emergency Preparedness Program (November 30, 1987)

Dinex D:1315

Use Type: Pesticide, Acaricide

CAS Number: 131-89-5

Formula: $C_{12}H_{14}N_2O_5$

Synonyms: 6-Cyclohexyl-2,4-dinitrophenol; 2-Cyclohexyl-4,6-dinitrophenol; Dinitrocyclophenol; 4,6-Dinitro-*o*-cyclohexylphenol; 2-Cyclohexyl-4,6-dinitrophenol; Dinitrocyclohexylphenol; Dinitro-*o*-cyclohexylphenol; 2,4-Dinitro-6-cyclohexylphenol; 4,6-Dinitro-*o*-cyclohexylphenol; DNOCHP; ENT 157; Phenol, 2-cyclohexyl-4,6-dinitro-

Trade Names: DN®; DN-111®; DN dry mix; MIX No. 1®; DN dust No. 12®; DOW SPRAY®-17; DRY MIX No. 1®; PEDINEX®; SN 46®

Chemical Class: Dinitrophenol derivative; Substituted nitrophenol

EPA/OPP PC Code: 037501

HSDB Number: 6046

UN/NA & ERG Number: UN2779 (Substituted nitrophenol pesticides, solid, toxic)/153

RTECS® Number: SK6650000

EC Number: 205-042-5 [*Annex I Index No.:* 609–028-00-3]

Uses: Used to control mites on citrus fruits. Not registered in the U.S. Not listed for use in EU countries[115]. There are 11 global suppliers[97].

Regulatory Authority and Advisory Information: Health Advisory: Skin irritant/sensitizer

Clean Water Act: Section 311 Hazardous Substances/RQ (same as CERCLA); Section 307 Toxic Pollutants as nitrophenols

U.S. EPA Hazardous Waste Number (RCRA No.): P034

EPCRA Section 304 RQ: CERCLA, 100 lb (45.4 kg) as nitrophenols

Marine pollutant (49CFR, Subchapter 172.101, Appendix B) as nitrophenols

European/International Regulations: Hazard Symbol: T, N; risk phrases: R23/24/25; R50/53; safety phrases: S1/2; S13; S60; S61 (see Appendix 1)

Description: Yellow, crystalline solid. Molecular weight = 266.25; Relative vapor density = 9.2; Freezing/Melting point = 107.22°C; Hazard Identification (based on NFPA-704 M Rating System): Health (Blue): 2; Flammability (Red): 2; Reactivity (Yellow): 2; Very slightly soluble in water.

Incompatibilities: Strong oxidizer. Some nitrophenols are explosive; may detonate under confined conditions. Reacts with other oxidizers, combustibles; risk of fire and explosion. Incompatible with sulfuric acid, nitric acid, caustics, aliphatic amines, isocyanates. Reacts with boranes, alkalies, aliphatic amines, amides, nitric acid, sulfuric acid. May detonate when heated under confinement.

Determination in Air: Filter; none; Gravimetric; NIOSH IV [Particulates NOR; #0500 (total), #0600 (respirable)][18].

Permissible Concentration in Water: State Drinking Water Guidelines: Florida 500 μg/L. Runoff from spills or fire control may cause water pollution. To protect freshwater aquatic life: 230 μg/L on an acute toxicity basis for nitrophenols as a class. To protect saltwater aquatic life: 4850 μg/L on an acute toxicity basis for nitrophenols as a class. To protect human health: 70.0 μg/L[6].

Determination in Water: Filter/Bubbler; 2-Propanol; high-pressure liquid chromatography/Ultraviolet detection; NIOSH II[5] Method #S166. Methylene chloride extraction followed by gas chromatography with flame ionization or electron capture detection. EPA Method 604, or gas chromatography plus mass spectrometry EPA Method 625. Log K_{ow} = >4.0. Values above 3.0 are likely to bioaccumulate in marine organisms.

Routes of Entry: Dermal contact, inhalation and ingestion.

Harmful Effects and Symptoms

Short Term Exposure: A metabolic stimulant. Solid is poisonous if swallowed. Severely irritates eyes, skin and respiratory tract, with burning sensation, pain, redness and swelling. Metabolic stimulant. If inhaled, causes coughing, dilated pupils, headache, profuse perspiration, intense thirst, extreme fatigue, rapid pulse, high fever, clammy, flushed skin, rapid breathing, yellowish face and lips, anxiety, convulsions, risk of lung edema. If swallowed, face and lips turn bluish. Severe exposure can cause death from heart failure. LD_{50} = 50–65 mg/kg (mouse); LD_{50} (dermal, rabbit) = 105 mg/kg.

Long Term Exposure: May damage the liver, kidneys and blood cells. May stain yellow the skin, eyes, and fingernails. Repeated exposure can cause anxiety, fatigue, insomnia, excessive perspiration, unusual thirst, weight loss and cataracts in the eyes.

Points of Attack: Skin, liver, kidneys, lungs, peripheral nervous system, eyes, thyroid gland and blood.

Medical Surveillance: Before beginning employment, at regular times after that and if symptoms develop or overexposure has occurred, the following may be useful: Exam of eyes for cataracts. Exam of skin and nails for staining. Blood tests for dinitro-*o*-cresol. Persons with blood levels over 10 ppm (10 mg/L) should be kept away from further exposure until levels return to normal. If symptoms develop or overexposure is suspected, the following may be useful: Liver and kidney function tests. Complete blood count

First Aid: If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least 15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately. If this chemical contacts the skin, remove contaminated clothing and wash immediately with soap and water. Seek medical attention immediately. If this chemical has been inhaled, remove from exposure, begin rescue breathing (using universal precautions) if breathing has stopped, and CPR if heart action has stopped. Transfer promptly to a medical facility. When this chemical has been swallowed, get medical attention. *Do not induce vomiting when formulations containing petroleum solvents are ingested*. Otherwise, give large quantities of water and induce vomiting. Do not make an unconscious person vomit. *Note to Physician:* Treat for methemoglobinemia. Spectrophotometry may be required for precise determination of levels of methemoglobinemia in urine.

Personal Protective Methods: Wear protective gloves and clothing to prevent any reasonable probability of dermal and/or eye contact. Safety equipment suppliers/manufacturers can provide recommendations on the most protective glove/clothing material for your operation. DuPont™ Tychem® suit fabrics[88]. Butyl rubber gloves. All protective clothing (suits, gloves, footwear, headgear) should be clean, available each day, and put on before work. Contact lenses should not be worn when working with this chemical. Wear splash-proof chemical goggles and face shield unless full facepiece respiratory protection is worn. Employees should wash immediately with soap when skin is wet or contaminated. Provide emergency showers and eyewash.

Respirator Selection: Wherever and whenever workplace conditions warrant respirator use, a respiratory protection program must be followed that meets one or more of the following government standards: OSHA's 29 CFR 1910.134, ANSI Z88.2, or European Standard EN 149.

Storage: Color Code-Blue: Health Hazard/Poison: Store in a tightly closed container in a dry, well-ventilated and secure poison location. Prior to working with this chemical you should be trained on its proper handling and storage. Where possible, automatically transfer material from other storage containers to process containers. NOAA/Cameo lists this material as corrosive: Color Code-White: Corrosive or Contact Hazard; Store separately in a corrosion-resistant location. Prior to working with this chemical you should be trained on its proper handling and storage. Store in tightly closed containers in a cool, well-ventilated area away from incompatible materials listed above. Metal containers involving the transfer of this chemical should be grounded and bonded. Drums must be equipped with self-closing valves, pressure vacuum bungs, and flame arresters. Use only non-sparking tools and equipment, especially when opening and closing containers of this chemical. If this material contains a flammable carrier, sources of ignition, such as smoking and open flames, are prohibited where this chemical is used, handled, or stored in a manner that could create a potential fire or explosion hazard. Wherever this chemical is used, handled, manufactured, or stored, use explosion-proof electrical equipment and fittings. Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: Substituted nitrophenol pesticides, solid, toxic, require a "poisonous materials" label. They are in Hazard Class 6.1.

Spill Handling: First remove all sources of ignition. Evacuate persons not wearing protective equipment from area of spill or leak until clean up is complete. Collect powdered material in the most convenient and safe manner and deposit in sealed containers. Ventilate area after clean up is complete. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable.

Fire Extinguishing: *On a small fire:* use dry chemical powder, carbon dioxide or water spray. *On a large fire:* use water spray, fog or alcohol -resistant foam. Move containers from fire area if you can do it without risk. Dike fire-control water for later disposal. Use water spray or fog; do not scatter material using straight water jet streams. *Fire involving storage or vehicular tanks:* isolate for 800 meters/0.5 mile in all directions; also, consider initial evacuation for 800 meters/0.5 mile in all directions. Fight fire from maximum distance or use unmanned hose holders or monitor nozzles. Do not allow water to get inside containers. Cool containers with flooding quantities of water until well after fire is out. Withdraw immediately in the case of rising sound from venting safety devices or discoloration of tank. *Always* stay away from tanks engulfed in fire. For massive fire, use unmanned hose holders or monitor nozzles; if this is impossible, withdraw from area and let fire burn.

Disposal Method Suggested: Do not discharge into drains or sewers. Dispose of waste material as hazardous waste using a licensed disposal contractor to an approved landfill. Contact a licensed disposal facility about surplus and non-recyclable solutions. Burn in a chemical incinerator equipped with an afterburner and scrubber. Extra care must be exercised as the material in an organic solvent is highly flammable. Consult with environmental regulatory agencies for guidance on acceptable disposal practices. Generators of waste containing this contaminant (≥100 kg/mo) must conform with EPA regulations governing storage, transportation, treatment, and waste disposal. Incineration with effluent gas scrubbing is recommended. Containers must be disposed of properly by following package label directions or by contacting your local or federal environmental control agency, or by contacting your regional EPA office.

References:

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- New Jersey Department of Health and Senior Services, “Hazardous Substance Fact Sheet, Dinex,” Trenton, NJ (May 2002). http://www.state.nj.us/health/eoh/rtkweb/0774.pdf
- USEPA, Nitrophenols: Ambient Water Quality Criteria, Washington DC (1980)
- USEPA, 2,4-Dinitrophenol, Health and Environmental Effects Profile No. 91, Washington DC, Office of Solid Waste (April 30, 1980)
- Sax, N. I., Ed., “Dangerous Properties of Industrial Materials Report,” 2, No. 2, 25-27 (1982) and 3, No. 2, 38-44 (1983)

Dinitro-*o*-cresol & salts D:1340

Use Type: Herbicide, Fungicide, Pesticide

CAS Number: 534-52-1; 2980-64-5 (ammonium salt); 5787-96-2 (potassium salt); 2312-76-7 (sodium salt)

Formula: $C_7H_6N_2O_5$

Synonyms: *o*-Cresol, 4,6-dinitro-; Dinitro; Dinitrocresol; Dinitro-*ortho*-cresol; Dinitrodendtroxal; 3,5-Dinitro-2-hydroxytoluene; Dinitrol; 4,6-Dinitro-2-methylphenol; 2,4-Dinitro-6-methylphenol; Dinitrocresol; 3,5-Dinitro-*o*-cresol; 4,6-Dinitro-*o*-cresol and salts; DNOC; 2-Methyl-4,6-dinitrophenol; 6-Methyl-2,4-dinitrophenol; Phenol, 2-methyl-4,6-dinitro-

Trade Names: ANTINONIN®; ANTINONNIN®; ARBOROL®; DEGRASSAN®; DEKRYSIL®; DETAL®; DILLEX®; DINOC®; DINURANIA®; DITROSOL®; DNOC®[C]; EFFUSAN®; EFFUSAN 3436®; ELGETOL®; ELGETOL 30®; ELIPOL®; EXTRAR®; FLAVIN-SANDOZ®; HEDOLIT®; HEDOLITE®; K III®; K IV®; KREOZAN®; KREZOTOL 50®; LIPAN®; NEUDORFF DN 50®; NITROFAN®; PROKARBOL®; RAFEX®; RAFEX 35®; RAPHATOX®; SANDOLIN®; SANDOLIN A®; SELINON®; SINOX®; WINTERWASH®

Chemical Class: Dinitrophenol

EPA/OPP PC Code: 037507; 600023 (code for chemical as impurity)

California DPR Chemical Code: 3170

HSDB Number: 1596

UN/NA & ERG Number: UN2779/153; UN1598/153

RTECS® Number: GO9625000

EC Number: 208-601-1 [*Annex I Index No.:* 609-020-00-X]

Uses: DNOC is widely used in agriculture as a herbicide and pesticide; it is also used in the dyestuff industry. Although 4,6-dinitro-*o*-cresol (DNOC) is no longer registered for use in the United States, it was used as a blossom-thinning agent on fruit trees and as a fungicide, insecticide, and miticides on fruit trees during the dormant season. It is used in mushroom houses to control foreign fungi; to kill locusts and other insects; and as a pre-harvest desiccant of potatoes and leguminous seed crops. DNOC is used as free radical polymerization inhibitor and agricultural chemical intermediate; widely used in agriculture as a herbicide and pesticide; Hence, individuals formulating or spraying the compound incur the highest risk of exposure to the compound. Not approved for use in EU countries[115]. DNOC’s registration in the U.S. as a pesticide was canceled in 1991. Currently, there are 39 global suppliers[97].

Fish toxicity (threshold)[101]: High–6.33138 ppb, MATC (Maximum Acceptable Toxicant Concentration)

Regulatory Authority and Advisory Information: Health Advisory: Mutagen, Developmental/Reproductive Toxin, Skin irritant/sensitizer (534-52-1 only); *Ammonium salt*: Mutagen, Developmental/Reproductive Toxin; *Sodium salt*: Mutagen

Acute Oral Category: 1, DANGER–POISON (534-52-1 only)

Clean Air Act: Hazardous Air Pollutants (Title I, Part A, Section 112)

Clean Water Act: Section 313 Water Priority Chemicals (57FR41331, 9/9/92)

U.S. EPA Hazardous Waste Number (RCRA No.): P047

RCRA 40CFR268.48; 61FR15654, Universal Treatment Standards: Wastewater (mg/L), 0.28; Non-wastewater (mg/kg), 160

RCRA 40CFR264, appendix 9; TSD Facilities Ground Water Monitoring List. Suggested test method(s) (PQL μg/L): 8040 (150); 8270 (50)

Superfund/EPCRA 302 Extremely Hazardous Substances: TPQ = 10/10,000 lb (4.54/4540 kg)

CERCLA Reportable Quantity (RQ): 10 lb (4.54 kg)

EPCRA Section 313 Form R *de minimis* concentration reporting level: 1.0%

US DOT Regulated Marine Pollutant (49CFR172.101, appendix B)

Rotterdam Convention Annex III [Chemicals Subject to the Prior Informed Consent Procedure (PIC)] [as dinitro-ortho-cresol (DNOC) and its salts (such as ammonium salt, potassium salt and sodium salt)]; Marine Pollutant; Rotterdam Convention (Class 1b)

European/International Regulations (*DNOC*): Hazard Symbol: T+, N; risk phrases: R26/27/28; R38; R41; R43; R44; R50/53; R68; Safety phrases: S1/2; S36/37; S45; S60; S61 (see Appendix 1)

(*ammonium salt 2980-64-5*) Hazard Symbol: T+, N; risk phrases: R26/27/28; R33; R50/53; safety phrases: S1/2; S13-S28-S45; S60; S61; (*sodium salt 2312-76-7; potassium salt 5787-96-2*) Hazard Symbol: T+, N; risk phrases: R23/24/25; R33; R50/53; safety phrases: S1/2; S13-S45; S60; S61 (see Appendix 1)

Description: DNOC exists in nine isomeric forms of which 4,6-dinitro-*o*-cresol is the most important commercially and the most heavily regulated. DNOC is a noncombustible, yellow crystalline solid. Commercial products may in the form of wettable powders or flakes, or liquid in petroleum distillates or as emulsifiable concentrates. Molecular weight = 198.13; Specific gravity (H_2O:1) = 1.58 @ 20°C; Boiling point = 312°C; 220°C; Freezing/Melting point = 86.5°C; Vapor pressure = 12×10^{-5} mmHg @ 25°C. Hazard Identification (based on NFPA-704 M Rating System): Health 3, Flammability 0, Reactivity 0. Practically insoluble in water; solubility = 0.01%. Physical and toxicological properties may be affected by carrier solvents in commercial formulations.

Incompatibilities: A strong oxidizer. Dust can form an explosive mixture with air. Strong oxidizers, oxidizers, strong bases. Protect from heat and shock. DNOCs are incompatible with strong reducing agents (i.e., hydrides, nitrides, alkali metals, sulfides, etc.). Flammable hydrogen gas may be generated; the heat from reaction may ignite the gas and cause explosion. Heat is also generated on contact with bases.

Permissible Exposure Limits in Air: OSHA PEL: 0.2 mg/m^3 TWA [skin]

NIOSH REL: 0.2 mg/m^3 TWA [skin]

ACGIH TLV®[1]: 0.2 mg/m^3 TWA [skin]

NIOSH IDLH: 5 mg/m^3

Protective Action Criteria (PAC) Ver. 27[89]

PAC-1: 0.2 mg/m^3

PAC-2: 0.5 mg/m^3

PAC-3: 5 mg/m^3

Determination in Air: Collection by charcoal tube, analysis by gas-liquid chromatography

Permissible Concentration in Water: To protect human health, 13.4 μg/L[6].

Determination in Water: Filter/Bubbler; 2-Propanol; high-pressure liquid chromatography/Ultraviolet detection; NIOSH II(5) Method #S166[18]. Methylene chloride extraction followed by gas chromatography with flame ionization or electron capture detection. EPA Method 604, or gas chromatography plus mass spectrometry EPA Method 625. Log K_{ow} = >2.0. Values above 3.0 are likely to bioaccumulate in aquatic organisms.

Routes of Entry: Inhalation, percutaneous absorption, ingestion, eye and/or dermal contact.

Harmful Effects and Symptoms

Short Term Exposure: Early manifestations of acute dinitrocresol exposure include fever, sweating, headache, and confusion. Blood pressure, pulse, and respiratory rate are often elevated. Severe exposure may result in restlessness, seizures, and coma. Other signs and symptoms include dyspnea (shortness of breath), cyanosis (blue tint to skin and mucous membranes), pulmonary edema, nausea, vomiting, and abdominal pain. Liver injury with associated jaundice, kidney failure, and cardiac arrhythmias are commonly noted. Dermal exposure results in yellow staining of the skin and may produce burns. Dinitrocresol may irritate and burn the eyes and mucous membranes. Delayed pulmonary edema may occur after inhalation. LD_{50} (oral, rat) = 7–25 mg/kg; LD_{50} (dermal, rat) = 200 mg/kg. Results for the sodium salt are similar.

Long Term Exposure: May damage the liver, kidneys and blood cells. May stain yellow the skin, eyes, and fingernails. Repeated exposure can cause anxiety, fatigue, insomnia, excessive perspiration, unusual thirst, weight loss and cataracts in the eyes. May cause skin sensitization.

Points of Attack: Cardiovascular system, endocrine system. May be a neurotoxin. Skin.

Medical Surveillance: Preliminary medical exam to detect chronic diseases of central nervous system, liver, heart, kidneys, lung and skin, as well as endocrinological or immunological disturbances, should protect susceptible individuals. Periodical medical exams of internal organs, skin and eyes are important to avoid chronic occupational intoxications. They should include lab and patch tests when necessary[83]. Medical observation is recommended for 24 to 48 hours following breathing overexposure, as pulmonary edema may be delayed. Before beginning employment, at regular times after that and if symptoms develop or overexposure has occurred, the following may be useful: Exam of eyes for cataracts. Exam of skin and nails for staining. Blood tests for 4,6-dinitro-*o*-cresol. Persons with blood levels over 10 ppm (10 mg/L) should be kept away from further exposure until levels return to normal. If symptoms develop or overexposure is suspected, the following may be useful: Liver and kidney function tests. Complete blood count. Evaluation by a qualified allergist, including exposure history and testing, may help diagnose allergy.

First Aid: If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least 15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately. If this chemical contacts the skin, remove contaminated clothing and wash immediately with soap and water. Seek medical attention immediately. If this chemical has been inhaled, remove from exposure, begin rescue breathing (using universal precautions) if breathing has stopped, and CPR if heart action has stopped. Transfer promptly to a medical facility. When this chemical has been swallowed, get medical attention. Give large quantities of water and induce vomiting. Do not make an unconscious person vomit. If high fever is present, drench victim's clothes in cool water, or immerse person in cool bath before transfer

Personal Protective Methods: Wear protective gloves and clothing to prevent any reasonable probability of dermal and/or eye contact. Safety equipment suppliers/manufacturers can provide recommendations on the most protective glove/clothing material for your operation. ACGIH recommends Saranex™ coated suits, natural rubber, Neoprene™ and chlorinated polyethylene as providing good to excellent protection. All protective clothing (suits, gloves, footwear, headgear) should be clean, available each day, and put on before work. Contact lenses should not be worn when working with this chemical. Wear dust-proof chemical goggles and face shield unless full facepiece respiratory protection is worn. Employees should wash immediately with soap when skin is wet or contaminated. Provide emergency showers and eyewash.

Respirator Selection: SCBA >0.2 mg/m^3. *up to 2 mg/m^3:* Any air-purifying full facepiece respirator equipped with an N95, R95, or P95 filter. The following filters may also be used: N99, R99, P99, N100, R100, P100. *Up to 5 mg/m^3:* 100 F (APF = 50) (any air-purifying, full facepiece respirator with an N100, R100, or P100 filter); or Sa:Cf* (any supplied-air respirator operated in a continuous-flow mode); or any self-contained breathing apparatus with a full facepiece; or SCBAF (APF = 50) (any supplied-air respirator with a full facepiece). *Emergency or planned entry into unknown concentrations or IDLH condition:* SCBAF: Pd,Pp (APF = 10,000) (any self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode); or SaF: Pd,Pp: ASCBA (APF = 10,000) (any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary, self-contained breathing apparatus operated in a pressure-demand or other positive-pressure mode). *Escape:* 100 F (APF = 50) (any air-purifying, full facepiece respirator with an N100, R100, or P100 filter); or SCBAE (any appropriate escape-type, self-contained breathing apparatus).

Storage: Color Code-Blue: Health Hazard/Poison. Store in a secure poison location. Prior to working with this chemical you should be trained on its proper handling and storage. 4,6-Dinitro-*o*-cresol must be stored to avoid contact with strong oxidizers (such as bromine, chlorine, chlorine dioxide and nitrates), since violent reactions occur. Store in tightly closed containers in a cool, well-ventilated area. If this material contains a flammable carrier, sources of ignition, such as smoking and open flames, are prohibited where 4,6-dinitro-*o*-cresol is used, handled, or stored in a manner that could create a potential fire or explosion hazard. Use only non-sparking tools and equipment, especially when opening and closing containers of 4,6-dinitro-*o*-cresol. Wherever 4,6-dinitro-*o*-cresol is used, handled, manufactured, or stored, use explosion-proof electrical equipment and fittings. Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: This compound requires a shipping label of "poisonous materials." It usually falls in Hazard Class 6.1 and Packing Group II.

Spill Handling: First remove all sources of ignition. Evacuate persons not wearing protective equipment from area of spill or leak until clean up is complete. Do not touch spilled material; stop leak if it can be done without risk. Take up *small spills* with sand or other noncombustible absorbent material; place into containers for later disposal. *Small dry spills*: collect powdered material in the most convenient and safe manner and deposit in sealed containers. Large spills should be diked for later disposal. Ventilate area after clean up is complete. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable.

Fire Extinguishing: Unless dissolved in a petroleum distillate, solid 4,6-dinitro-*o*-cresol may burn but does not easily ignite. The dust can form an explosive mixture with air. Use dry chemical, carbon dioxide; water spray; or alcohol foam extinguishers. Hazardous decomposition includes nitrogen oxides. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies. From a secure, explosion-proof location, use water spray to cool exposed containers. If cooling streams are ineffective (venting sound increases in volume and pitch, tank discolors, or shows any signs of deforming), withdraw immediately to a secure position. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode.

Disposal Method Suggested: Incineration (593°C minimum) with adequate scrubbing and ash-disposal facilities. Containers must be disposed of properly by following package label directions or by contacting your local or federal environmental control agency, or by contacting your regional EPA office. Consult with environmental regulatory agencies for guidance on acceptable disposal practices. Generators of waste containing this contaminant (≥100 kg/mo) must conform with EPA regulations governing storage, transportation, treatment, and waste disposal.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- EXTOXNET, Extension Toxicology Network, "Pesticide Information Profile," Oregon State University, Corvallis, OR
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- National Institute for Occupational Safety and Health, "Criteria for a Recommended Standards: Occupational Exposure to Dinitro-ortho-Cresol," NIOSH Publication No. 78-131, Washington DC (1978)/U.S. Environmental Protection Agency, Nitrophenols: Ambient Water Quality Criteria, Washington DC (1980)
- USEPA, "4,6-Dinitro-*o*-Cresol, Health and Environmental Effects," Profile No. 90, Washington DC, Office of Solid Waste (April 30, 1980)
- Sax, N. I., Ed., "Dangerous Properties of Industrial Materials Report," 2, No. 5, 54-59 (1982) and 4, No. 1, 62-66 (1984)
- USEPA, "Chemical Profile: Dinitrocresol," Washington DC, Chemical Emergency Preparedness Program (November 30, 1987)
- New Jersey Department of Health, "Hazardous Substance Fact Sheet: 4,6-Dinitro-*o*-Cresol," Trenton, NJ (June 1998). http://www.state.nj.us/health/eoh/rtk-web/0779.pdf

Dinocap D:1375

Use Type: Fungicide, Acaricide
CAS Number: 39300-45-3; 6119-92-2
Formula: $C_{18}H_{24}N_2O_6$
Synonyms: 2-Butenoic acid, 2-isooctyl-4,6-dinitrophenyl ester; 2-Butenoic acid, 4-isooctyl-2,6-dinitrophenyl ester; 2-Butenoic acid 2-(1-methylheptyl)-4,6-dinitrophenyl ester; Capryldinitrophenyl crotonate; 2-Capryl-4,6-dinitrophenyl crotonate; Caswell No. 391D; CPC; Crotonic acid 2,4-dinitro-6-(1-methylheptyl)phenyl ester; Crotonic acid 2,4-dinitro-6-(2-octyl)phenyl ester; Crotonic acid, 2-(1-methylheptyl)-4,6-dinitrophenyl ester; Crotonic acid, 4-(1-methylheptyl)-2,6-dinitrophenyl ester; Crotonic acid 2-(1-methylheptyl)-4,6-dinitrophenyl ester; DCPC; 4,6-Dinitro-2-(2-capryl)phenyl crotonate; 4,6-Dinitro-2-caprylphenyl crotonate; Dinitrocaprylphenyl crotonate; Dinitro(1-methylheptyl)phenyl crotonate; 2,4-Dinitro-6-(1-methylheptyl)phenyl crotonate; 4,6-Dinitro-2-(1-methylheptyl)phenyl crotonate; 2,4-Dinitro-6-octyl* phenyl crotonate, 2,6-Dinitro-4-octyl* phenylcrotonate, and nitrooctylphenols (principally dinitro); Dinitromethylheptyphenyl crotonate; Dinitro(1-methylheptyl)phenyl crotonate; 2,4-Dinitro-6-(2-octyl)phenyl crotonate; 2,4-Dinitro-6-octyl-phenyl crotonate; 2,6-Dinitro-4-octyl-phenyl crotonate; DNOCP; DNOPC; DPC; ENT 24727; 2-(1-Methylheptyl)-4,6-dinitrophenylcrotonate; Phenol, 2-(1-methylheptyl)-4,6-dinitro-, crotonate (ester)

*(A mixture of 1-methylheptyl, 1-ethylhexyl and 1-propylpentyl derivatives, chiefly 2-(1-methyl)-4,6-dinitrophenol)

Trade Names: ACTUAL DINOCAP®; ARATHANE®; CAPRANE®; CR 1639®; CEKUCAP® 25 WP; CROTOTHANE®; DICAP®; DIKAR®; EZENOAN®; ISCOTHANE®; ISOCOTHANE®; KARATHANE®[C]; KARATHANE® WD[C]; KARATHENE®[C]; MILDANE®; MILDEX®
Chemical Class: Dinitrophenyl
EPA/OPP PC Code: 036001
California DPR Chemical Code: 344
HSDB Number: 1597
UN/NA & ERG Number: UN2779 (Substituted nitrophenol pesticides, solid, toxic)/153; UN3082 (liquid)/171
RTECS® Number: GQ5775000
EC Number: 254-408-0 [*Annex I Index No.:* 609-023-00-6]; 228-088-8 (CAS: 6119-92-2)
Uses: Dinocap is a foliar fungicide/miticide used to control powdery mildew. It is applied to limit mites in apples and grapes crops outside the U.S., mainly in Europe, the Middle East and northern Africa. It is also used to control powdery mildew on fruit, vegetables and ornamentals. DAS, the registrant of dinocap, intends to support tolerances for dinocap residues in/on apples and grapes to permit legal importation of these commodities into the U.S. Not approved for use in EU countries[115]. Not currently registered in the U.S. There are 17 global suppliers[97].
U.S. Maximum Allowable Residue Levels for Dinocap (40 CFR 180.341): Apple 0.1; Grape 0.1.
Human toxicity (long-term)[101]: Intermediate–28.00 ppb, Health Advisory
Fish toxicity (threshold)[101]: High–1.06008 ppb, MATC (Maximum Acceptable Toxicant Concentration)
Regulatory Authority and Advisory Information:
Carcinogenicity[83]: EPA Group E, evidence of non-carcinogenicity for humans.
California Proposition 65 Chemical: Developmental/Reproductive toxin (4/1/1990)
Health Advisory: Mutagen, Developmental/Reproductive Toxin (TRI)
Acute Oral Category: 2, WARNING
EPCRA Section 313 Form R *de minimus* concentration reporting level: 1.0%
Clean Water Act: Section 311 Hazardous Substances/RQ (same as CERCLA); Section 307 Toxic Pollutants as nitrophenols
EPCRA Section 304 RQ: CERCLA, 100 lb (45.4 kg) as nitrophenols
U.S. DOT Marine pollutant (49CFR, Subchapter 172.101, Appendix B) as nitrophenols
European/International Regulations: Hazard Symbol: Xn, Xi, N; risk phrases: R20/22; R38, R43; R48/22;

R50/53; R61; safety phrases: S2; S45; S53; S60; S61 (see Appendix 1)

Description: Dark reddish-brown viscous liquid. Combustible. Molecular weight = 364.43; Specific gravity (H_2O:1) = 1.12; Boiling point = 139°C @ 0.07 mmHg; Freezing/Melting point = –25°C; Vapor pressure = 4×10^{-8} mmHg @ 20°C; flash point = 65°C. Practically insoluble in water; solubility = 0.01%. Hazard Identification (based on NFPA-704 M Rating System): Health 3, Flammability 0, Reactivity 1. Physical and toxicological properties may be affected by carrier solvents in commercial formulations.

Incompatibilities: Containers may explode when heated. Contact with strong bases and alkalies can cause hydrolysis. May react with strong oxidizers such as chlorates, peroxides, nitrates, etc. Some dinitrophenols are strong oxidizers and sensitive to heat, friction, and sudden shock.

Permissible Concentration in Water: To protect freshwater aquatic life: 230 μg/L on an acute toxicity basis for nitrophenols as a class. To protect saltwater aquatic life: 4850 μg/L on an acute toxicity basis for nitrophenols as a class. To protect human health: 70.0 μg/L[6].

Determination in Water: Filter/Bubbler; 2-Propanol; high-pressure liquid chromatography/Ultraviolet detection; NIOSH II[5] Method #S166. Methylene chloride extraction followed by gas chromatography with flame ionization or electron capture detection. EPA Method 604, or gas chromatography plus mass spectrometry EPA Method 625. Log K_{ow} = >6.0. Values above 3.0 are likely to bioaccumulate in aquatic organisms.

Routes of Entry: Dermal contact, inhalation and ingestion

Harmful Effects and Symptoms

Short Term Exposure: Severely irritates eyes, skin and respiratory tract, with burning sensation, pain, redness and swelling. Metabolic stimulant. If inhaled, causes coughing, dilated pupils, headache, profuse perspiration, intense thirst, extreme fatigue, rapid pulse, high fever, clammy, flushed skin, rapid breathing, nausea, vomiting, yellowish tint to skin and lips, anxiety and confusion, convulsions, risk of lung edema. If swallowed, face and lips turn bluish. Liver injury with associated jaundice, kidney failure, and cardiac arrhythmias are commonly noted. Severe exposure can cause death from heart failure. LD_{50} (oral, rat) = 750–1000 mg/kg; LD_{50} (dermal, rat) = >5 g/kg.

Long Term Exposure: May cause tumors. May damage the liver, kidneys, gastrointestinal tract and blood cells. May stain yellow the skin, eyes, and fingernails. Repeated exposure can cause anxiety, fatigue, insomnia, excessive perspiration, unusual thirst, weight loss and cataracts in the eyes. Skin and respiratory sensitizer.

Points of Attack: Skin, liver, kidneys, lungs, gastrointestinal tract, peripheral nervous system, eyes, thyroid gland, blood.

Medical Surveillance: In addition to comprehensive initial medical and work histories emphasizing reproductive experience and menstrual history, patient should have physical examination and testing of genito-urinary tract, sperm count, motility and morphology. If required, other tests, such as serum testosterone, serum follicle stimulating hormone (FSH), and serum lutenizing hormone (LH), may be indicated. Evaluation by a qualified allergist, including exposure history and testing, may help diagnose skin or respiratory allergy. Before beginning employment, at regular times after that and if symptoms develop or overexposure has occurred, the following may be useful: Exam of eyes for cataracts. Exam of skin and nails for staining. Blood tests for dinitro-*o*-cresol. Persons with blood levels over 10 ppm (10 mg/L) should be kept away from further exposure until levels return to normal. If symptoms develop or overexposure is suspected, the following may be useful: Liver and kidney function tests. Complete blood count.

First Aid: If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least 15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately. If this chemical contacts the skin, remove contaminated clothing and wash immediately with soap and water. Seek medical attention immediately. If this chemical has been inhaled, remove from exposure, begin rescue breathing (using universal precautions) if breathing has stopped, and CPR if heart action has stopped. Transfer promptly to a medical facility. When this chemical has been swallowed, get medical attention. *Do not induce vomiting when formulations containing petroleum solvents are ingested*. Otherwise, give large quantities of water and induce vomiting. Do not make an unconscious person vomit. *Note to physician or authorized medical personnel:* Treat for methemoglobinemia. Spectrophotometry may be required for precise determination of levels of methemoglobinemia in urine

Personal Protective Methods: Wear protective gloves and clothing to prevent any reasonable probability of dermal and/or eye contact. Safety equipment suppliers/manufacturers can provide recommendations on the most protective glove/clothing material for your operation. DuPont™ Tychem® suit fabrics[88]. Butyl rubber gloves. All protective clothing (suits, gloves, footwear, headgear) should be clean, available each day, and put on before work. Contact lenses should not be worn when working with this chemical. Wear splash-proof chemical goggles and face shield unless full facepiece respiratory protection is worn. Employees should wash immediately with soap when skin is wet or contaminated. Provide emergency showers and eyewash.

Respirator Selection: Wherever and whenever workplace conditions warrant respirator use, a respiratory protection program must be followed that meets one or more of the following government standards: OSHA's 29 CFR 1910.134, ANSI Z88.2, or European Standard EN 149.

Storage: *May be highly explosive and flammable; highly reactive when dry.* Color Code-Blue: Health Hazard/Poison. Store in a secure poison location. Prior to working with this chemical you should be trained on its proper handling and storage. Dinocap must be stored to avoid contact with strong oxidizers (such as bromine, chlorine, chlorine dioxide and nitrates), since violent reactions occur. Store in tightly closed containers in a cool, well-ventilated area. If this material contains a flammable carrier, sources of ignition, such as smoking and open flames, are prohibited where dinocap is used, handled, or stored in a manner that could create a potential fire or explosion hazard. Use only non-sparking tools and equipment, especially when opening and closing containers of Dinocap. Wherever dinocap is used, handled, manufactured, or stored, use explosion-proof electrical equipment and fittings. Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: Dinitrophenol solutions or substituted nitrophenol pesticides, solid, toxic and/or corrosive require a label of "poisonous materials." This material falls in Hazard Class 6.1. Depending on formulation, this material may be classified as Environmentally hazardous substances, solid, n. o. s. It usually falls in Hazard Class 9.

Spill Handling: First remove all sources of ignition. Evacuate persons not wearing protective equipment from area of spill or leak until clean up is complete. Collect powdered material in the most convenient and safe manner and deposit in sealed containers. Ventilate area after clean up is complete. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable.

Fire Extinguishing: Decomposition product includes oxides of nitrogen, carbon. As an immediate precautionary measure, isolate spill or leak area in all directions for at least 50 meters/150 feet for liquids and at least 25 meters/75 feet for solids. *Fire involving storage or vehicular tanks:* isolate for 800 meters/0.5 mile in all directions; also, consider initial evacuation for 800 meters/0.5 mile in all directions. *On a small fire:* use dry chemical, CO_2, water spray or regular foam. *On a large fire:* use water spray, fog or regular foam. Do not scatter spilled material with high pressure streams of water. Move containers from fire area if you can do it without risk. Dike fire-control water for later disposal. *Fire involving tanks:* from a secure, explosion-proof location, use water spray to cool exposed containers. If cooling streams are ineffective (venting sound increases in volume and pitch, tank discolors, or shows any signs of deforming), withdraw immediately to a secure position. Always stay away from tanks engulfed in fire. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode.

Disposal Method Suggested: Do not discharge into drains or sewers. Dispose of waste material as hazardous waste using a licensed disposal contractor to an approved landfill. Contact a licensed disposal facility about surplus and non-recyclable solutions. Burn in a chemical incinerator equipped with an afterburner and scrubber. Extra care must be exercised as the material in an organic solvent is highly flammable. Consult with environmental regulatory agencies for guidance on acceptable disposal practices. Incineration with effluent gas scrubbing is recommended. Containers must be disposed of properly by following package label directions or by contacting your local or federal environmental control agency, or by contacting your regional EPA office.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- USEPA, "Reregistration Eligibility Decision (RED), Dinocap" Office of Prevention, Pesticides and Toxic Substances, Washington DC (May 29, 2003). http://www.epa.gov/REDs/dinocap_red.pdf
- USEPA, Office of Pesticide Programs, Pesticide Residue Limits, "Dinocap," 40 CFR 180.341. http://www.epa.gov/pesticides/food/viewtols.htm
- EXTOXNET, Extension Toxicology Network, "Pesticide Information Profile, Dinocap," Oregon State University, Corvallis, OR (June 1996). http://extoxnet.orst.edu/pips/dinocap.htm
- USEPA, Nitrophenols: Ambient Water Quality Criteria, Washington DC (1980)
- USEPA, 2,4-Dinitrophenol, Health and Environmental Effects Profile No. 91, Washington DC, Office of Solid Waste (April 30, 1980)
- Sax, N. I., Ed., "Dangerous Properties of Industrial Materials Report," 2, No. 2, 25-27 (1982) and 3, No. 2, 38-44 (1983)
- New Jersey Department of Health, "Hazardous Substance Fact Sheet: Dinitrophenol," Trenton, NJ (October 1996, rev. February 2003). http://www.state.nj.us/health/eoh/rtkweb/0780.pdf

Dinoseb D:1380

Use Type: Plant growth regulator, Herbicide
CAS Number: 88-85-7
Formula: $C_{10}H_{12}N_2O_5$; $C_6H_2(NO_2)_2(C_4H_9)OH$

Synonyms: 2-*sec*-Butyl-4,6-dinitrophenol; DBNF; Dinitrobutylphenol; 2,4-Dinitro-6-*sec*-butylphenol; 4,6-Dinitro-*o*-*sec*-butylphenol; 4,6-Dinitro-2-*sec*-butylphenol; 4,6-Dinitro-2-(1-methyl-*N*-propyl) phenol; 2,4-Dinitro-6-(1-methylpropyl)phenol; 4,6-Dinitro-2-(1-methyl-propyl)phenol; Dinitro-*ortho*-*sec*-butylphenol; 4,6-Dinitro-*o*-*sec*-butylphenol; 4,6-Dinitro-2-*sec*-butylphenol; DN 289; DNBP; DNOSBP; DNPB; DNSBP; ENT 1,122; 2-(1-Methylpropyl)-4,6-dinitrophenol;

NSC 202753; Phenol, 2-*sec*-butyl-4,6-dinitro-; Phenol, 2-(1-methylpropyl)-4,6-dinitro-

Trade Names: AATOX®; AI3-01122®; ARETIT®; BASANITE®; BNP 20®; BNP 30®; BUTAPHENE®; CALDON®; CASWELL No. 392DD®; CHEMOX®[C]; CHEMOX GENERAL®[C]; CHEMOX P. E. ®[C]; CHEMSECT DNBP®; DESICOIL®; DIBUTOX®; DINITRALL®; DINITRO®; DN 289®; DOW GENERAL®[C]; DOW GENERAL WEED KILLER®[C]; DOW SELECTIVE WEED KILLER®[C]; DYNAMYTE®[C]; DYTOP®; ELGETOL 318®; FANICIDE®; GEBUTOX®; HEL-FIRE®[C]; HIVERTOX®; HOE 26150®; IVOSIT®; KILOSEB®; KNOWX-WEED®; KNOX-WEED®; LADOB®; LASEB®; LIRO DNBP®; NITROPONE C®; PERSEVTOX®; PHENOTAN®; PREMERGE®; SINOX GENERAL®[C]; SPARIC®; SPURGE®; SUBITEX®; UNICROP DNBP®; VERTAC DINITRO WEED KILLER®[C]; VERTAC GENERAL WEED KILLER®[C]; VERTAC SELECTIVE WEED KILLER®[C]

Chemical Class: Dinitrophenol

EPA/OPP PC Code: 037505

California DPR Chemical Code: 238

HSDB Number: 1445

UN/NA & ERG Number: UN2779/153

RTECS® Number: SJ9800000

EC Number: 201-861-7 [*Annex I Index No.:* 609-025-00-7]

Uses: Dinoseb is a phenolic herbicide used in soybeans, vegetables, fruits and nuts, citrus, and other field crops for the selective control of grass and broadleaf weeds (e.g., in corn). It is also used as an insecticide in grapes, and as a seed crop drying agent. It is produced in emuslifiable concentrates or as water-soluble ammonium or amine salts. It is no longer available in the U.S. Formerly widely used in the UK for the fumigation of potatoes; however, dinoseb acetate and dinoseb amine were banned from use in 1988. Dinoseb's primary use is as a contact herbicide for post-emergence weed control in cereals, undersown cereals, seedling lucerne and peas. Dinoseb is also used as a corn yield enhancer and an insecticide and miticide. Banned for use in EU countries (includes salts and acetate). A U.S. EPA restricted Use Pesticide (RUP). The use of dinoseb was canceled in the U.S. in 1986 based on the potential risk of birth defects and other adverse health effects for applicators and other persons having substantial dinoseb exposure. There are 20 global suppliers[97].

Human toxicity (long-term)[101]: Extra high–0.70 ppb, Health Advisory

Fish toxicity (threshold)[101]: High–2.85539 ppb, MATC (Maximum Acceptable Toxicant Concentration)

Regulatory Authority and Advisory Information: Carcinogenicity[83]: EPA Group C, Possible human carcinogen

California Proposition 65 Chemical: Developmental/Reproductive toxin (male) 1/1/1989

Poison (oral) Category: 1, DANGER

Health Advisory: Mutagen, Developmental/Reproductive Toxin, Skin irritant/sensitizer.

U.S. EPA Hazardous Waste Number (RCRA No.): P020

RCRA 40CFR268.48; 61FR15654, Universal Treatment Standards: Wastewater (mg/L), 0.066; Non-wastewater (mg/kg), 2.515

RCRA 40CFR264, appendix 9; TSD Facilities Ground Water Monitoring List. Suggested test method(s) (PQL μg/L): 8150 (1); 8270 (10)

Safe Drinking Water Act: MCL, 0.007 mg/L; MCLG, 0.007 mg/L; Regulated chemical (47FR9352)

Superfund/EPCRA 302 Extremely Hazardous Substances: TPQ = 100/10,000 lb (45.4/4540 kg)

CERCLA Reportable Quantity (RQ): 1000 lb (454 kg)

EPCRA Section 313 Form R *de minimis* concentration reporting level: 1.0%

US DOT Regulated Marine Pollutant (49CFR172.101, appendix B)

Rotterdam Convention Annex III [Chemicals Subject to the Prior Informed Consent Procedure (PIC)] (dinoseb and its salts and esters)

European/International Regulations (*88-85-7*): Hazard Symbol: T, N; risk phrases: R61; R62; R24/25; R36; R44; R50/53; safety phrases: S2; S53; S45; S60; S61 (see Appendix 1)

WGK (German Aquatic Hazard Class): 2-Hazard to waters

Description: Dinoseb is an orange crystalline solid when pure. However, it may be formulated with a flammable organic solvent as a brown viscous liquid. Pungent odor. Molecular weight = 240.21; Specific gravity (H_2O:1) = 1.27 @ 45°C; Freezing/Melting point = 40°C; Vapor pressure = 1.0 mmHg @ 151°C; Flash point (hydrocarbon solvent) = 15.6–29.4°C (for three commercial products)[83]. Hazard Identification (based on NFPA-704 M Rating System): Health 3, Flammability 2, Reactivity 2. Insoluble in water. Physical and toxicological properties may be affected by carrier solvents in commercial formulations.

Incompatibilities: This is a dinitrophenol herbicide. Dangerously explosive. When not water-wet it is a high explosive. In dry form, the material is easily ignited and it will burn very vigorously. On decomposition, nitro compounds such as this emit toxic fumes of nitrogen and carbon oxides. Appear to be stable in acid solution, but are susceptible to decomposition by ultraviolet radiation in alkaline solution[83]. The solution in water is a weak acid. Attacks many metals in presence of water.

Permissible Exposure Limits in Air: Protective Action Criteria (PAC) Ver. 27[89]

PAC-1: 0.41 mg/m^3
PAC-2: 4.5 mg/m^3
PAC-3: 4.5 mg/m^3

Permissible Concentration in Water: Federal Drinking Water Guidelines: EPA 7 μg/L. Canadian Drinking Water Standards: MAC 0.01 mg/L. A health advisory of 3.5 μg/L has been developed by EPA based on possible teratogenic action of dinoseb as described in the U.S. EPA document in "References."

Determination in Water: Extraction with ether, conversion to methyl ester and determination by electron capture gas chromatography

Routes of Entry: Inhalation, skin and eye contact, and ingestion

Harmful Effects and Symptoms

Short Term Exposure: Dinoseb causes eye irritation. May affect the gastrointestinal tract and central nervous system. Early manifestations of dinoseb exposure include fever, sweating, headache, and confusion. Elevations of blood pressure, pulse, and respiratory rate are common. Severe exposure may result in restlessness, seizures, and coma. Other signs and symptoms include dyspnea (shortness of breath), nausea, vomiting, and abdominal pain. Liver injury with associated jaundice, kidney failure, and cardiac arrhythmias may be noted. Inhalation of the aerosol may cause pulmonary edema, a medical emergency that can be delayed for several hours. This can cause death. Muscle weakness may be pronounced. Dermal exposure results in yellow staining of the skin and may produce burns.

Warning: Exposure to dinoseb fumes or aerosol in hot environment may cause death. Effects may be delayed from several hours to 2 days. Caution is advised. Toxicity of dinoseb is enhanced by high ambient temperature and physical activity. Dinoseb is extremely toxic: Probable oral lethal dose is 5–50 mg/kg; between 7 drops and 1 teaspoonful for 70 kg person (150 lb). Delayed pulmonary edema may occur after inhalation. LD_{50} (oral, rat) = 25 mg/kg; LD_{50} (dermal, rat) = 80 mg/kg.

Long Term Exposure: May cause tumors. Dinoseb may affect the kidneys, liver, blood, immune system, and eyes; may cause cataracts. May cause reproductive toxicity in humans.

Points of Attack: Liver, kidneys, blood, cardiovascular system, immune system, eyes. Reproductive cells in animals; DNA.

Medical Surveillance: This chemical is a suspected or known human carcinogen. Exposed persons should contact a physician for advice regarding the possible long term health effects and advice for medical monitoring. Comprehensive physical examination with emphasis on the genito-urinary tract including testicle size and consistency in males. Semen analysis to include sperm count, motility and morphology. Other tests, such as serum testosterone, serum follicle stimulating hormone (FSH), and serum lutenizing hormone (LH), may be carried out if, in the opinion of a physician, they are indicated. Medical observation is recommended for 24 to 48 hours following breathing overexposure, as pulmonary edema may be delayed. Liver and kidney function tests. Complete blood count. Eye examination. EKG.

First Aid: If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least 15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately. If this chemical contacts the skin, remove contaminated clothing and wash immediately with soap and water. Seek medical attention immediately. If this chemical has been inhaled, remove from exposure, begin rescue breathing (using universal precautions) if breathing has stopped, and CPR if heart action has stopped. Transfer promptly to a medical facility. When this chemical has been swallowed, get medical attention. Give large quantities of water and induce vomiting. Do not make an unconscious person vomit. Consult poison center on use of antidotes.

Personal Protective Methods: Wear protective gloves and clothing to prevent any reasonable probability of dermal and/or eye contact. Safety equipment suppliers/manufacturers can provide recommendations on the most protective glove/clothing material for your operation. DuPont™ Tychem® suit fabrics[88]. All protective clothing (suits, gloves, footwear, headgear) should be clean, available each day, and put on before work. Contact lenses should not be worn when working with this chemical. If working with liquid wear splash-proof chemical goggles, if working with dry material wear dust-proof chemical goggles and face shield unless full- face-piece respiratory protection is worn. Employees should wash immediately with soap when skin is wet or contaminated. Provide emergency showers and eyewash.

Respirator Selection: SCBA >0.41 mg/m^3. Where there exists a potential for exposures over *0.2 mg/m*^{3}, use an NIOSH/MSHA- or European Standard EN 149-approved supplied-air respirator with a full facepiece operated in the positive-pressure mode, or with a full facepiece, hood, or helmet in the continuous-flow mode; or use an NIOSH/MSHA- or European Standard EN 149-approved self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive-pressure mode.

Storage: Color Code-Blue: Health Hazard/Poison. Store in a secure poison location. Prior to working with dinoseb you should be trained on its proper handling and storage. Store in tightly closed containers in a cool, well-ventilated area. Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: Dinitrophenol solutions or substituted nitrophenol pesticides, solid, toxic and/or corrosive require a label of "poisonous materials." This material falls in Hazard Class 6.1.

Spill Handling: Do not handle broken packages without protective equipment. Wash away any material which may have contacted the body with copious amounts of water. *Dry material:* First remove all sources of ignition. Evacuate persons not wearing protective equipment from area of spill or leak until clean up is complete. Keep spilled material wet. Do not attempt to sweep up dry material. Use HEPA vacuum or wet method to reduce dust during clean up. *Do not dry sweep*. Collect powdered material in the most convenient and safe manner and deposit in sealed containers. Ventilate area after clean up is complete. Keep material out of water sources and sewers. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable. *Liquid:* Evacuate and restrict persons not wearing protective equipment from area of spill or leak until clean up is complete. Ventilate area of spill or leak. Absorb liquids in vermiculite, dry sand, earth, peat, carbon, or a similar material and deposit in sealed containers. Keep material out of water sources and sewers. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable.

Fire Extinguishing: Hazardous decomposition includes oxides of nitrogen and carbon. Extinguish by flooding with water. Cool all affected containers with flooding quantities of water. Wear self-contained breathing apparatus and full protective clothing. If fire becomes uncontrollable, evacuate for a radius of 1 mile. It is dangerously explosive. When not water-wet it is a high explosive. Dry, the material is easily ignited and it will burn very vigorously. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies. From a secure, explosion-proof location, use water spray to cool exposed containers. If cooling streams are ineffective (venting sound increases in volume and pitch, tank discolors, or shows any signs of deforming), withdraw immediately to a secure position. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode.

Disposal Method Suggested: Dissolve or mix the material with a combustible solvent and burn in a chemical incinerator equipped with an afterburner and scrubber. All federal, state, and local environmental regulations must be observed. Conduct @ 1000°C for 2.0 seconds minimum with scrubber for nitrogen oxide removal is recommended. In accordance with 40CFR165, follow recommendations for the disposal of pesticides and pesticide containers. Containers must be disposed of properly by following package label directions or by contacting your local or federal environmental control agency, or by contacting your regional EPA office. Consult with environmental regulatory agencies for guidance on acceptable disposal practices. Generators of waste containing this contaminant (≥100 kg/mo) must conform with EPA regulations governing storage, transportation, treatment, and waste disposal.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- EXTOXNET, Extension Toxicology Network, "Pesticide Information Profile, Dinoseb," Oregon State University, Corvallis, OR (June 1996). http://ace.orst.edu/info/extoxnet/pips/dinoseb.htm
- USEPA, "Chemical Profile: Dinoseb," Washington DC, Chemical Emergency Preparedness Program (November 30, 1987)
- USEPA, "Health Advisory: Dinoseb," Washington DC, Office of Drinking Water (August 1987)

Dinotefuran D:1385

Use Type: Insecticide
CAS Number: 165252-70-0
Formula: $C_7H_{14}N_4O_3$
Synonyms: 1-Methyl-2-nitro-3-(tetrahydro-3-furylmethyl) guanidine; (*RS*)-1-Methyl-2-nitro-3-(tetrahydro-3-furylmethyl)guanidine; *N*-Methyl-*N*'-nitro-*N*"-[(tetrahydro-3-furanyl)methyl]guanidine; Guanidine, *N*-methyl-*N*′-nitro-*N*″-[(tetrahydro-3-furanyl)methyl]-
Trade names: ALBARIN®; MIKEBLOCK MTI-446®; SAFARI®; SPARKLE®; VENOM®
Chemical Class: Neonicotinoid
EPA/OPP PC Code: 044321
California DPR Chemical Code: 5822
HSDB Number: 7465
UN/NA & ERG Number: UN3077(solid)/171
EC Number: Not found

Uses: Controls insect pests such as aphids, whiteflies, thrips, leafhopper, leafminer, sawfly, mole cricket, white grubs, lacebugs, billbugs, beetles, mealybugs, sawfly larvae, and cockroaches in leafy vegetables, in residential and commercial buildings, outdoor uses for professional turf management, turf farms, professional ornamental production, golf courses, residential indoor, lawn and garden use[83]. Not listed for use in EU countries[115]. Actively registered in the U.S. and other countries.

U.S. Maximum Allowable Residue Levels for the combined residues of Dinotefuran, and its metabolites DN [1-methyl-3-(tetrahydro-3-furylmethyl)guanidine] and UF [1-methyl-3-(tetrahydro-3-furylmethyl)urea], expressed as dinotefuran [40 CFR 180.603(a)(1)]: Brassica, head and stem, subgroup 5A, 1.4 ppm; cotton, undelinted seed 0.4 ppm; cotton, gin byproducts 8.0 ppm; grape 0.9 ppm; grape, raisin 2.5 ppm; potato 0.05 ppm; potato, chips 0.1 ppm; potato, granules/flakes 0.15 ppm; tomato, paste 1.0 ppm; vegetable, fruiting, group 8, 0.7 ppm; vegetable, cucurbit, group 9, 0.5 ppm; vegetable, leafy, except brassica, group 4, 5.0 ppm. ***[40 CFR 180.603(a)(2)]:*** in or on the following commodities: cattle, fat 0.05 ppm; cattle, meat byproducts 0.05 ppm; cattle, meat 0.05 ppm; goat, fat 0.05 ppm; goat, meat byproducts 0.05 ppm; goat, meat 0.05 ppm; hog, fat 0.05 ppm; hog, meat byproducts 0.05 ppm; hog, meat 0.05 ppm; horse, fat 0.05 ppm; horse, meat byproducts 0.05 ppm; horse, meat 0.05 ppm; milk 0.05 ppm; sheep, fat 0.05 ppm; sheep, meat byproducts 0.05 ppm; sheep, meat 0.05 ppm.

Regulatory Authority and Advisory Information:
Carcinogenicity[83]: EPA, Not likely to be carcinogenic in humans.
Acute Oral Category: 4, Caution

Potential Ground Water Pollutant [California FAC Section 13145(d)/12811, active]

European/International Regulations: Hazard Symbol: Xn, Xi, N; risk phrases: R22; R36, R53; R56; S57; safety phrases: S2; S61 (see Appendix 1)

Description: White crystalline solid or powder. Odorless. Commercial formulations include the technical product, formulation intermediates, soluble concentrates, granulars, soluble granules, baits, gels, and ready-to-use sprays[83]. Molecular weight = 202.21; Specific gravity (H_2O:1) = 1.41 @ 20°C; Boiling point = (decomposes); Freezing/Melting point = 107.5; Vapor pressure = 1.3×10^{-8} mmHg @ 25°C[83]; Flash point = 350°C; Henry's Law constant = 6.4×10^{-14} atm-m^3/mol @ 25°C (est)[83]. Highly soluble in water; solubility 39.83 g/L[83].

Incompatibilities: Strong oxidizers. Dust may form explosive mixture with air.

Permissible Concentration in Water: Not listed.

Determination in Water: Log K_{ow} = –0.549 @ 25°C. Unlikely to bioaccumulate in marine organisms.

Routes of Entry: Inhalation ingestion, dermal and/or eye contact.

Harmful Effects and Symptoms

The main target tissues are the nervous system and the immune system, with effects seen in several species. Nervous system toxicity is manifested as clinical signs and decreased motor activity seen after acute dosing (in both rats and rabbits) and increased motor activity seen after repeated dosing; these findings are consistent with effects on the nicotinic cholinergic nervous system[83].

Short Term Exposure: May cause irritation to the eyes, skin, and respiratory tract. Technical dinotefuran has low acute toxicity by the oral (toxicity category IV), dermal (toxicity category IV), and inhalation (toxicity category IV) routes. It is not a dermal sensitizer, causes a low level of skin irritation (toxicity category IV) and moderate eye irritation (toxicity category II)[83].

LD_{50} (oral, rat) = >2 g/kg[83]; LD_{50} (dermal, rat) = >2 g/kg.

Long Term Exposure: May affect immune system (decreases in spleen and thymus weights as seen in multiple studies and animal species). Indications of endocrine-related toxicity, abnormal sperm in animal males; changes in testes or ovary weight were also seen in several species.

Points of Attack: Immune system, spleen, thymus, endocrine system.

Medical Surveillance: Comprehensive physical examination with emphasis on the genito-urinary tract analysis to include sperm count, motility and morphology. Other tests, such as serum testosterone, serum follicle stimulating hormone (FSH), and serum lutenizing hormone (LH), may be carried out if, in the opinion of a physician, they are indicated.

First Aid: If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least 15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately. If this chemical contacts the skin, remove contaminated clothing and wash immediately with soap and water. Seek medical attention immediately. If this chemical has been inhaled, remove from exposure, begin rescue breathing (using universal precautions) if breathing has stopped, and CPR if heart action has stopped. Transfer promptly to a medical facility. When this chemical has been swallowed, get medical attention. Give large quantities of water and induce vomiting. Do not make an unconscious person vomit.

Personal Protective Methods: Applicators and other handlers must wear: Coveralls worn over long-sleeved shirt and long pants; Chemical-resistant gloves such as DuPont™ Tychem® suit fabrics, barrier laminate, or Viton®; Chemical-resistant footwear plus socks; Protective eye wear; Chemical-resistant headgear for overhead exposure; Chemical-resistant apron when cleaning equipment, mixing, or loading[83]. Agricultural Use/Engineering Controls: When handlers use closed systems, enclosed cabs, or aircraft in a manner that meets the requirements listed in the Worker Protection Standard (WPS) for agricultural pesticides, ***40 CFR 170.240(d)(4-6),*** the handler PPE requirements may be reduced or modified as specified in the Worker Protection Standard. Firefighters should wear NIOSH approved self-contained breathing apparatus and full protective clothing.

Respirator Selection: Where the neat (undiluted) test chemical is weighed and diluted, wear a NIOSH-approved half-face respirator equipped with a combination filter cartridge, i.e. organic vapor/acid gas/HEPA (specific for organic vapors, HCl, acid gas, SO_2 and a high-efficiency particulate filter)[88].

Storage: Color Code-Blue: Health Hazard/Poison. Store in a tightly closed container in a dry, well-ventilated and secure poison location. Prior to working with this chemical you should be trained on its proper handling and storage. Where possible, automatically transfer material from other storage containers to process containers. Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: Environmentally hazardous substances, solid or liquid, usually fall in Hazard Class 9 and Packing Group III.

Spill Handling: Evacuate and restrict persons not wearing protective equipment from area of spill or leak until clean up is complete. Ventilate area of spill or leak. Absorb liquids in vermiculite, dry sand, earth, peat, carbon, or a similar material and deposit in sealed containers. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable.

Fire Extinguishing: Hazardous decomposition includes oxides of nitrogen and carbon. This chemical is combustible; it may burn but does not easily ignite. As an immediate precautionary measure, isolate spill or leak area in all directions for at least 50 meters/150 feet for liquids and at least 25 meters/75 feet for solids. *Fire involving storage or vehicular tanks:* isolate for 800 meters/0.5 mile in all directions; also, consider initial evacuation for 800 meters/0.5 mile in all directions. *On a small fire:* use dry chemical, CO_2, water spray or regular foam. *On a large fire:* use water spray, fog or regular foam. Do not scatter spilled material with high-pressure streams of water. Move containers from fire area if you can do it without risk. Dike fire-control water for later disposal. *Fire involving tanks:* from a secure, explosion-proof location, use water spray to cool exposed containers. If cooling streams are ineffective (venting sound increases in volume and pitch, tank discolors, or shows any signs of deforming), withdraw immediately to a secure position. Always stay away from tanks engulfed in fire. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode.

Disposal Method Suggested: Containers must be disposed of properly by following package label directions or by contacting your local or federal environmental control agency, or by contacting your regional EPA office. If this material cannot be disposed of according to label instructions, it may be dissolved or mixed with a combustible solvent and burned in a chemical incinerator equipped with an afterburner and scrubber. In accordance with 40CFR165, follow recommendations for the disposal of pesticides and pesticide containers.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- Fishel, Frederick M., Document PI-80, Pesticide Information Office, Florida Cooperative Extension Service, Institute of Food and Agricultural Sciences, University of Florida, Gainesville, FL, October 2005; Revised February 2013.
- U.S. Environmental Protection Agency, Office of Pesticide Programs, "Pesticide Fact Sheet Dinotefuran" 7501C, Washington DC (September 2004)

Dinoterb D:1390

Use Type: Herbicide, Rodenticide

CAS Number: 1420-07-1

Formula: $C_{10}H_{12}N_2O_5$; $C_6H_2(NO_2)_2(C_4H_9)(OH)$

Synonyms: *o-tert*-Butyl-4,6-dinitrophenol; 2-(1,1-Dimethylethyl)-4,6-dinitrophenol; 2,4-Dinitro-6-*tert*-butylphenol; Dinitroterb; DNTBP; Phenol, 2-(1,1-dimethylethyl)4,6-dinitro-; Phenol-2-*tert*-butyl-4, 6-dinitro-

Trade Names: HERBOGIL®; HERBOGIL® FLUSSIG

Chemical Class: Dinitrophenol derivative

EPA/OPP PC Code: 228400

HSDB Number: 1598

UN/NA & ERG Number: UN2779 (Substituted nitrophenol pesticides, solid, toxic)/153

RTECS® Number: SK0160000

EC Number: 215-813-8 [*Annex I Index No.:* 609-030-00-4]

Uses: Not approved for use in the U.S. or EU countries[115] There are 17 global suppliers[97].

Regulatory Authority and Advisory Information: Acute Oral Category: 1, DANGER–POISON

Health Advisory: Reproductive/Developmental hazard

Superfund/EPCRA 302 Extremely Hazardous Substances: TPQ = 500/10,000 lb (227/4540 kg)

CERCLA Reportable Quantity (RQ): 500 lb (227 kg)

European/International Regulations: Hazard Symbol: T, N; risk phrases: R24; R28; R44; R50/53; R61; safety phrases: S2; S45; S53; S60; S61 (see Appendix 1)

Description: Dinoterb is a yellow solid. Phenol-like odor. May be formulated in a hydrocarbon solvent which changes the physical properties shown here. Molecular weight = 240.24; Specific Gravity = 1.27 @ 45°C; Freezing/Melting point = 126°C; 37.8 to 42.2°C[83]; Vapor density = 7.73; Vapor Pressure = 1 mmHg @ 151°C; Flash point = 15.6 to 29.4°C (based on three commercial products)[83]. Hazard Identification (based on NFPA-704 M Rating System): Health 3, Flammability 1, Reactivity 2. Practically insoluble in water.

Incompatibilities: Dinoseb is a strong oxidizer. If mixed with reducing agents, including hydrides, sulfides and nitrides, they may begin a vigorous reaction that culminates in a detonation. This is a dinitrophenol herbicide. It is dangerously explosive. When not water wet it is a high explosive. In dry form, the material is easily ignited and it will burn very vigorously. On decomposition, nitro compounds such as this emit toxic fumes of nitrogen and carbon oxides. Appear to be stable in acid solution, but are susceptible to decomposition by ultraviolet radiation in alkaline solution[83]. The aromatic nitro compounds may explode in the presence of a base such as sodium hydroxide or potassium hydroxide even in the presence of water or organic solvents[88]. Corrosive to metals in the presence of moisture.

Permissible Exposure Limits in Air: Protective Action Criteria (PAC) Ver. 27[89]

PAC-1: 2.3 mg/m^3

PAC-2: 25 mg/m^3

PAC-3: 25 mg/m^3

Permissible Concentration in Water: Runoff from spills or fire control may cause water pollution.

Determination in Water: Log K_{ow} = >3.0. Values above 3.0 are likely to bioaccumulate in aquatic organisms.

Routes of Entry: Inhalation and ingestion. Persons with who are taking anticoagulants or are suffering from bleeding disorders must be protected from exposure.

Harmful Effects and Symptoms

Short Term Exposure: Highly toxic. Symptoms of poisoning are similar to other dinitrophenols and may include nausea, gastric distress, restlessness, sensation of heat, flushed skin, sweating, thirst, deep and rapid breathing, rapid heart rate, fever, and lack of oxygen to tissues (blueness of skin). This compound is toxic by all routes of exposure. The dangerous single oral dose of dinitro-*o*-cresol, a structurally similar compound, is estimated to be about 29 mg/kg. Delayed pulmonary edema may occur after inhalation. High ambient temperature and physical activity may enhance effects of toxicity. LD_{50} (oral, rat) = 26 mg/kg.

Medical Surveillance: Preliminary medical exam to detect chronic diseases of central nervous system, liver, heart, kidneys, lung and skin, as well as endocrinological or immunological disturbances, should protect susceptible individuals. Periodical medical exams of internal organs, skin and eyes are important to avoid chronic occupational intoxications. They should include lab and patch tests when necessary[83]. Medical observation is recommended for 24 to 48 hours following breathing overexposure, as pulmonary edema may be delayed.

First Aid: Warning: Effects may be delayed from several hours to 2 days. Caution is advised. Toxicity of dinoterb is enhanced by high ambient temperature and physical activity. *Signs and symptoms of exposure:* Early manifestations of dinoterb exposure include fever, sweating, thirst, headache, and confusion. Elevations of blood pressure, pulse, and respiratory rate are common. Severe exposure may result in restlessness, seizures, and coma. Other signs and symptoms include dyspnea (shortness of breath), deep and rapid breathing, flushed or blueness of skin, pulmonary edema, nausea, vomiting, and abdominal pain. Liver injury with associated jaundice, kidney failure, and cardiac arrhythmias may be noted. Muscle weakness may be pronounced. Dermal exposure results in yellow staining of the skin and may produce burns. *Emergency life-support procedures*: Acute exposure to dinoterb exposure may require decontamination and life support for the victims. Emergency personnel should wear protective clothing appropriate to the type and degree of contamination. Air-purifying or supplied-air respiratory equipment should also be worn, as necessary. Rescue vehicles should carry supplies such as plastic sheeting and disposable plastic bags to assist in preventing spread of contamination. *Inhalation:* Move victims to fresh air. Emergency personnel should avoid self-exposure to dinoterb. Evaluate vital signs including pulse and respiratory rate, and note any trauma. If no pulse is detected, provide CPR. If not breathing, provide artificial respiration. If breathing is labored, administer oxygen or other respiratory support. Obtain authorization and/or further instructions from the local hospital for administration of an antidote or performance of other invasive procedures. Transport to a health care facility. *Skin and/or Eye Contact:* Remove victims from exposure. Emergency personnel should avoid self-exposure to dinoterb. Evaluate vital signs including pulse and respiratory rate, and note any trauma. If no pulse is detected, provide CPR. If not breathing, provide artificial respiration. If breathing is labored, administer oxygen or other respiratory support. Remove contaminated clothing as soon as possible. If eye exposure has occurred, eyes must be flushed with lukewarm water for at least 15 minutes. Vigorously wash exposed skin areas with soap and water. Yellowish coloration usually accompanies dermal exposure; the discoloration does not have to be fully removed to prevent further absorption. Obtain authorization and/or further instructions from the local hospital for administration of an antidote or performance of other invasive procedures. Transport to a health care facility. *Ingestion:* Evaluate vital signs including pulse and respiratory rate, and note any trauma. If no pulse is detected, provide CPR. If not breathing, provide artificial respiration. If breathing is labored, administer oxygen or other respiratory support. Obtain authorization and/or further instructions from the local hospital for administration of an antidote or performance of other invasive procedures. Vomiting may be induced with syrup of ipecac. If elapsed time since ingestion of dinoterb is unknown or suspected to be greater than 30 minutes, do not induce vomiting and proceed to hospital. Ipecac should not be administered to children under 6 months of age. *Warning*: Ingestion of dinoterb may result in sudden onset of seizures or loss of consciousness. Syrup of ipecac should be administered only if victims are alert, have an active gag-reflex, and show no signs of impending seizure or coma. If ANY uncertainty exists, proceed to hospital. The following dosages of ipecac are recommended: children up to 1 year old, 10 mL (1/3 oz); children 1 to 12 years old, 15 mL (1/2 oz); adults, 30 mL (1 oz). Ambulate (walk) the victims and give large quantities of water. If vomiting has not occurred after 15 minutes, ipecac may be re-administered. Continue to ambulate, and give water to the victims. If vomiting has not occurred within 15 minutes after second administration of ipecac, administer activated charcoal. Activated charcoal may be administered if victims are conscious and alert. Use 15 to 30 g (1/2 to 1 oz) for children, 50 to 100 g (1-3/4 to 3-1/2 oz) for adults, with 125 to 250 mL (1/2 to 1 cup) of water. Promote excretion by administering a saline cathartic or sorbitol to conscious and alert victims. Children require 15 to 30 g (1/2 to 1 oz) of cathartic; 50 to 100 g (1-3/4 to 3- 1/2 oz) is recommended for adults. Transport to a health care facility[83].

Personal Protective Methods: Wear protective gloves and clothing to prevent any reasonable probability of dermal and/or eye contact. Safety equipment suppliers/manufacturers can provide recommendations on the most protective glove/clothing material for your operation. DuPont™ Tychem® suit fabrics[88]. All protective clothing (suits, gloves, footwear, headgear) should be clean, available each day, and put on before work. Contact lenses should not be worn when working with this chemical. Wear dust-proof chemical goggles and face shield unless full facepiece respiratory protection is worn. Employees should wash immediately with soap when skin is wet or contaminated. Provide emergency showers and eyewash.

Respirator Selection: SCBA >2.3 mg/m³. Where potential for exposure to dinoterb exists, use a NIOSH/MSHA- or

European Standard EN149-approved supplied-air respirator with a full facepiece operated in the positive-pressure mode, or with a full facepiece, hood, or helmet in the continuous-flow mode; or use a NIOSH/MSHA- or European Standard EN149-approved self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive-pressure mode.

Storage: Color Code-Blue: Health Hazard/Poison. Store in a secure poison location. Prior to working with dinoterb you should be trained on its proper handling and storage. Store in tightly closed containers in a cool, well-ventilated area. Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: Dinitrophenol solutions or substituted nitrophenol pesticides, solid, toxic and/or corrosive require a label of "poisonous materials." This material falls in Hazard Class 6.1.

Spill Handling: *Dry material:* first remove all sources of ignition. Evacuate persons not wearing protective equipment from area of spill or leak until clean up is complete. Collect powdered material in the most convenient and safe manner and deposit in sealed containers. Ventilate area after clean up is complete. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable. *Wet spills:* evacuate and restrict persons not wearing protective equipment from area of spill or leak until clean up is complete. Ventilate area of spill or leak. Absorb liquids in vermiculite, dry sand, earth, peat, carbon, or a similar material and deposit in sealed containers. Keep this chemical out of a confined space, such as a sewer, because of the possibility of an explosion, unless the sewer is designed to prevent the build-up of explosive concentrations. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable.

Fire Extinguishing: Hazardous decomposition includes oxides of nitrogen and carbon. Heat may cause material to explode. *Fire involving storage or vehicular tanks:* isolate for 800 meters/0.5 mile in all directions; also, consider initial evacuation for 800 meters/0.5 mile in all directions. *Small fire:* dry chemical, carbon dioxide or water spray. *Large fire:* dry chemical, carbon dioxide, alcohol-resistant foam or water spray. Move containers from fire area if you can do it without risk. Dike fire-control water for later disposal; do not scatter the material. *Fire involving tanks or car/trailer loads:* fight fire from maximum distance or use unmanned hose holders or monitor nozzles. Do not get water inside containers. Cool containers with flooding quantities of water until well after fire is out. Withdraw immediately in the case of rising sound from venting safety devices or discoloration of tank. Always stay away from tanks engulfed in fire. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode.

Disposal Method Suggested: Dissolve or mix the material with a combustible solvent and burn in a chemical incinerator equipped with an afterburner and scrubber. All federal, state, and local environmental regulations must be observed. Conduct @ 1000°C for 2.0 seconds minimum with scrubber for nitrogen oxides removal is recommended. In accordance with 40CFR165, follow recommendations for the disposal of pesticides and pesticide containers. Containers must be disposed of properly by following package label directions or by contacting your local or federal environmental control agency, or by contacting your regional EPA office. Consult with environmental regulatory agencies for guidance on acceptable disposal practices.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- U.S. Department of Health and Human Services, Agency for Toxic Substances and Disease Registry, "ToxFAQs for Nitrophenols," Atlanta, GA (September 1995). http://www.atsdr.cdc.gov/tfacts50.html
- New Jersey Department of Health, "Hazardous Substance Fact Sheet: Dinitrophenol," Trenton, NJ (October 1996). http://www.state.nj.us/health/eoh/rtkweb/0780.pdf
- USEPA, "Chemical Profile: Dinoterb," Washington, DC, Chemical Emergency Preparedness Program (November 30, 1987)

Dipentene D:1440

Use Type: Insecticide, Animal and insect repellant, Slimicide

CAS Number: 5989-27-5 (D-Limonene); 138-86-3 (*dl*-Limonene)

Formula: $C_{10}H_{16}$

Synonyms: Cajeputene; Cinene; Dipentene; Limonene: D-Limonene; D-(+)-Limonene; (+)-R-Limonene; *p*-Mentha-1,8-diene; 1-Methyl-4-(1-methylethenyl) cyclohexane; Terpinene; *dl*-*p*-mentha-1,8-diene

Trade Names: BUGAWAY®[C]; BUGCHASER®[C]; CARVENE®; DOO-NOT®; HOLIDAY FIRE ANT KILLER®

Chemical Class: Miscellaneous hydrocarbon; Essential oil

EPA/OPP PC Code: 079701

California DPR Chemical Code: 979, 2531

HSDB Number: 4186 (CAS: 5989-27-5); 1809 (CAS: 138-86-3) limonene mixture

UN/NA & ERG Number: UN2052/128

RTECS® Number: OS8100000; GW6360000 (D-Limonene); RJ3697600 (tea tree oil)

EC Number: CAS: 5989-27-5: 227-813-5 [*Annex I Index No.:* 601-029-00-7]; CAS: 138-86-3: 205-341-0 [*Annex I Index No.:* 601-029-00-7]; CAS: 8028-48-6: 232-433-8

Uses: Used as an insecticide, insect repellent, and animal repellent. Not listed for use in EU countries[115]. Registered for use in the U.S., Canada and other countries. There are 49 global suppliers[97].

U.S. Maximum Allowable Residue Levels for Limonene (40 CFR 180.539): Limonene is exempt from tolerance levels when used in establishments making animal feed and processed food.

Regulatory Authority and Advisory Information: Carcinogenicity[83]: (*D-limonene 5989-27-5*), IARC: Human Inadequate Evidence; Animal, No Evidence*, not classifiable as carcinogenic to humans*, Group 3.

Acute Oral Category: 3, CAUTION

Health Advisory: Reproductive Toxin

European/International Regulations: Hazard Symbol: Xi, N; risk phrases: R10, R38; R43; R50/53; safety phrases: S2; S24; S37, S60; S61 (see Appendix 1)

WGK (German Aquatic Hazard Class): 2-Hazard to waters

Description: Colorless to straw colored liquid. Lemon-like odor. Molecular weight = 136.24; Specific gravity (H_2O:1) = 0.84; Boiling point = 177.78°C. Freezing/Melting point = –40°C; Vapor pressure = 20 mmHg @ 68.2°C. Flash point = 46.1°C. Autoignition temperature = 237°C. Explosive limits: LEL = 0.7%; UEL = 6.1%, both @ 150°C. Hazard Identification (based on NFPA-704 M Rating System): Health 2, Flammability 2, Reactivity 0. Practically insoluble in water.

Incompatibilities: Mist may form explosive mixture with air. Incompatible with acids, alkalies, oxidizers. Contact with oxidizers can cause fire and may be an explosion hazard.

Permissible Exposure Limits in Air: AIHA WEEL: 30 ppm TWA (CAS:138-86-3)

Protective Action Criteria (PAC) Ver. 27[89]

PAC-1: 20 ppm
PAC-2: 20 ppm
PAC-3: 160 ppm

Determination in Water: Log K_{ow} = >4.0. Values above 3.0 are likely to bioaccumulate in marine organisms.

Routes of Entry: Inhalation, passing through the unbroken skin, ingestion.

Harmful Effects and Symptoms

Short Term Exposure: Contact can irritate the eyes and skin. High exposures may damage the kidneys. LD_{50} (oral, rat) = >5 g/kg; LD_{50} (dermal, rat) = >5 g/kg.

Long Term Exposure: May cause tumors. Dipentene may cause a skin allergy; very low future exposures can cause itching and a skin rash.

Points of Attack: Skin. There is limited evidence that dipentene causes kidney cancer in male rats.

Medical Surveillance: If symptoms develop or overexposure is suspected, the following may be useful: Evaluation by a qualified allergist, including exposure history and testing, may help diagnose allergy. Kidney function tests.

First Aid: If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least 15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately. If this chemical contacts the skin, remove contaminated clothing and wash immediately with soap and water. Seek medical attention immediately. If this chemical has been inhaled, remove from exposure, begin rescue breathing (using universal precautions) if breathing has stopped, and CPR if heart action has stopped. Transfer promptly to a medical facility. When this chemical has been swallowed, get medical attention. Give large quantities of water and induce vomiting. Do not make an unconscious person vomit. Do not induce vomiting when formulations containing petroleum solvents are ingested

Personal Protective Methods: Wear protective gloves and clothing to prevent any reasonable probability of dermal and/or eye contact. Safety equipment suppliers/manufacturers can provide recommendations on the most protective glove/clothing material for your operation. All protective clothing (suits, gloves, footwear, headgear) should be clean, available each day, and put on before work. Contact lenses should not be worn when working with this chemical. Wear dust-proof chemical goggles and face shield unless full facepiece respiratory protection is worn. Employees should wash immediately with soap when skin is wet or contaminated. Provide emergency showers and eyewash.

Respirator Selection: SCBA >20 ppm. Wherever and whenever workplace conditions warrant respirator use, a respiratory protection program must be followed that meets one or more of the following government standards: OSHA's 29 CFR 1910.134, ANSI Z88.2, or European Standard EN 149.

Storage: Color Code-Red: Flammability Hazard: Store in a flammable liquid storage area or approved cabinet away from ignition sources and corrosive and reactive materials. Store in tightly closed containers in a cool, well-ventilated area. Before entering confined space where this chemical may be present, check to make sure that an explosive concentration does not exist. Store in tightly closed containers in a cool, well-ventilated area away from heat and incompatible materials. If this material contains a flammable carrier, sources of ignition, such as smoking and open flames, are prohibited where this chemical is used, handled, or stored in a manner that could create a potential fire or explosion hazard. Metal containers involving the transfer of 5 gallons or more of this chemical should be grounded and bonded. Drums must be equipped with self-closing valves, pressure vacuum bungs, and flame arresters. Use only nonsparking tools and equipment, especially when opening and closing containers of this chemical. Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: This requires a label of "FLAMMABLE LIQUIDS." It falls in Hazard Class 3.3 and Packing Group II.

Spill Handling: As an immediate precautionary measure, isolate spill or leak area for at least 50 meters/150 feet in all directions. *Large spill*: consider initial downwind evacuation for at least 300 meters/1000 feet. *Eliminate* all ignition sources (no smoking, flares, sparks or flames in immediate area). All equipment used when handling the product must be grounded. Do not touch or walk through spilled material. Stop leak if you can do it without risk. Prevent entry into waterways, sewers, basements or confined areas. A vapor-suppressing foam may be used to reduce vapors. Absorb or cover with dry earth, sand or other noncombustible material and transfer to containers. Use clean non-sparking tools to collect absorbed material. *Large spill*: dike far ahead of liquid spill for later disposal. Water spray may reduce vapor; but may not prevent ignition in closed spaces.

Fire Extinguishing: This chemical is a flammable liquid. Hazardous decomposition includess acidic smoke and oxides of carbon. As an immediate precautionary measure, isolate spill or leak area in all directions for at least 50 meters/150 feet for liquids and at least 25 meters/75 feet for solids. *Fire involving storage or vehicular tanks:* isolate for 800 meters/0.5 mile in all directions; also, consider initial evacuation for 800 meters (0.5 mile) in all directions. CAUTION: (1) This product may have a very low flash point: Use of water spray when fighting fire may be inefficient. (2) For mixtures containing alcohol or polar solvent, alcohol-resistant foam may be more effective. *Small fire*: dry chemical, CO_2, water spray or regular foam. *Large fire:* water spray, fog or regular foam. Do not use straight streams. Move containers from fire area if you can do it without risk. *Fire involving tanks or vehicle loads:* fight fire from maximum distance or use unmanned hose holders or monitor nozzles. Cool containers with flooding quantities of water until well after fire is out. Withdraw immediately in the case of rising sound from venting safety devices or discoloration of tank. ALWAYS stay away from tanks engulfed in fire. For massive fire, use unmanned hose holders or monitor nozzles; if this is impossible, withdraw from area and let fire burn.

Disposal Method Suggested: Do not discharge into drains or sewers. Dispose of waste material as hazardous waste using a licensed disposal contractor to an approved landfill. Consult with environmental regulatory agencies for guidance on acceptable disposal practices. Generators of waste containing this contaminant must conform with EPA regulations governing storage, transportation, treatment, and waste disposal. If allowed, incineration with effluent gas scrubbing is recommended. Containers must be disposed of properly by following package label directions or by contacting your local or federal environmental control agency, or by contacting your regional EPA office.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- Sax, N. I., Ed., "Dangerous Properties of Industrial Materials Report," 2, No. 3, 78-79 (1982)
- New Jersey Department of Health, "Hazardous Substance Fact Sheet: Dipentene," Trenton, NJ (December 1996, rev. May 2003). http://www.state.nj.us/health/eoh/rtkweb/0792.pdf
- USEPA, Office of Pesticide Programs, Pesticide Residue Limits, "Limonene," 40 CFR 180.539. http://www.epa.gov/pesticides/food/viewtols.htm

Diphacinone D:1450

Use Type: Rodenticide

CAS Number: 82-66-6; 42721-99-3 (sodium salt)

Formula: $C_{23}H_{16}O_3$

Synonyms: Dipazin; Diphacin (Italy and Turkey); Diphacinon; Diphenacin; Diphenadion; Diphenadione; 2-Diphenylacetyl-1,3-diketohydrindene; 2-(Diphenylacetyl) indan-1,3-indandione; 2-(Diphenylacetyl)-1*H*-indene-1,3(2*H*)-dione; Ratindan (Russia)

Trade Names: DE-PESTER®[C]; DIDANDIN®; DIPAXIN®; DITRAC®; GOLD CREST®; KILL-RO RAT KILLER®; LIQUA-TOX®, diphacinone sodium salt; ORAGULANT®; P. C. Q. ®; PID®; PROMAR®; RAMIK®; RAT KILLER®; RODENT CAKE®[C]; SOLVAN®; TOMCAT®; U 1363®

Chemical Class: 1,3-Indandione

EPA/OPP PC Code: 067701; 067705 (Na salt)

California DPR Chemical Code: 225; 1636 (Na salt)

HSDB Number: 2788

UN/NA & ERG Number: UN2811/154

RTECS® Number: NK5600000

EC Number: 201-434-5 [*Annex I Index No.:* 606-038-00-X]

Uses: A U.S. EPA restricted Use Pesticide (RUP) when the formulation contains 3% or more of diphacinone. Diphacinone is an anti-coagulant rodenticide bait used for control of rats, mice, voles and other rodents. It is available in meal, pellet, wax block, and liquid bait formulations, as well as in tracking powder and concentrate formulations. It is used in general agriculture and in food-processing areas. The top five uses for diphacinone in California are on landscapes, general vertebrate pest control, around structures and right of ways, and on oranges. This material is also used as an anticoagulant medication. Not approved for use in EU countries[115].

Regulatory Authority and Advisory Information: Acute Oral Category: 1, DANGER–POISON

PAN Bad Actor Chemical (82-66-6 only)

Superfund/EPCRA 302 Extremely Hazardous Substances: TPQ = 10/10,000 lb (4.54/4,540 kg)

Superfund/EPCRA 40CFR302.4 RQ: EHS, 1 lb (0.454 kg)

Marine pollutant

European/International Regulations: Hazard Symbol: T+, N; risk phrases: R28; R48/23/24/25; safety phrases: S1/2; S36/37; S45 (see Appendix 1)

Description: Diphacinone is a pale yellow, crystalline solid. Odorless. Molecular weight = 340.38; Specific gravity (H_2O:1) = 1.281 @ 25°C; Boiling point = (decomposes); Freezing/Melting point = 147°C. Hazard Identification (based on NFPA-704 M Rating System): Health 4, Flammability 1, Reactivity 0. Practically insoluble in water. Physical and toxicological properties may be affected by carrier solvents in commercial formulations.

Incompatibilities: Hydrolyzed by strong acids. Incompatible with oxidizers, chlorates nitrates, peroxides, water and strong light including ultraviolet light can cause decomposition. Diphacinone is a ketone, and behaves as a weak acid. Forms water-soluble alkali metal salts. Ketones are reactive with many acids and bases, liberating heat and flammable gases. The amount of heat may be sufficient to start a fire in the unreacted portion of the ketone. Ketones react with reducing agents such as hydrides, alkali metals, and nitrides to produce flammable hydrogen gas and heat. Ketones are incompatible with isocyanates, aldehydes, cyanides, peroxides, and anhydrides. They react violently with aldehydes, nitric acid and perchloric acid[88].

Permissible Exposure Limits in Air: Protective Action Criteria (PAC) Ver. 27[89]

PAC-1: 0.082 mg/m^3
PAC-2: 0.9 mg/m^3
PAC-3: 88 mg/m^3

Permissible Concentration in Water: Runoff from spills or fire control may cause water pollution.

Determination in Water: Log K_{ow} = >4.5. Values above 3.0 are likely to bioaccumulate in aquatic organisms.

Routes of Entry: Inhalation, dermal or eye contact. Persons with who are taking anticoagulants or are suffering from bleeding disorders must be protected from exposure.

Harmful Effects and Symptoms

Short Term Exposure: This material is extremely toxic and an anticoagulant. Probable oral lethal dose in humans is 5–50 mg/kg, or between 7 drops and 1 teaspoonful for a 150 lb person. Diphacinone is an anticoagulant (inhibits blood clotting). Hemorrhage is the most common effect and may be manifested by nose bleeding, gum bleeding, bloody stools and urine, ecchymoses (extravasations of blood into skin), and hemoptysis (coughing up blood). Bruising is heightened. Abdominal and flank pain are also common. Other signs and symptoms include flushing, dizziness, hypotension (low blood pressure), dyspnea (shortness of breath), cyanosis (blue tint to the skin and mucous membranes), fever, and diarrhea. LD_{50} (oral, rat) = 7 mg/kg; LD_{50} (dermal, rat) = 200 mg/kg.

Long Term Exposure: May affect the liver and kidneys. Repeated exposure may cause low white blood cell count and affect the brain.

Points of Attack: Blood, liver, kidneys.

Medical Surveillance: Blood test for clotting time (PT, INR, or PTT). Stool and urine tests for blood. Liver and kidney function tests. Complete blood count. EEG.

First Aid: *Emergency Life-Support Procedures:* Acute exposure RUSH to health care facility; may require decontamination and life support for the victims. Emergency personnel should wear protective clothing appropriate to the type and degree of contamination. Air-purifying or supplied-air respiratory equipment should also be worn, as necessary. Rescue vehicles should carry supplies such as plastic sheeting and disposable plastic bags to assist in preventing spread of contamination. *Inhalation Exposure:* 1. Move victims to fresh air. Emergency personnel should avoid self-exposure. 2. Evaluate vital signs including pulse and respiratory rate, and note any trauma. If no pulse is detected, provide CPR. If not breathing, provide artificial respiration. If breathing is labored, administer oxygen or other respiratory support. 3. Obtain authorization and/or further instructions from the local hospital for administration of an antidote or performance of other invasive procedures. 4. RUSH to a health care facility. *Dermal/Eye Exposure:* 1. Remove victims from exposure. Emergency personnel should avoid self- exposure. 2. Evaluate vital signs including pulse and respiratory rate, and note any trauma. If no pulse is detected, provide CPR. If not breathing, provide artificial respiration. If breathing is labored, administer oxygen or other respiratory support. 3. Remove contaminated clothing as soon as possible. 4. If eye exposure has occurred, eyes must be flushed with lukewarm water for at least 15 minutes. 5. Wash exposed skin areas twice with soap and water. 6. Obtain authorization and/or further instructions from the local hospital for administration of an antidote or performance of other invasive procedures. 7. RUSH to a health care facility. *Ingestion Exposure:* 1. Evaluate vital signs including pulse and respiratory rate, and note any trauma. If no pulse is detected, provide CPR. If not breathing, provide artificial respiration. If breathing is labored, administer oxygen or other respiratory support. 2. Obtain authorization and/or further instructions from the local hospital for administration of an antidote or performance of other invasive procedures. 3. Vomiting may be induced with syrup of ipecac. If elapsed time since ingestion of diphacinone is unknown or suspected to be greater than 30 minutes, do not induce vomiting and RUSH to a health care facility. 4. ipecac should not be administered to children under 6 months of age. ***Warning:*** Syrup of ipecac should be administered only if victims are alert, have an active gag-reflex, and show no signs of impending seizure or coma. If ANY uncertainty exists, RUSH to a health care facility. 4. The following dosages of ipecac are recommended: children up to 1 year old, 10 mL (1/3 oz); children 1 to 12 years old, 15 mL (1/2 oz); adults, 30 mL (1 oz). Ambulate (walk) the victims and give large quantities of water. If vomiting has not occurred after 15 minutes, ipecac may be re-administered. Continue to ambulate and give water to the victims. If vomiting has not occurred within 15 minutes after second administration of ipecac, administer activated charcoal. 4. Activated charcoal may be administered if victims are conscious and alert. Use 15 to 30 g (1/2 to 1 oz) for children, 50 to 100 g (1-3/4 to 3-1/2 oz) for adults, with 125 to 250 mL (1/2 to

1 cup) of water. 5. Promote excretion by administering a saline cathartic or sorbitol to conscious and alert victims. Children require 15 to 30 g (1/2 to 1 oz) of cathartic; 50 to 100 g (1-3/4 to 3-1/2 oz) is recommended for adults. 6. RUSH to a health care facility[83].

Note to physician: A collection of published articles. from the literature has been submitted to support the use of Vitamin K as an antidote in treating diphacinone poisoning[83]. See record number 2788 for HSDB (Hazardous Substance Data Bank).

Personal Protective Methods: For emergency situations, wear a positive-pressure, pressure-demand, full facepiece self-contained breathing apparatus (SCBA) or pressure-demand supplied-air respirator with escape SCBA and a fully encapsulating, chemical-resistant suit. Safety equipment suppliers/manufacturers can provide recommendations on the most protective glove/clothing material for your operation. All protective clothing (suits, gloves, footwear, headgear) should be clean, available each day, and put on before work. Contact lenses should not be worn when working with this chemical. Employees should wash immediately with soap when skin is wet or contaminated. Provide emergency showers and eyewash.

Respirator Selection: Where potential exists for exposure to diphacinone, use a NIOSH/MSHA- or European Standard EN149-approved supplied-air respirator with a full facepiece operated in the positive-pressure mode, or with a full facepiece, hood, or helmet in the continuous-flow mode; or use a NIOSH/MSHA- or European Standard EN149-approved self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive-pressure mode.

Storage: Color Code-Blue: Health Hazard/Poison. Store in a secure poison location. Prior to working with this chemical you should be trained on its proper handling and storage. Store in tightly closed containers in a cool, well-ventilated area. Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: Indandione pesticides, solid, toxic, n. o. s., require a "poisonous materials" label.Hazard Class is 6.1.

Spill Handling: First remove all sources of ignition. Evacuate persons not wearing protective equipment from area of spill or leak until clean up is complete. Do not touch spilled material; stop leak if you can do it without risk. Use water spray to reduce vapors. *Small spills*: take up with sand or other noncombustible absorbent material and place into containers for later disposal. *Small dry spills:* with clean shovel place material into clean, dry container and cover; move containers from spill area. *Large spills*: dike far ahead of spill for later disposal. Ventilate area after clean up is complete. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable.

Fire Extinguishing: Use dry chemical, carbon dioxide; water spray; or foam extinguishers. Hazardous decomposition includes oxides of carbon. *Fire involving storage or vehicular tanks:* isolate for 800 meters/0.5 mile in all directions; also, consider initial evacuation for 800 meters/0.5 mile in all directions. *Small fire:* dry chemical, carbon dioxide or water spray. *Large fire:* dry chemical, carbon dioxide, alcohol-resistant foam or water spray. Move containers from fire area if you can do it without risk. Dike fire-control water for later disposal; do not scatter the material. *Fire involving tanks or car/trailer loads:* fight fire from maximum distance or use unmanned hose holders or monitor nozzles. Do not get water inside containers. Cool containers with flooding quantities of water until well after fire is out. Withdraw immediately in the case of rising sound from venting safety devices or discoloration of tank. Always stay away from tanks engulfed in fire. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode.

Disposal Method Suggested: In accordance with 40CFR165, follow recommendations for the disposal of pesticides and pesticide containers. Containers must be disposed of properly by following package label directions or by contacting your local or federal environmental control agency, or by contacting your regional EPA office.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- EXTOXNET, Extension Toxicology Network, "Pesticide Information Profile, Diphacinone," Oregon State University, Corvallis, OR (June 1996). http://ace.orst.edu/info/extoxnet/pips/diphacin.htm
- New Jersey Department of Health and Senior Services, "Hazardous Substance Fact Sheet, Diphacinone," Trenton, NJ (May 1999). http://www.state.nj.us/health/eoh/rtkweb/0794.pdf
- USEPA, "Chemical Profile: Diphacinone," Washington DC, Chemical Emergency Preparedness Program (November 30, 1987)

Diphenamid D:1460

Use Type: Herbicide

CAS Number: 957-51-7

Formula: $C_{16}H_{17}NO$; $(CH_3)_2NCOCH(C_6H_5)_2$

Synonyms: Acetamide, *N,N*-dimethyl-2,2-diphenyl-; Benzeneacetamide, *N,N*-dimethyl-α-phenyl-; Difenamid (Spanish); *N,N*-Dimethyl-α,α-diphenylacetamide; *N,N*-Dimethyl-α-phenylbenzeneacetamide; *N,N*-

Dimethyldiphenylacetamide; *N,N*-Dimethyl-2,2- diphenylacetamide; *N,N*-Dimethyl-α-phenylbenzeneacetamide; Dimid; Diphenamide; Diphenylamide; 2,2-Diphenyl-*N,N*-dimethylacetamide

Trade Names: DIF 4®; DYMID®[C]; ENIDE®[C]; FDN®; FENAM®; L 34314®; LILLY 34314®; RIDEON®; U 4513®; ZARUR®

Chemical Class: Amide Herbicide; Alkanamide; Phenylamide

EPA/OPP PC Code: 036601

California DPR Chemical Code: 226

HSDB Number: 367

UN/NA & ERG Number: UN3077(solid)/171

RTECS® Number: AB8050000

EC Number: 213-482-4 [*Annex I Index No.:* 616-007-00-2]

Uses: This material is used as a pre-emergent and selective herbicide for tomatoes, peanuts, alfalfa, soybeans, cotton and other crops. Not approved for use in the U.S. or EU countries[115]. There are 18 global suppliers[97].

U.S. Maximum Allowable Residue Levels for Diphenamid including its desmethyl metabolite (N-methyl-2,2-diphenylacetamide) [(40 CFR 180.230)]: in or on raw agricultural commodities as follows: peanut hay and forage 2 ppm; potatoes and strawberries 1 ppm; peanut hulls and soybean, hay and forage 0.5 ppm; cotton forage 0.2 ppm; apples, cottonseed, fruiting vegetables, okra, peaches, peanuts, soybeans, and sweet potatoes 0.1 ppm (negligible residue); in meat, fat, and meat byproducts of cattle, goats, hogs, horses, and sheep 0.05 ppm (negligible residue); in milk 0.01 ppm (negligible residues); rasberries 1.0 ppm.

Human toxicity (long-term)[101]: Very low–200.00 ppb, Health Advisory

Fish toxicity (threshold)[101]: High–5.00495 ppb, MATC (Maximum Acceptable Toxicant Concentration)

Regulatory Authority and Advisory Information: Toxicity (oral) Category: 3, CAUTION

Health Advisory: Mutagen

EPCRA Section 313 Form R *de minimus* concentration reporting level: 1.0%

European/International Regulations: Hazard Symbol: Xn, N; risk phrases: R22; R52/53; safety phrases: S2; S61 (see Appendix 1)

Description: Diphenamid is a white crystalline solid in various forms. Molecular weight = 239.32; Specific gravity (H_2O:1) = 1.18 @ 25°C; Freezing/Melting point = 135°C; Vapor pressure = 2.8×10^{-8} mmHg @ 20°C. Hazard Identification (based on NFPA-704 M Rating System): Health 1, Flammability 0, Reactivity 0. Moderately soluble in water. Physical and toxicological properties may be affected by carrier solvents in commercial formulations.

Incompatibilities: Reacts with strong oxidants, strong acids and alkalies. Diphenamid is an amide. Amides react with azo and diazo compounds to generate toxic gases. Flammable gases are formed by the reaction of organic amides with strong reducing agents. Amides are very weak bases (weaker than water). Mixing amides with dehydrating agents such as phosphorus pentoxide or thionyl chloride generates the corresponding nitrile. The combustion of these compounds generates mixed oxides of nitrogen. This compound is decomposed by strong base or acid[88].

Permissible Exposure Limits in Air: OEL (Russia): 5 mg/m³ STEL (1/1993)[9]

Permissible Concentration in Water: Federal Drinking Water Guidelines: 200 μg/L; State Drinking Water Guidelines: Florida 210 μg/L; California 200 μg/L.

Determination in Water: Log K_{ow} = <2.5. Unlikely to bioaccumulate in marine organisms.

Routes of Entry: Ingestion, inhalation, dermal and/or eye contact.

Harmful Effects and Symptoms

Short Term Exposure: May cause irritation of the eyes, skin and respiratory tract. Ingestion can cause nausea and vomiting. May cause convulsions. LD_{50} (oral, rat) = 650 mg/kg; LD_{50} (dermal, rat) = >6000 mg/kg.

Long Term Exposure: A slight increase in liver weights was observed in long-term animal feeding studies. Mutation data reported.

Medical Surveillance: Preliminary medical exam to detect chronic diseases of central nervous system, liver, heart, kidneys, lung and skin, as well as endocrinological or immunological disturbances, should protect susceptible individuals. In addition to comprehensive initial medical and work histories emphasizing reproductive experience and menstrual history, patient should have physical examination and testing of genito-urinary tract, sperm count, motility and morphology. If required, other tests, such as serum testosterone, serum follicle stimulating hormone (FSH), and serum lutenizing hormone (LH), may be indicated. Periodical medical exams of internal organs, skin and eyes are important to avoid chronic occupational intoxications. They should include lab and patch tests when necessary[83].

First Aid: If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least 15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately. If this chemical contacts the skin, remove contaminated clothing and wash immediately with soap and water. Seek medical attention immediately. If this chemical has been inhaled, remove from exposure, begin rescue breathing (using universal precautions) if breathing has stopped, and CPR if heart action has stopped. Transfer promptly to a medical facility. When this chemical has been swallowed, get medical attention. Give large quantities of water and induce vomiting. Do not make an unconscious person vomit.

Personal Protective Methods: Wear protective gloves and clothing to prevent any reasonable probability of dermal and/or eye contact. Safety equipment suppliers/manufacturers can provide recommendations on the most protective glove/clothing material for your operation. All protective clothing (suits, gloves, footwear, headgear) should be clean, available each day, and put on before work. Contact lenses should not be worn when working with this chemical. Wear dust-proof chemical goggles and face shield unless full facepiece respiratory protection is worn. Employees should wash immediately with soap when skin is wet or contaminated. Provide emergency showers and eyewash.

Respirator Selection: Where there is potential for exposure to diphenamidexists, use a NIOSH/MSHA- or European Standard EN149-approved supplied-air respirator with a full facepiece operated in the positive-pressure mode, or with a full facepiece, hood, or helmet in the continuous flow mode; or use a NIOSH/MSHA- or European Standard EN149-approved self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive-pressure mode.

Storage: Color Code-Blue: Health Hazard/Poison. Store in a secure poison location. Color Code-White: Corrosive or Contact Hazard; Store separately in a corrosion-resistant location. Prior to working with this chemical you should be trained on its proper handling and storage. Store in tightly closed containers in a cool, well-ventilated area away from strong oxidizers, strong acids, strong alkalies. Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: Environmentally hazardous substances, solid, n.o.s. This chemical requires a shipping label of "CLASS 9." It usually falls in Hazard Class 9.

Spill Handling: First remove all sources of ignition. Evacuate persons not wearing protective equipment from area of spill or leak until clean up is complete. Collect powdered material in the most convenient and safe manner and deposit in sealed containers. Ventilate area after clean up is complete. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable.

Fire Extinguishing: This chemical is a combustible solid. Use dry chemical, carbon dioxide; water spray; or alcohol foam extinguishers. Diphenamid decomposes @ 210°C forming toxic and corrosive gases, including nitrogen oxides. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies. From a secure, explosion-proof location, use water spray to cool exposed containers. If cooling streams are ineffective (venting sound increases in volume and pitch, tank discolors, or shows any signs of deforming), withdraw immediately to a secure position. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode.

Disposal Method Suggested: Small amounts may be destroyed by alkaline hydrolysis. Admixture with alkali can be followed by soil burial. Larger quantities can be disposed of by incineration in admixture with acetone or xylene and using effluent gas scrubbing.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- 40 CFR 180.230, Diphenamid. http://www.setonresourcecenter.com/40CFR/Docs/wcd0004c/wcd04cdd.asp
- USEPA, "Chemical Profile: Diphenamid," Washington DC, Office of Drinking Water (August 1987)

Diphenylamine D:1470

Use Type: Insecticide, Fungicide, Herbicide, Plant growth regulator

CAS Number: 122-39-4

Formula: $C_{12}H_{11}N$

Synonyms: Acetamide, 2-Biphenylyl-*N*-pyridyl-; AI3-00781; Aniline, *n*-phenyl-; Anilinobenzene; Benzenamine, *n*-phenyl-; Benzene, anilino-; Benzene, (phenylamino)-; Big Dipper; 2-Biphenylyl-*N*-pyridylacetamide; Caswell No. 398; C.I. 10355; Deccoscald 282; DFA; Difenilamina (Spanish); Diphenpyramide; *N*,*N*-Diphenylamine; DPA; NSC 215210; *n*-Phenylaniline; Phenylaniline; *n*-Phenylbenzenamine; *n*-Phenylbenzeneamine; Poly(diphenylamine); Pyridyl-biphenylyl-acetamide

Trade names: NO- SCALD DPA 31; NO- SCALD DPA 283; SCALDIP; Z-876

Chemical Class: Amine

EPA/OPP PC Code: 038501

California DPR Chemical Code: 228

HSDB Number: 1108

UN/NA & ERG Number: UN2811/154

RTECS® Number: JJ7800000

EC Number: 204-539-4[*Annex I Index No.:* 612-026-00-5]

Uses: Topically in anti-screwworm mixtures, foliar application in a modified growth chamber to decrease ozone injury to leaves of apple, bean, muskmelon, petunia, and tobacco plants. To control weather fleck in tobacco and inhibit algae formation. To prolong the fresh appearance of snapdragons. Protect rice from the toxic effects of thiolcarbamate herbicides[83]. Not currently approved for use in EU countries (resubmitted) [115]. Registered for use in the U.S. and other countries.

U.S. Maximum Allowable Residue Levels for diphenylamine [40 CFR 180.190(a)]: in or on the following commodities: apple, wet pomace 30.0 ppm; apple from preharvest or postharvest use, including use of impregnated wraps 10.0 ppm; cattle, fat 0.01 ppm; cattle, liver 0.1 ppm; cattle, meat byproducts, except liver 0.01 ppm; cattle, meat 0.01 ppm; goat, fat 0.01 ppm; goat, liver 0.1 ppm; goat, meat byproducts, except liver 0.01 ppm; goat, meat 0.01 ppm; horse, fat 0.01 ppm; horse, liver 0.1 ppm; horse, meat byproducts, except liver 0.01 ppm;

horse, meat 0.01 ppm; milk 0.01 ppm; sheep, fat 0.01 ppm; sheep, liver 0.1 ppm; sheep, meat byproducts, except liver 0.01 ppm; and sheep, meat 0.01 ppm.

Regulatory Authority and Advisory Information: Health Advisory: Mutagen, Developmental/Reproductive Toxin.

Acute Oral Category: 3, CAUTION

U.S. EPA Gene-Tox Program, Positive: Cell transform SA7/SHE

RCRA Hazardous Constituent Waste[5].

European/International Regulations: Hazard Symbol: T, N; risk phrases: R23; R24; R25; R33; R50/53; safety phrases: S1/2; S28; S36/37; S45; S60; S61 (see Appendix 1).

WGK (German Aquatic Hazard Class): 3-Severe hazard to waters.

Description: DPA is a colorless to amber to brown crystalline solid or liquid. Contact with light causes a color change. Pleasant to pungent, floral odor. Molecular weight = 169.22; Specific gravity (H_2O:1) = 1.158 @ 22°C; Boiling point = 302°C; Freezing/Melting point = 53.2°C; Vapor pressure = 2×10^{-4} mmHg @ 20°C; Flash point = 153°C (cc); Explosive limits: LEL = 0.7%; UEL 5.4%; Autoignition temperature = 634°C. Henry's Law constant = 2.69×10^{-006} atm-m^3/mol @ 25°C (est)[83]. Hazard Identification (based on NFPA-704 M Rating System): Health 2, Flammability 1, Reactivity 0. Low solubility in water.

Incompatibilities: Dust forms explosive mixture with air. Incompatible with strong acids; strong oxidizers; aldehydes, organic anhydrides; isocyanates, hexachloromelamine, trichloromelamine. Reacts with nitrogen oxides forming *N*-nitrosodiphenylamine and heat-, friction-, and shock-sensitive nitro products.

Permissible Exposure Limits in Air: OSHA PEL: None

NIOSH REL: 10 mg/m^3 TWA

ACGIH TLV®[1]: 10 mg/m^3 TWA; not classifiable as a human carcinogen

Protective Action Criteria (PAC) Ver. 27[89]

PAC-1: 30 mg/m^3
PAC-2: 65 mg/m^3
PAC-3: 220 mg/m^3

Determination in Air: Use OSHA Analytical Method 78.

Permissible Concentration in Water: Federal Drinking Water Guidelines: EPA 200 μg/L; State Drinking Water Guidelines: Maine 175 μg/L; Florida 175 μg/L. EU Drinking Water Guidelines (MAC) = 90 μg/L.

Determination in Water: Log K_{ow} = >3.5. Values above 3.0 are likely to bioaccumulate in aquatic organisms.

Routes of Entry: Inhalation of dust, ingestion, skin absorption; eye and/or dermal and/or eye contact.

Harmful Effects and Symptoms

Short Term Exposure: DPA irritates the eyes, skin, and respiratory tract. It may affect the blood (resulting in formation of methemoglobin). Industrial poisoning has been encountered and was manifested clinically by bladder symptoms, tachycardia, hypertension and skin trouble. Overexposure can damage the liver, kidneys (polycystic kidneys), and may cause bladder symptoms and blood in the urine. LD_{50} (oral, rat) = >15 g/kg; LD_{50} (dermal, rat) = >7500 mg/kg.

Long Term Exposure: DPA may affect the liver, kidneys and blood, forming methemoglobin. NIOSH warns that the carcinogen 4-aminodiphenyl may be present as an impurity in the commercial product. In animals: teratogenic effects. May cause reproductive and fetal effects. May cause problems of the gastrointestinal tract, cardiovascular system and spleen. May cause kidney and liver problems.

Points of Attack: Eyes, skin, respiratory system; cardiovascular system, blood, bladder, reproductive system.

Medical Surveillance: In addition to comprehensive initial medical and work histories emphasizing reproductive experience and menstrual history, patient should have physical examination and testing of genito-urinary tract, sperm count, motility and morphology. If required, other tests, such as serum testosterone, serum follicle stimulating hormone (FSH), and serum lutenizing hormone (LH), may be indicated. If symptoms develop or overexposure is suspected, the following may be useful: evaluation of the kidneys and urinary system. Urine cytology (to look for abnormal cells). Liver function tests.

First Aid: If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least 15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately. If this chemical contacts the skin, remove contaminated clothing and wash immediately with soap and water. Seek medical attention immediately. If this chemical has been inhaled, remove from exposure, begin rescue breathing (using universal precautions, including resuscitation mask) if breathing has stopped and CPR if heart action has stopped. Transfer promptly to a medical facility. When this chemical has been swallowed, get medical attention. Give large quantities of water and induce vomiting. Do not make an unconscious person vomit. Medical observation is recommended.

Personal Protective Methods: Wear protective gloves and clothing to prevent any reasonable probability of dermal and/or eye contact. Safety equipment suppliers/manufacturers can provide recommendations on the most protective glove/clothing material for your operation. All protective clothing (suits, gloves, footwear, headgear) should be clean, available each day, and put on before work. Contact lenses should not be worn when working with this chemical. Wear dust-proof chemical goggles and face shield unless full facepiece respiratory protection is worn. Employees should wash immediately with soap when skin is wet or contaminated. Provide emergency showers and eyewash.

Respirator Selection: SCBA >30 mg/m^3. Where potential exists for exposures over *10 mg/m*^{3}, use a NIOSH/MSHA- or European Standard EN149-approved full facepiece respirator with a high-efficiency particulate filter. Greater protection is provided by a powered air-purifying respirator. Particulate filters must be checked every day before work for physical damage, such as rips or tears, and replaced as needed. If while wearing a filter, cartridge or canister respirator, you can smell, taste, or otherwise detect diphenylamine, or in the case of a full facepiece respirator you experience eye irritation, leave the area immediately. Check to make sure the respirator-to-face seal is still good. If it is, replace the filter, cartridge, or canister. If the seal is no longer good, you may need a new respirator. *Where potential for high exposures exists*, use a NIOSH/MSHA- or European Standard EN149-approved supplied-air respirator with a full facepiece operated in the positive-pressure mode, or with a full facepiece, hood, or helmet in the continuous-flow mode; or use a NIOSH/MSHA- or European Standard EN149-approved self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive-pressure mode.

Storage: Color Code-Blue: Health Hazard/Poison: Store in a secure poison location. Store in tightly closed containers in a cool, well-ventilated area away from light. If this material contains a flammable carrier, sources of ignition, such as smoking and open flames, are prohibited where diphenylamine is used, handled, or stored in a manner that could create a potential fire or explosion hazard. Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: Toxic solids, flammable, organic, n.o.s. requires a shipping label of "poisonous materials." It falls into Hazard Class 6.1.

Spill Handling: Evacuate persons not wearing protective equipment from area of spill or leak until clean up is complete. Collect powdered material in the most convenient and safe manner and deposit in sealed containers. Ventilate area after clean up is complete. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable.

Fire Extinguishing: Hazardous decomposition include oxides of carbon. *Fire involving storage or vehicular tanks:* isolate for 800 meters/0.5 mile in all directions; also, consider initial evacuation for 800 meters/0.5 mile in all directions. *Small fire:* dry chemical, carbon dioxide or water spray. *Large fire:* dry chemical, carbon dioxide, alcohol-resistant foam or water spray. Move containers from fire area if you can do it without risk. Dike fire-control water for later disposal; do not scatter the material. *Fire involving tanks or car/trailer loads:* fight fire from maximum distance or use unmanned hose holders or monitor nozzles. Do not get water inside containers. Cool containers with flooding quantities of water until well after fire is out. Withdraw immediately in the case of rising sound from venting safety devices or discoloration of tank. Always stay away from tanks engulfed in fire. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode.

Disposal Method Suggested: Burn in admixture with flammable solvent in furnace equipped with afterburner and scrubber.

References:

- Sax N. I., Ed., "*Dangerous Properties of Industrial Materials Report*," 2, No. 5, 63-66 (1982)
- U.S. Environmental Protection Agency, Special Review and Reregistration Division Office of Pesticide Programs*, Agency Status of Pesticides in Registration, Reregistration, and Special Review* (Rainbow Report), Washington DC, (1998)
- New Jersey Department of Health and Senior Services, *Hazardous Substances Fact Sheet:* Diphenylamine, Trenton, NJ (May 2003)

Diquat D:1540

Use Type: Herbicide, Desiccant

CAS Number: 2764-72-9 (ion); 85-00-7 (dibromide); 6385-62-2 (monohydrate)

Formula: $C_{12}H_{12}N_2Br_2$

Synonyms: 9,10-Dihydro-8a,10-diazoniaphenanthrene dibromide;9,10-Dihydro-8a,10a-diazoniaphenanthrene(1,1'-ethylene-2,2'-bipyridylium)dibromide; 5,6-Dihydro-dipyrido(1,2a,2,1c)pyrazinium dibromide; 5,6-Dihydro-dipyrido(1,2-a:2,1'-c)pyrazinium dibromide; 6,7-Dihydropyrido(1,2-a:2',1'-c)pyrazinedium dibromide; 6,7-Dihydropyridol(1,2-a:2',1'-c)pyrazinedium dibromide; Dipyrido(1,2-a:2',1'-c)pyrazinediium, 6,7-dihydro-, dibromide; *o*-Diquat; Diquat dibromide; 1,1'-Ethylene-2,2'-bipyridyliumdibromide; Ethylene dipyridylium dibromide; 1,1-Ethylene 2,2-dipyridylium dibromide; 1,1'-Ethylene-2,2'-dipyridylium dibromide

Trade Names: AQUACIDE®; AQUA-CLEAR®[C] AQUAKILL®; CLEANSWEEP®; DEIQUAT®; DEXTRONE®; FARMON PDQ®; FB/2®; FEGLOX®; GROUNDHOG SOLTAIR®; ORTHO DIQUAT®; PATHCLEAR®; PREEGLONE®; REGLON®; REGLONE®; Zeneca Ag Products; REGLOX®; REWARD®; TAG®; TORPEDO®; VEGATROLE®; WEEDOL (ICI)®; WEEDTRINE-D®

Chemical Class: Bipyridilium

EPA/OPP PC Code: 032201

California DPR Chemical Code: 229

HSDB Number: 1700

UN/NA & ERG Number: UN2781/151

RTECS® Number: JM5690000

EC Number: 220-433-0; 201-579-4 [*Annex I Index No.:* 613-089-00-1] (*dibromide CAS: 85-00-7*)

Uses: Diquat or diquat dibromide is a nonselective, quick-acting herbicide and plant growth regulator, causing injury only to the parts of the plant to which it is applied.

Diquat is referred to as a desiccant because it causes a leaf or an entire plant to dry out quickly. It is used to desiccate potato vines and seed crops, to control flowering of sugarcane, and for industrial and aquatic weed control in environments such as catfish farms. It is not residual; it does not leave any trace of herbicide on or in plants, soil, or water.
U.S. Maximum Allowable Residue Levels for residues of the plant growth regulator diquat (6,7-dihydrodipyrido (1,2-a: 2(a) Tolerancprime;,1-c)pyrazinediium) derived from application of the dibromide salt and calculated as the cation [40 CFR 180.226 (a)(1)]: in or on the following food commodities: cattle, fat 0.02 ppm; cattle, meat byproducts 0.02 ppm; cattle, meat 0.02 ppm; egg 0.02 ppm; goat, fat 0.02 ppm; goat, meat byproducts 0.02 ppm; goat, meat 0.02 ppm; hog, fat 0.02 ppm; hog, meat byproducts 0.02 ppm; hot, meat 0.02 ppm; horse, fat 0.02 ppm; horse, meat byproducts 0.02 ppm; horse, meat 0.02 ppm; milk 0.02 ppm; potato 0.1 ppm; potato, waste, dried 1.0 ppm; poultry, fat 0.02 ppm; poultry, meat byproducts 0.02 ppm; poultry, meat 0.02 ppm; sheep, fat 0.02 ppm; sheep, meat byproducts: 0.02 ppm; and sheep, meat 0.02 ppm. ***Tolerances are established for residues of the herbicide diquat (calculated as the cation) derived from the application of the dibromide salt to ponds, lakes, reservoirs, marshes, drainage ditches, canals, streams, and rivers which are slow-moving or quiescent in programs of the Corps of Engineers or other Federal or State public agencies and to ponds, lakes and drainage ditches only where there is little or no outflow of water and which are totally under the control of the user [40 CFR 180.226 (a)(2)(I)]:*** in or on the following food commodities: avocado 0.02 ppm; cotton, undelinted seed 0.02 ppm; fish 0.1 ppm; fruit, citrus, group 0.02 ppm; fruit, pome group 0.02 ppm; fruit, small 0.02 ppm; fruit, stone, group 0.02 ppm; grain, crop 0.02 ppm; grass, forage 0.1 ppm; hop, dried cones 0.02 ppm; nut, tree, group 0.02 ppm; shellfish 0.1 ppm; sugarcane, cane 0.02 ppm; vegetable, cucurbit, group 0.02 ppm; vegetable, foliage of legume, group 0.1 ppm; vegetable, fruiting, group 0.02 ppm; vegetable, leafy 0.02 ppm; vegetable, root and tuber, group 0.02 ppm; and vegetable, seed and pod 0.02 ppm. ***Where tolerances are established at higher levels from other uses of diquat on the subject crops, the higher tolerances applies also to residues of the aquatic uses cited in this paragraph [40 CFR 180.226 (a)(2)(ii)]. Tolerances are established for residues of the plant growth regulator diquat derived from application of the dibromide salt and calculated as the cation [40 CFR 180.226 (a)(3)]:*** in or on the following food commodities: banana 0.05 ppm; and coffee 0.05 ppm. ***A tolerance is established for residues of diquat [40 CFR 180.226 (a)(5)]: in potato granules/flakes & potato chips 0.5 ppm. A tolerance regulation is established for residues of the desiccant diquat derived from application of the dibromide salt and calculated as the cation [40 CFR 180.226 (a)(6)]:*** in processed, dried potato waste 1.0 ppm.
Human toxicity (long-term)* [101]*: Intermediate–35.00 ppb, Health Advisory
Fish toxicity (threshold)* [101]*: Very low–932.73871 ppb, MATC (Maximum Acceptable Toxicant Concentration)

Regulatory Authority and Advisory Information:
Carcinogenicty: EPA Group E, evidence of non-carcinogenicity for humans (Diquat dibromide)
Health Advisory: Mutagen, Developmental/Reproductive Toxin, Skin irritant/sensitizer, Very toxic by Inhalation (EU)
Poison (oral) Category: 2, WARNING
Potential Ground Water Pollutant [California FAC Section 13145(d)/12811, active] (dibromide)
Clean Water Act: Section 311 Hazardous Substances/RQ 40CFR117.3 (same as CERCLA, see below)
Safe Drinking Water Act: MCL, 0.02 mg/L; MCLG, 0.02 mg/L; Regulated chemical (47 FR 9352)
Superfund/EPCRA 40CFR302.4 RQ: CERCLA, 1000 lb (454 kg)
European/International Regulations (*includes salts*): Hazard Symbol: T+, Xn, Xi, N; risk phrases: R22; R26; R36/37/38; R43; R48/25; R50/53; safety phrases: S1/2; S28; S36/37/39; S45; S60; S61 (see Appendix 1)
Description: Diquat forms a monohydrate which is a colorless to yellow crystalline solid. The crystals are usually dissolved in a solution; commercial products may be found as a liquid concentrate or a solution. Molecular weight = 184.23 (cation); 344.1 (dibromide); Specific gravity (H_2O:1) = 122–127 @ 20°C; Boiling point = (decomposes); Freezing/Melting point = (decomposes) 320°C[88]; Vapor pressure = 0.0001 mmHg @ 20°C. Hazard Identification (based on NFPA-704 M Rating System): Health 3, Flammability 1, Reactivity 0. Soluble in water; solubility = 100 mg/L @ 20°C. Physical and toxicological properties may be affected by carrier solvents in commercial formulations.
Incompatibilities: Incompatible with alkalis, UV light, basic solutions. The active ingredient is corrosive to metals. Concentrated solutions attack aluminum. Diquat cylinder may explode in heat of fire.
Permissible Exposure Limits in Air: OSHA PEL: None
NIOSH REL: 0.5 mg/m^3 TWA
ACGIH TLV®[1]: 0.5 mg/m^3 TWA, inhalable fraction, 0.1 mg/m^3 TWA, respirable fraction; not classifiable as a human carcinogen [skin]
No Protective Action Criteria (PAC) Available.
Determination in Air: No method available.
Permissible Concentration in Water: Federal Drinking Water Guidelines: EPA 20 μg/L; State Drinking Water Guidelines: Maine 14 μg/L. Canadian Drinking Water Standards: MAC 0.07 mg/L. Runoff from spills or fire control may cause water pollution. (Dibromide)
Determination in Water: Log K_{ow} = <1. Values above 3.0 are likely to bioaccumulate in aquatic organisms.
Routes of Entry: Inhalation, skin absorption, ingestion, skin and/or eye contact.
Harmful Effects and Symptoms
Short Term Exposure: Diquat can affect you when breathed in and by passing through your skin. Dermal contact can cause burns. High exposure can cause nausea, diarrhea, lung, liver, and kidney damage. Higher exposures can cause pulmonary edema, a medical emergency that can be delayed for several hours. LD_{50} (oral, rat) = <500 mg/kg; LD_{50} (dermal, rat) = >200–<2,000 mg/kg.

Long Term Exposure: Long term or repeated exposure may cause cataracts. Repeated contact causes dry, cracked skin and nail damage. May cause skin sensitization. Exposure can cause nosebleeds. Diquat may cause mutations. Handle with extreme caution. Diquat may damage the developing fetus. Lung damage may occur. May cause cataracts.

Points of Attack: Eyes, skin, respiratory system including lungs, kidneys, liver, central nervous system.

Medical Surveillance: Preliminary medical exam to detect chronic diseases of central nervous system, liver, heart, kidneys, lung and skin, as well as endocrinological or immunological disturbances, should protect susceptible individuals. Periodical medical exams of internal organs, skin and eyes are important to avoid chronic occupational intoxications. They should include lab and patch tests when necessary[83]. If symptoms develop or overexposure has occurred, the following may be useful: Lung function tests. Examination of the eyes. Kidney function tests. Evaluation by a qualified allergist, including exposure history and testing, may help diagnose allergy.

First Aid: If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least 15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately. If this chemical contacts the skin, remove contaminated clothing and wash immediately with soap and water. Seek medical attention immediately. If this chemical has been inhaled, remove from exposure, begin rescue breathing (using universal precautions) if breathing has stopped, and CPR if heart action has stopped. Transfer promptly to a medical facility. When this chemical has been swallowed, get medical attention. Give large quantities of water and induce vomiting. Do not make an unconscious person vomit.

Personal Protective Methods: Wear protective gloves and clothing to prevent any reasonable probability of dermal and/or eye contact. NIOSH recommends: **4 hr** (At least 4 but <8 hours of resistance to breakthrough >0.1 μg/cm^2/min): 4H™ and Silver Shield™ gloves. Safety equipment suppliers/manufacturers can provide recommendations on the most protective glove/clothing material for your operation. All protective clothing (suits, gloves, footwear, headgear) should be clean, available each day, and put on before work. Contact lenses should not be worn when working with this chemical. Wear dust-proof chemical goggles and face shield unless full facepiece respiratory protection is worn. Employees should wash immediately with soap when skin is wet or contaminated. Provide emergency showers and eyewash.

Respirator Selection: Where potential exists for exposures over 0.5 mg/m^3, use a NIOSH/MSHA- or European Standard EN149-approved full facepiece respirator with a pesticide cartridge. Increased protection is obtained from full facepiece air-purifying respirators. If while wearing filter, cartridge or canister respirator, you can smell, taste, or otherwise detect diquat, or in the case of a full facepiece respirator you experience eye irritation, leave the area immediately. Check to make sure the respirator to face seal is still good. If it is, replace the filter, cartridge, or canister. If the seal is no longer good, you may need a new respirator. *Where potential for high exposures exists*, use a NIOSH/MSHA- or European Standard EN149-approved supplied-air respirator with a full facepiece operated in the positive-pressure mode, or with a full facepiece, hood, or helmet in the continuous-flow mode; or use a MSHA/NIODH approved self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive-pressure mode.

Storage: Color Code-White: Corrosive or Contact Hazard; Store separately in a corrosion resistant location. Prior to working with this chemical you should be trained on its proper handling and storage. Store in tightly closed containers in a cool, well ventilated area. Color Code-Blue: Health Hazard/Poison. Store in a secure poison location. Prior to working with diquat you should be trained on its proper handling and storage. Store in tightly closed containers in a cool, well-ventilated area away from oxidizers and reducing agents. Drums must be equipped with self-closing valves, pressure vacuum bungs, and flame arresters. Use only non-sparking tools and equipment, especially when opening and closing containers of this chemical. If this material contains a flammable carrier, sources of ignition, such as smoking and open flames, are prohibited where this chemical is used, handled, or stored in a manner that could create a potential fire or explosion hazard. Wherever this chemical is used, handled, manufactured, or stored, use explosion-proof electrical equipment and fittings. Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: Bipyridilium pesticides, solid, toxic are "POISONOUS MATERIALS" They usually fall in Hazard Class 6.1.

Spill Handling: *Dry material:* First remove all sources of ignition. Evacuate persons not wearing protective equipment from area of spill or leak until clean up is complete. Collect powdered material in the most convenient and safe manner and deposit in sealed containers. Ventilate area after clean up is complete. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable. *Liquid:* Evacuate and restrict persons not wearing protective equipment from area of spill or leak until clean up is complete. Ventilate area of spill or leak. Absorb liquids in vermiculite, dry sand, earth, peat, carbon, or a similar material and deposit in sealed containers. Oil-skimming equipment may be used to remove slicks from water. Keep this chemical out of a confined space, such as a sewer, because of the possibility of an explosion, unless the sewer is designed to prevent the build-up of explosive concentrations. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable.

Fire Extinguishing: Hazardous decomposition includes oxides of nitrogen and carbon and hydrogen bromide gas. Diquat cylinder may explode in fire. Diquat is a combustible solid but does not readily ignite and burns with difficulty. *Fire involving storage or vehicular tanks:* isolate for 800 meters/0.5 mile in all directions; also, consider initial evacuation for 800 meters/0.5 mile in all directions. *Small fire:* dry chemical, carbon dioxide or water spray. *Large fire:* dry chemical, carbon dioxide, alcohol-resistant foam or water spray. Move containers from fire area if you can do it without risk. Dike fire-control water for later disposal; do not scatter the material. *Fire involving tanks or car/trailer loads:* fight fire from maximum distance or use unmanned hose holders or monitor nozzles. Do not get water inside containers. Cool containers with flooding quantities of water until well after fire is out. Withdraw immediately in the case of rising sound from venting safety devices or discoloration of tank. Always stay away from tanks engulfed in fire. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode.

Disposal Method Suggested: Diquat is inactivated by inert clay or by anionic surfactants. Therefore, an effective and environmentally safe disposal method would be to mix the product with ordinary household detergent and bury the mixture in clay soil. Containers must be disposed of properly by following package label directions or by contacting your local or federal environmental control agency, or by contacting your regional EPA office.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- EXTOXNET, Extension Toxicology Network, "Pesticide Information Profile, Diquat Dibromide," Oregon State University, Corvallis, OR (June 1996). http://ace.orst.edu/info/extoxnet/pips/diquatdi.htm
- New Jersey Department of Health, "Hazardous Substance Fact Sheet: Diquat," Trenton, NJ (June 1986, rev. January 2001). http://www.state.nj.us/health/eoh/rtkweb/0808.pdf

Disulfoton D:1580

Use Type: Insecticide, Acaricide

CAS Number: 298-04-4

Formula: $C_8H_{19}O_2PS_3$

Synonyms: *O,O*-diethyl *S*-(2-eththioethyl) phosphorodithioate; *O,O*-diethyl *S*-(2-eththioethyl) thiothionophosphate; *O,O*-Diethyl *S*-(2-ethylmercaptoethyl) dithiophosphate; *O,O*-Diethyl 2-ethylthioethylphosphorodithioate; *O,O*-Diethyls-2-(ethylthio)ethylphosphorodithioate; ENT 23,437; *O,O*-Ethyl *S*-2(ethylthio)ethylphosphorodithioate; *S*-2-(Ethylthio)ethyl *O,O*-diethylester of phosphorodithioic acid; Ethylthiodemeton; Phosphorodithionic acid, *S*-(2-(ethylthio)ethyl-*O,O*-diethylester; Phosphorodithionic acid, *O,O*-diethyl *S*-2-(ethylthio)ethyl ester

Trade names: BAY 19639®; BAYER 19639®; DIMAZ®; DISULFATON®; DI-SYSTON®[C]; DISYSTON®[C]; DISYSTOX®; DITHIODEMETON®; DITHIOSYSTOX®; EKATIN TD®; FRUMIN-AL®; FRUMIN G®; GLEBOFOS®; M-74®; S 276®; SOLVIREX®; THIODEMETON®; THIODEMETRON®

Chemical Class: Organophosphate

EPA/OPP PC Code: 032501

California DPR Chemical Code: 230 (inactive)

HSDB Number: 379

UN/NA & ERG Number: UN2783 (solid)/152

RTECS® Number: TD9275000

EC Number: 206-054-3 [*Annex I Index No.:* 015-060-00-3]

Uses: All products formulated at greater than 2% disulfoton are classified as Restricted Use Pesticides (RUP). Disulfoton is a selective, systemic organophosphate insecticide and acaricide that is especially effective against sucking insects. It is used to control aphids, leafhoppers, thrips, beet flies, spider mites, and coffee leaf miners. Not approved for use in EU countries[115]. There are 21 global suppliers[97].

U.S. Maximum Allowable Residue Levels for Disulfoton [40 CFR 180.183(a)]: (*Note*: all 2003 cancellations removed) in or on the following raw agricultural commodities: barley, grain 0.75 ppm; barley, straw 5.0 ppm; bean, dry, seed 0.75 ppm; bean, lima 0.75 ppm; beans, snap 0.75 ppm; broccoli 0.75 ppm; Brussels sprouts 0.75 ppm; cabbage 0.75 ppm; cauliflower 0.75 ppm; coffee, bean 0.3 ppm; cotton, undelinted seed 0.75 ppm; hop, dried cones 0.5 ppm; lettuce 0.75 ppm; peanut 0.75 ppm; pea 0.75 ppm; pea, field, vines 5.0 ppm; pepper 0.1 ppm; potato 0.75 ppm; sorghum, forager 5.0 ppm; sorghum, grain, grain 0.75 ppm; sorghum, grain, stover 5.0 ppm; soybean 0.1 ppm; soybean, forage 0.25 ppm; soybean, hay 0.25 ppm; spinach 0.75 ppm; sugarcane, cane 0.3 ppm; tomato 0.75 ppm; wheat, hay 5.0 ppm; wheat, grain 0.3 ppm; and wheat, straw 5.0 ppm. ***Regional registration, as defined in section 180.1(n) [40 CFR 180.183(c)]:*** in or on the following raw agricultural commodities: asparagus, 0.1 ppm; wheat, ornamentals and potatoes.

Human toxicity (long-term): Extra high–0.30 ppb, Health Advisory

Fish toxicity (threshold): High–2.90001 ppb, MATC (Maximum Acceptable Toxicant Concentration)

Regulatory Authority and Advisory Information: Carcinogenicity[83]: EPA Group E, evidence of non-carcinogenicity for humans

Acute Oral Category: 1, DANGER–POISON
Health Advisory: Nerve Toxin, Mutagen
Potential Ground Water Pollutant [California FAC Section 13145(d)/12811, inactive)
CLEAN WATER ACT: Section 311 Hazardous Substances/ RQ 40CFR117.3 (same as CERCLA, see below)
EPA HAZARDOUS WASTE NUMBER (RCRA No.): P039
RCRA 40CFR268.48; 61FR15654, Universal Treatment Standards: Wastewater (mg/L), 0.017; Non-wastewater (mg/kg), 6.2
RCRA 40CFR264, Appendix 9; TSD Facilities Ground Water Monitoring List. Suggested test method(s) (PQL ug/L): 8140(2)
SUPERFUND/EPCRA 302 Extremely Hazardous Substances: TPQ = 500 lb (227 kg)
SUPERFUND/EPCRA 40CFR302.4 RQ: CERCLA, 1 lb (0.454 kg)
U.S. DOT Regulated Marine Pollutant (49CFR172.101, Appendix B)
European/International Regulations: Hazard Symbol: T+, N; risk phrases: R27/28; R50/53; safety phrases: S1/2; S28; S36/37; S45; S60; S61 (see Appendix 1)
WGK (German Aquatic Hazard Class): 3-Severe hazard to waters

Description: Disulfoton is a combustible, colorless to yellowish oil (when pure). Characteristic sulfur-like odor. Technical product is a brown liquid. Molecular weight = 274.42; Specific gravity (H_2O:1) = 1.144 @ 20°C; Boiling point = 132–133°C @ 1.5 mm pressure; Freezing/Melting point = ≥ –25°C; Vapor pressure = 0.0002 mmHg @ 20°C; 5.4×10^{-5} mmHg @ 20°C; Flash point ≥82°C; 133°C. Hazard Identification (based on NFPA-704 M Rating System): Health 4, Flammability 1, Reactivity 0. Practically insoluble in water; solubility = 0.003% @ 25°C.

Incompatibilities: Alkalies, strong bases and oxidizers. Forms toxic nitrogen and sulfur oxides when heated to decomposition. In the presence of strong reducing agents such as hydrides, organophosphates form highly toxic and flammable phosphine gas. Contact with oxidizers can cause the release of toxic oxides of phosphorus.

Permissible Exposure Limits in Air: OSHA PEL: None
NIOSH REL: 0.1 mg/m^3 TWA [skin]
ACGIH TLV®[1]: 0.05 mg/m^3 TWA inhalable fraction and vapor [skin]; not classifiable as a human carcinogen; BEI_A issued for acetylcholinesterase-inhibiting pesticides.
Protective Action Criteria (PAC) Ver. 27[89]

PAC-1: 0.18 mg/m^3
PAC-2: 2 mg/m^3
PAC-3: 8.8 mg/m^3

Determination in Air: Use NIOSH Analytical Method (IV) Method #5600, Organophosphorus Pesticides.

Permissible Concentration in Water: Federal Drinking Water Guidelines: 0.3 ppb[93]; Arizona 0.03 μg/L; Florida 0.5 μg/L; Minnesota 0.03 μg/L.

Determination in Water: Extraction with methylene chloride followed by measurement by gas chromatography using a nitrogen-phosphorus detector. Log K_{ow} = >3.5. Values above 3.0 are likely to bioaccumulate in aquatic organisms.

Routes of Entry: Inhalation, skin absorption (rapidly absorbed), ingestion, skin and/or eye contact.

Harmful Effects and Symptoms

Organophosphates are highly toxic. Symptoms may develop rapidly, or there may be a delay of several hours following exposure before they become noticeable. The delay tends to be longer in the case of some compounds that dissolve fats, lipids, oils and non-polar solvents such as toluene. Symptoms may increase in severity for more than a single day and last for several days. In severe cases of organophosphate intoxication, respiratory failure may occur.

Short Term Exposure: Contact may cause burns to skin and eyes. Symptoms include pinpoint pupils, blurred vision, headache, dizziness, muscle spasms, and profound weakness. Vomiting, diarrhea, abdominal pain, seizures, and coma may also occur. The heart rate may decrease following oral exposure or increase following dermal exposure. Hypotension (low blood pressure) and chest pain may be noted. Hypertension (high blood pressure) is not uncommon. Respiratory symptoms include dyspnea (shortness of breath), respiratory depression, and respiratory paralysis. Psychosis may occur. It is poisonous and may be fatal if inhaled, swallowed, or absorbed through the skin. LD_{50} (oral, rat) = 2.6–6.8 mg/kg. LD_{50} (dermal, rat) = 6–25 mg/kg.

Long Term Exposure: Cholinesterase inhibitor; cumulative effect is possible. This chemical may damage the nervous system with repeated exposure, resulting in convulsions, respiratory failure. May cause liver damage.

Points of Attack: Respiratory system, lungs, central nervous system, cardiovascular system, skin, eyes, plasma and red blood cell cholinesterase. May be a neurotoxin.

Medical Surveillance: Routine biological monitoring of pesticide applicators and field workers includes testing of plasma and red blood cell acetylcholinesterase levels (for enzyme poisoned by this chemical). These tests are normally accurate only if done within about two hours of exposure. If exposure stops, plasma levels return to normal in 1–2 weeks while red blood cell levels may be reduced for 1–3 months. When acetylcholinesterase enzyme levels are reduced by 25% or more below preemployment levels, risk of poisoning is increased, even if results are in lower ranges of "normal." Reassignment to work not involving organophosphate pesticides is recommended until enzyme levels recover. Do not drink any alcoholic beverages before or during use as it promotes absorption of organophosphates.

First Aid: **Treatment for organophosphate poisoning consists of thorough decontamination, cardiorespiratory support, and administration of the antidotes atropine and pralidoxime. In cases of severe poisoning, diazepam, an anticonvulsant, should also be administered. Antidotes should be administered as prevention even if the diagnosis is in doubt**. Speed in removing material from eyes and skin is of extreme importance. *Eyes:* Eye contact can cause dangerous amounts of these chemicals to be quickly absorbed through the mucous membrane into the bloodstream. Immediately and gently flush eyes with plenty of warm or cold water (NO hot water) for at least 15 minutes, occasionally lifting the upper and lower eyelids. Get medical aid immediately. *Skin:* Get medical aid. Dermal contact can cause dangerous amounts of these chemicals to be absorbed into the bloodstream. Wearing the appropriate PPE equipment and respirator for organophosphate/carbamate pesticides, immediately flush skin with plenty of soap and water for at least 15 minutes while removing contaminated clothing and shoes. Shampoo hair promptly if contaminated. The removed, contaminated clothing and shoes should be double-bagged and left in Hot Zone for later disposal by hazardous materials experts. Skin may also be decontaminated with diluted hypochlorite solution. *Inhalation:* Get medical aid. Do not contaminate yourself. Wearing the appropriate PPE equipment and respirator for organophosphate pesticides, immediately remove the victim from the contaminated area to fresh air. If the victim is not breathing, administer artificial respiration. Do not use mouth-to-mouth method if victim ingested or inhaled the substance; give artificial respiration with the aid of a pocket mask equipped with a one-way valve or other proper respiratory medical device. If breathing is difficult, administer oxygen through bag/mask apparatus until medical help arrives. Do not leave victim unattended. *Ingestion:* Call poison control. Loosen all clothing. Never give anything by mouth to an unconscious person. If victim is *unconscious or having convulsions,* do nothing except keep victim warm. Get medical aid. Transfer promptly to a medical facility. In cases of ingestion, **do not induce vomiting**. If the victim is alert and asymptomatic, administer a slurry of activated charcoal at a dose of 1 g/kg (infant, child, and adult dose). A soda can and straw may be of assistance when offering charcoal to a child. *In some cases you may be specifically instructed by poison control to induce vomiting by way of 2 tablespoons of syrup of ipecac (adult) washed down with a cup of water*. Do NOT give activated charcoal before or with ipecac syrup. *Note to physician or authorized medical personnel:* Treat cases of respiratory compromise, coma, or excessive pulmonary secretions with respiratory support using protocols and techniques available and within the scope of training. Some cases may necessitate procedures such as endotracheal intubation or cricothyrotomy by properly trained and equipped personnel. When possible, atropine (see *Antidotes*, below) should be given under medical supervision. Patients who are comatose, hypotensive, or having seizures or cardiac arrhythmias should be treated according to advanced life support protocols. *Antidotes*: Two antidotes are administered to treat organophosphate poisoning. Atropine is a competitive antagonist of acetylcholine at muscarinic receptors and is used to control the excessive bronchial secretions which are often responsible for death. Pralidoxime relieves both the nicotinic and muscarine effects of organophosphate poisoning by regenerating acetylcholinesterase and can reduce both the bronchial secretions and the muscle weakness associated with poisoning. The initial intravenous dose of atropine in adults should be determined by the severity of symptoms: An initial adult dose of 1.0 to 2.0 mg or pediatric dose of 0.01 mg/kg (minimum 0.01 mg) should be administered intravenously. If intravenous access cannot be established, atropine may also be given intramuscularly, subcutaneously or via endotracheal tube. Doses should be repeated every 15 minutes until excessive secretions and sweating have been controlled. Once bronchial secretion has been controlled, atropine administration should be repeated whenever the secretions begin to recur. In seriously poisoned patients, very large doses may be required. Alterations of pulse rate and pupillary size should not be used as indicators of treatment adequacy. Pralidoxime should be administered as early in poisoning as possible as its efficacy may diminish when given more than 24 to 36 hours after exposure. Doses are as follows: adult 1.0 g; pediatric 25 to 50 mg/kg. The drug should be administered intravenously over 30 to 60 minutes, but in a life-threatening situation one-half of the total dose can be given per minute for a total administration time of 2 minutes. Treatment should begin to take effect within 40 minutes with a reduction in symptoms and the amount of atropine necessary to control bronchial secretion. The initial dose can be repeated in 1 hour and then every 8 to 12 hours until the patient is clinically well and no longer requires atropine. If intravenous access cannot be established, pralidoxime may also be given intramuscularly. Early administration of diazepam in addition to the combined atropine and pralidoxime treatment may help prevent the onset of seizures and potential brain and cardiac morphologic damage following high-level organophosphate poisoning.

Personal Protective Methods: Wear protective gloves and clothing to prevent any reasonable probability of dermal and/or eye contact. Safety equipment suppliers/manufacturers can provide recommendations on the most protective glove/clothing material for your operation. All protective clothing (suits, gloves, footwear, headgear) should be clean, available each day, and put on before work. Contact lenses should not be worn when working with this chemical. Wear splash-proof chemical goggles and face shield unless full facepiece respiratory protection is worn. Employees should wash immediately with soap when skin is wet or contaminated. Provide emergency showers and eyewash.

Respirator Selection: Where potential exists for exposures over *0.1 mg/m*^{3}, use a NIOSH/MSHA- or European Standard EN149-approved supplied-air respirator with a full facepiece operated in the positive-pressure mode, or with a full facepiece, hood, or helmet in the continuous flow mode; or use a NIOSH/MSHA- or European Standard EN149-approved self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive-pressure mode.

Storage: Color Code-Blue: Health Hazard/Poison. Store in a secure poison location. Prior to working with disulfoton you should be trained on its proper handling and storage. Store in tightly closed containers in a cool, well-ventilated area away from alkalies. Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: Organophosphorus pesticides, solid, toxic, n.o.s. require a shipping label of "poisonous materials." They fall in DOT Hazard Class 6.1 and disulfoton in Packing Group I.

Spill Handling: Evacuate and restrict persons not wearing protective equipment from area of spill or leak until clean up is complete. Ventilate area of spill or leak. Do not touch spill material. Exposure by dermal contact is likely to be more significant than inhalation. *Small spills:* take up with sand or other noncombustible absorbent materials and place into containers for later disposal. *Large spills:* dike far ahead of spill for later disposal. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable.

Fire Extinguishing: Hazardous decomposition includes hydrogen chloride and oxides of phosphorus, sulfur, and nitrogen. A combustible liquid, but will not ignite easily. Extinguish with dry chemical, carbon dioxide; water spray, fog, or foam. Fight fire from maximum distance. Dike fire-control water for later disposal; do not scatter the material. Wear positive-pressure breathing apparatus and special protective clothing. Containers may explode in fire. Storage containers and parts of containers may rocket great distances, in many directions. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies. From a secure, explosion-proof location, use water spray to cool exposed containers. If cooling streams are ineffective (venting sound increases in volume and pitch, tank discolors, or shows any signs of deforming), withdraw immediately to a secure position. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode.

Disposal Method Suggested: Generators of waste containing this contaminant (≥100 kg/mo) must conform with EPA regulations governing storage, transportation, treatment, and waste disposal. Incineration with added flammable solvent in a furnace with alkali scrubber. Acid or alkaline hydrolysis may also be used. Containers must be disposed of properly by following package label directions or by contacting your local or federal environmental control agency, or by contacting your regional EPA office. Consult with environmental regulatory agencies for guidance on acceptable disposal practices.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- EXTOXNET, Extension Toxicology Network, "Pesticide Information Profile, Disulfoton," Oregon State University, Corvallis, OR (June 1996). http://ace.orst.edu/info/extoxnet/pips/disulfot.htm
- USEPA, Office of Pesticide Programs, Pesticide Residue Limits, "Disulfoton", 40 CFR 180.183. http://www.epa.gov/pesticides/food/viewtols.htm
- Agency for Toxic Substances and Disease Registry, "ToxFAQs for Disulfoton," Atlanta, GA (September 1996). http://www.atsdr.cdc.gov/tfacts65.html
- New Jersey Department of Health, "Hazardous Substance Fact Sheet: Disulfoton," Trenton, NJ (January 1999). http://www.state.nj.us/health/eoh/rtkweb/0812.pdf
- International Programme on Chemical Safety (IPCS), "*Data Sheets on Pesticides No. 68, Disulfoton*," Geneva, Switzerland (March, 1988). http://www.inchem.org/documents/pds/pds/pest68_e.htm
- USEPA, Disulfoton, Health and Environmental Effects Profile No. 97, Washington DC, Office of Solid Waste (April 30, 1980)
- USEPA, "Chemical Profile: Disulfoton," Washington DC, Chemical Emergency Preparedness Program (November 30, 1987)
- USEPA, "Health Advisory: Disulfoton," Washington DC, Office of Drinking Water (August 1987)
- Sax, N. I., Ed., "Dangerous Properties of Industrial Materials Report," 8, No. 5, 74-85 (1988)

Dithianon D:1685

Use Type: Fungicide

CAS Number: 3347-22-6

Formula: $C_{14}H_4N_2O_2S_2$

Synonyms: 2,3-Dicarbonitrilo-1,4-diathiaanthrachinon; 2,3-Dicyano-1,4-dithia-anthraquinone; 5,10-Dihydro-5,10-dioxonaphtho(2,3-b)-p-dithiin-2,3-dicarbonitrile; 2,3-Dinitrilo-1,4-dithioanthrachinon; 2,3-Dinitrilo-1,4-dithia-anthraquinone; 1,4-Dithiaanthraquinone-2,3-dicarbonitrile; 1,4-Dithiaanthraquinone-2,3-dinitrile; Dithianone

Trade names: DELAN®; DELAN-COL®; DELAN 70WG®; DITHIANON FLOWABLE®; DITHIANON-WG®; IT 931®; MV 119A®; STAUFFER MV-119A®; THYNON®

Chemical Class: Quinone

EPA/OPP PC Code: 099201

HSDB Number: 1583

UN/NA & ERG Number: UN3077 (solid)/171; UN3082 (liquid)/171

RTECS® Number: QL0700000

EC Number: 222-098-6 [*Annex I Index No.* 613-021-00-0]

Uses: Fungicide used to control certain mildews. A seed dressing; used to attack foliar diseases of fruits (pome, stone, etc,), coffeee, wine, and vegetables. Not currently registered for use in the U.S. Approved for use in most EU countries.

Regulatory Authority and Advisory Information: Acute Oral Category: 3, CAUTION
Health Advisory: Mutagen
European/International Regulations: Hazard Symbol T, Xn, Xi, N; risk phrases: R22; R23; R40; R41; R43; R50; R53; R66; safety phrases: S2; S13; S36/37/39; S45 (see Appendix 1)

Description: Dark brown to gray-browish fibrous needles. Commercial product is available as an emulsifiable concentrate or wettable granules. Odorless. Molecular weight = 296.32; Specific gravity (H_2O:1) = 1.55 @ 20°C; Boiling point = (decomposes) @ 220°C; Freezing/Melting point = 215–220°C; Vapor pressure = 2×10^{-11} mmHg @ 25°C; Henry's Law constant = 6×10^{-11} atm-m^3/mol @ 25°C (est). Practically insoluble in water; solubility = <0.1 ppm.

Incompatibilities: Decomposes when exposed to alkaline media, acids and oxidizers. Keep away from sulfur compounds.

Determination in Water: Log K_{ow} = ~3.0. Values above 3.0 are likely to bioaccumulate in aquatic organisms.

Routes of Entry: Ingestion, dermal contact, inhalation.

Harmful Effects and Symptoms

Short Term Exposure: May cause eye, skin, and respiratory tract irritation. If ingested, may cause nausea, vomiting and diarrhea. May be able to penetrate the unbroken skin. May cause skin sensitization. LD_{50} (oral, rat) = 300–638 mg/kg; LD_{50} (dermal, rat) = >2 g/kg.

Long Term Exposure: Skin sensitizer. May cause liver and kidney effects. May cause reproductive and fetal effects.

Points of Attack: Kidney and liver.

Medical Surveillance: In addition to comprehensive initial medical and work histories emphasizing reproductive experience and menstrual history, patient should have physical examination and testing of genito-urinary tract, sperm count, motility and morphology. If required, other tests, such as serum testosterone, serum follicle stimulating hormone (FSH), and serum lutenizing hormone (LH), may be indicated. Evaluation by a qualified allergist, including exposure history and testing, may help diagnose allergy. Liver and kidney function tests.

First Aid: *Eyes:* First check the victim for contact lenses and remove if present. Flush victim's eyes with water or normal saline solution for 20 to 30 minutes while simultaneously calling a hospital or poison control center. Do not put any ointments, oils, or medication in the victim's eyes without specific instructions from a physician. *Immediately* transport the victim after flushing eyes to a hospital even if no symptoms (such as redness or irritation) develop. *Skin: Immediately* flood affected skin with water while removing and isolating all contaminated clothing. Gently wash all affected skin areas thoroughly with soap and water. If symptoms such as redness or irritation develop, *immediately* call a physician and be prepared to transport the victim to a hospital for treatment. *Inhalation: Immediately* leave the contaminated area; take deep breaths of fresh air. If symptoms (such as wheezing, coughing, shortness of breath, or burning in the mouth, throat, or chest) develop, call a physician and be prepared to transport the victim to a hospital. Provide proper respiratory protection to rescuers entering an unknown atmosphere. Whenever possible, self-contained breathing apparatus (SCBA) should be used; if not available, use a level of protection greater than or equal to that advised under Protective Clothing. *Ingestion: Do not induce vomiting.* If the victim is conscious and not convulsing, give 1 or 2 glasses of water to dilute the chemical and *immediately* call a hospital or poison control center. Be prepared to transport the victim to a hospital if advised by a physician. If the victim is convulsing or unconscious, do not give anything by mouth, ensure that the victim's airway is open and lay the victim on his/her side with the head lower than the body. *Do not induce vomiting. Immediately* transport the victim to a hospital[88].

Personal Protective Methods: Smoking, eating, and drinking before washing should be absolutely prohibited when any pesticide is being handled or used. Applicators and other handlers must wear: Coveralls worn over long-sleeved shirt and long pants; Chemical-resistant gloves such as DuPont™ Tychem® suit fabrics, barrier laminate, or Viton®; Chemical-resistant footwear plus socks; Protective eye wear; Chemical-resistant headgear for overhead exposure; Chemical-resistant apron when cleaning equipment, mixing, or loading[83]. Agricultural Use/Engineering Controls: When handlers use closed systems, enclosed cabs, or aircraft in a manner that meets the requirements listed in the Worker Protection Standard (WPS) for agricultural pesticides, ***40 CFR 170.240(d)(4-6),*** the handler PPE requirements may be reduced or modified as specified in the Worker Protection Standard.

Respirator Selection: Wherever and whenever workplace conditions warrant respirator use, a respiratory protection program must be followed that meets one or more of the following government standards: OSHA's 29 CFR 1910.134, ANSI Z88.2, or European Standard EN 149.

Storage: Color Code-Blue: Health Hazard/Poison: Store in a tightly closed container in a dry, well-ventilated and secure poison location. Prior to working with this chemical you should be trained on its proper handling and storage. Where possible, automatically transfer material from other storage containers to process containers. Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: Environmentally hazardous substances, solid or liquid, n. o. s. It usually falls in Hazard Class 9.

Spill Handling: First remove all sources of ignition. Evacuate persons not wearing protective equipment from area of spill or leak until clean up is complete. Collect powdered material in the most convenient and safe manner and deposit in sealed containers. Ventilate area after clean up is complete. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable.

Fire Extinguishing: Hazardous decomposition includes oxides of nitrogen, carbon, sulfur, and cyanide fumes. Combustible. As an immediate precautionary measure, isolate spill or leak area in all directions for at least 50 meters/150 feet for liquids and at least 25 meters/75 feet for solids. *Fire involving storage or vehicular tanks:* isolate for 800 meters/0.5 mile in all directions; also, consider initial evacuation for 800 meters/0.5 mile in all directions. *On a small fire:* use dry chemical, CO_2, water spray or regular foam. *On a large fire:* use water spray, fog or regular foam. Do not scatter spilled material with high-pressure streams of water. Move containers from fire area if you can do it without risk. Dike fire-control water for later disposal. *Fire involving tanks:* from a secure, explosion-proof location, use water spray to cool exposed containers. If cooling streams are ineffective (venting sound increases in volume and pitch, tank discolors, or shows any signs of deforming), withdraw immediately to a secure position. Always stay away from tanks engulfed in fire. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode.

Disposal Method Suggested: Do not discharge into drains or sewers. Dispose of waste material as hazardous waste using a licensed disposal contractor to an approved landfill. Consult with environmental regulatory agencies for guidance on acceptable disposal practices. A potential candidate for liquid injection incineration at a temperature range of 650 to 1600 °C and a residence time 0.1 to 2 seconds. Also, a potential candidate for rotary kiln incineration at a temperature range of 820 to 1600°C and residence times of seconds for liquids and gases, and hours for solids[83]. In accordance with 40CFR165, follow recommendations for the disposal of pesticides and pesticide containers. Containers must be disposed of properly by following package label directions or by contacting your local or federal environmental control agency, or by contacting your regional EPA office.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- United States National Library of Medicine, ChemIDplus Advanced, Bethesda, MD. http://chem.sis.nlm.nih.gov/chemidplus/rn/3347-22-6

Diuron D:1610

Use Type: Herbicide

CAS Number: 330-54-1

Formula: $C_9H_{10}Cl_2N_2O$; $Cl_2C_6H_3NHCON(CH_3)_2$

Synonyms: Caswell No. 410®; DCMU (In Japan); Dichlorfenidim; 3-(3,4-Dichlorophenol)-1,1-dimethylurea; 3-(3,4-Dichlorophenyl)-1,1-demethylurea; *N'*-(3,4-dichlorophenyl)-*N,N*-dimethylurea; *N*-(3,4-Dichlorophenyl)-*N',N'*-dimethylurea; 1-(3,4-Dichlorophenyl)-3,3-dimethylurea; 1,1-Dimethyl-3-(3,4-dichlorophenyl)urea; 3-(3,4-Diclorofenil)-1,1-dimetilurea (Spanish); Urea, *N'*-(3,4-dichlorophenyl)-*N,N*-dimethyl-; Urea, 3-(3,4-dichlorophenyl)-1,1-dimethyl-

Trade Names: 330541®; AF 101®; AI3-61438®; AMETRON SC®; BOUNDRY®[C]; CHEMIURON®[C]; CEKIURON®; CRISURON®; DAILON®; DIATER®; DI-ON®; DIREX®; DITOX®; DIUMATE® Diuron; DIUREX®,[C]; DIUROL® Diuron; DIURON 4L®; DMU®; DREXEL DIURON 4L®; DROPP ULTRA®; DURAN®; DYNEX®[C] FARMCO DIURON®; FORTEX SC®; FREEFLO®; GINSTAR®; HERBURON 500 BR®; HW 920®; KARMEX®[C]; K-4®; KARMEX DIURON HERBICIDE®; KARMEX DW®; KROVAR IDF®[C]; MARMER®; STRIKER®; SUP'R FLO®; TELVAR®; TIGREX®; TREVISSIMO®; UNIDRON®; UROX D®[C]; VONDURON®

Chemical Class: Phenylurea; Substituted urea

EPA/OPP PC Code: 035505

California DPR Chemical Code: 231

HSDB Number: 382

UN/NA & ERG Number: UN3077(solid)/171

RTECS® Number: YS8925000

EC Number: 206-354-4 [*Annex I Index No.:* 006-015-00-9]

Uses: Diuron is a substituted urea herbicide used to control a wide variety of annual and perennial broadleaf and grassy weeds, as well as mosses. It is used on non-crop areas and many agricultural crops such as fruit, cotton, sugar cane, alfalfa, and wheat. Diuron works by inhibiting photosynthesis. It may be found in formulations as wettable powders and suspension concentrates.

U.S. Maximum Allowable Residue Levels for Diuron and its metabolites convertible to 3,4-dichloroaniline [40CFR 180.106(a)]: Alfalfa, forage 3.0 ppm; alfalfa, hay 2.0 ppm; apple 0.1 ppm; artichoke, globe 1 ppm; asparagus 7 ppm; banana 0.1 ppm; berry group 13, 0.1 ppm; cattle, fat 1 ppm; cattle, meat 1 ppm; cattle, meat byproducts 1 ppm; citrus, oil 3.0 ppm; corn, field, grain 0.1 ppm; corn, pop, grain 0.1 ppm; cotton, undelinted seed 0.2 ppm; fish – freshwater finfish, farm raised 2.0 ppm; fruit, citrus, group 10, except lemon 0.05 ppm; goat, fat 1 ppm; goat, meat 1 ppm; goat, meat byproducts 1 ppm; grain, aspirated fractions 5.0 ppm; grape 0.05 ppm; grass, forage, except bermudagrass 2 ppm; grass, hay, except bermudagrass 2 ppm; hazelnut 0.1 ppm; hog, fat 1 ppm; hog, meat 1 ppm; hog, meat byproducts 1 ppm; horse, fat 1 ppm; horse, meat 1 ppm; horse, meat byproducts 1 ppm; lemon 0.5 ppm; nut, macadamia 0.05 ppm; olive 1 ppm; papaya 0.5 ppm; peach 0.1 ppm; pear 1 ppm; pea, field, seed 0.1 ppm; pea, field, vines 2 ppm; pea, field, hay 2 ppm; pecan 0.05 ppm; peppermint, tops 1.5 ppm; pineapple 0.1 ppm; pineapple, process residue 0.4 ppm; sheep, fat 1 ppm; sheep, meat 1 ppm; sheep, meat byproducts 1 ppm; sorghum, grain, forage 2 ppm; sorghum, grain, grain 0.5 ppm; sorghum, grain, stover 2 ppm; spearmint, tops 1.5 ppm; sugarcane, cane 0.2 ppm; sugarcane, molasses 0.7 ppm; walnut 0.05 ppm; wheat, bran 0.7 ppm; wheat, forage 2 ppm; wheat, grain 0.5 ppm; wheat, hay 2 ppm; wheat, straw 1.5 ppm; ppm. ***Regional registration, as defined in section 180.1(n) [40CFR 180.106(c)]:*** Barley, bran 0.7 ppm; Barley, grain 0.2 ppm; Barley, hay 2 ppm; Barley, straw 1.5 ppm; Cactus 0.05 ppm; Clover, forage 0.1 ppm; Clover, hay 1.0 ppm; Oat, forage 2 ppm; Oat, grain 0.1 ppm; Oat, hay 2 ppm; Oat, straw 1.5 ppm; Trefoil, forage 0.1 ppm; Trefoil, hay 1.5 ppm; Vetch, forage 0.1 ppm; Vetch, hay 1.5 ppm.

Human toxicity (long-term)[101]: Intermediate–18.32460 ppb, CHCL (Chronic Human Carcinogen Level)

Fish toxicity (threshold)* [101]*: Intermediate–40.39243 ppb, MATC (Maximum Acceptable Toxicant Concentration)

Regulatory Authority and Advisory Information: Carcinogenicty, EPA, Known/likely to be a carcinogen; EU GHS Category 2: Suspected human carcinogen; ACGIH, A4 Not classifiable as a human carcinogen.

California Proposition 65 Chemical: Carcinogen (5/31/2002)

Health Advisory: Mutagen, Developmental/Reproductive Toxin, Endocrine disruptor (S!)

Acute Oral Category: 2, WARNING

Potential Ground Water Pollutant [California FAC Section 13149)

Clean Water Act: Section 311 Hazardous Substances/RQ 40CFR117.3 (same as CERCLA, see below)

Superfund/EPCRA 40CFR302.4 RQ: CERCLA, 100 lb (45.4 kg)

EPCRA Section 313 Form R *de minimus* concentration reporting level: 1.0%

European/International Regulations: Hazard Symbol: Xn, N; risk phrases: R22; R40; R48/22; R48/22; R50/53; safety phrases: S2; S13; S22; S23; S36/37; S46; S60; S61 (see Appendix 1)

WGK (German Aquatic Hazard Class): 3-Severe hazard to waters

Description: Diuron is a clear or white crystalline solid. Odorless. Molecular weight = 233.11; Specific gravity (H_2O:1) = 1.48; Boiling point = 180°C (decomposes before boiling); Freezing/Melting point = 157.8°C; Vapor pressure = 2×10^{-9} mmHg; 6.9×10^{-8} mmHg @ 20°C. Flash point = >200°C. Hazard Identification (based on NFPA-704 M Rating System): Health 1, Flammability 0, Reactivity 0. Very slightly soluble in water; solubility = 0.004%.

Incompatibilities: Keep away from strong acids. Stable under normal conditions, decomposed on heating to 180 to 190°C producing dimethylamine and 3,4-dichlorophenyl isocyanate.

Permissible Exposure Limits in Air: OSHA PEL: None

NIOSH REL: 10 mg/m^3 TWA

ACGIH TLV®[1]: 10 mg/m^3 TWA; not classifiable as a human carcinogen

No Protective Action Criteria (PAC) available.

Determination in Air: OSHA versatile sampler-2; Reagent; high-pressure liquid chromatography/Ultraviolet detection; NIOSH IV, Method #5601[18]

Permissible Concentration in Water: Federal Drinking Water Guidelines: 1.0 ppb[93]; Arizona 14 μg/L; Florida 14 μg/L; Maine 14 μg/L. Canadian Drinking Water Standards: MAC 0.15 mg/L

Determination in Water: High-performance liquid chromatography may be used after extraction with methylene chloride. Measurement is made using an ultraviolet detector. Log K_{ow} = >2.5–<3.0. Values at or above 3.0 are likely to bioaccumulate in marine organisms. Harmful to aquatic life in very low concentrations.

Routes of Entry: Inhalation, ingestion, skin and/or eye contact.

Harmful Effects and Symptoms

Short Term Exposure: Exposure may irritate the skin, eyes, and respiratory tract. LD_{50} (oral, rat) = 360–1250 mg/kg; LD_{50} (dermal, rat) = >5 g/kg.

Long Term Exposure: May cause tumors. May cause reproductive and fetal effects. May damage the developing fetus. In animals: anemia, methemoglobinemia.

Points of Attack: Eyes, skin, respiratory system, blood, reproductive system.

Medical Surveillance: In addition to comprehensive initial medical and work histories emphasizing reproductive experience and menstrual history, patient should have physical examination and testing of genito-urinary tract, sperm count, motility and morphology. If required, other tests, such as serum testosterone, serum follicle stimulating hormone (FSH), and serum lutenizing hormone (LH), may be indicated. Preliminary medical exam to detect chronic diseases of central nervous system, liver, heart, kidneys, lung and skin, as well as endocrinological or immunological disturbances, should protect susceptible individuals. Periodical medical exams of internal organs, skin and eyes are important to avoid chronic occupational intoxications. They should include lab and patch tests when necessary[83]. If symptoms develop or overexposure is suspected, the following may be useful: Complete blood count.

First Aid: If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least 15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately. If this chemical contacts the skin, remove contaminated clothing and wash immediately with soap and water. Seek medical attention immediately. If this chemical has been inhaled, remove from exposure, begin rescue breathing (using universal precautions) if breathing has stopped, and CPR if heart action has stopped. Transfer promptly to a medical facility. When this chemical has been swallowed, get medical attention. Give large quantities of water and induce vomiting. Do not make an unconscious person vomit.

Note to physician or authorized medical personnel: Treat for methemoglobinemia. Spectrophotometry may be required for precise determination of levels of methemoglobinemia in urine

Personal Protective Methods: Wear protective gloves and clothing to prevent any reasonable probability of dermal and/or eye contact. Safety equipment suppliers/manufacturers can provide recommendations on the most protective glove/clothing material for your operation. All protective clothing (suits, gloves, footwear, headgear) should be clean, available each day, and put on before work. Contact lenses should not be worn when working with this chemical. Wear dust-proof chemical goggles and face shield unless full facepiece respiratory protection is worn. Employees should wash immediately with soap when skin is wet or contaminated. Provide emergency showers and eyewash.

Respirator Selection: *At any detectable concentration:* SCBAF: Pd,Pp (APF = 10,000) (any NIOSH/MSHA- or European Standard EN 149-approved self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode); or SaF: Pd,Pp: ASCBA (APF = 10,000) (any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary, self-contained breathing apparatus operated in a pressure-demand or other positive-pressure mode). *Escape:* 100F (APF = 50) (any air purifying, full facepiece respirator with an N100, R100, or P100 filter k-mounted organic vapor canister having a high-efficiency particulate filter); or SCBAE (any appropriate escape-type, self-contained breathing apparatus).

Storage: Color Code-Blue: Health Hazard/Poison. Store in a secure poison location. Prior to working with diuron you should be trained on its proper handling and storage. Store in tightly closed containers in a cool, well-ventilated area. Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: Phenyl urea pesticides, solid, toxic, require a label of "poisonous materials." This compound falls in Hazard Class 6.1.

Spill Handling: First remove all sources of ignition. Evacuate persons not wearing protective equipment from area of spill or leak until clean up is complete. Do not touch spilled material; stop leak if you can do it without risk. Use water spray to reduce vapors. Collect powdered material in the most convenient and safe manner and deposit in sealed containers. *Large spills:* dike far ahead of spill for later disposal. Ventilate area after clean up is complete. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable.

Fire Extinguishing: Decomposes @ 180–190°C[86]. Hazardous decomposition includes oxides of nitrogen and carbon, and corrosive fumes of hydrogen chloride and chlorine gas, dimethylamine and 3,4-dichlorophenyl isocyanate. As an immediate precautionary measure, isolate spill or leak area in all directions for at least 50 meters/150 feet for liquids and at least 25 meters/75 feet for solids. *Fire involving storage or vehicular tanks:* isolate for 800 meters/0.5 mile in all directions; also, consider initial evacuation for 800 meters/0.5 mile in all directions. *On a small fire:* use dry chemical, CO_2, water spray or regular foam. *On a large fire:* use water spray, fog or regular foam. Do not scatter spilled material with high-pressure streams of water. Move containers from fire area if you can do it without risk. Dike fire-control water for later disposal. *Fire involving tanks:* from a secure, explosion-proof location, use water spray to cool exposed containers. If cooling streams are ineffective (venting sound increases in volume and pitch, tank discolors, or shows any signs of deforming), withdraw immediately to a secure position. Always stay away from tanks engulfed in fire. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode.

Disposal Method Suggested: Incinerate in a unit with effluent gas scrubbing. Containers must be disposed of properly by following package label directions or by contacting your local or federal environmental control agency, or by contacting your regional EPA office.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- EXTOXNET, Extension Toxicology Network, "Pesticide Information Profile, Diuron," Oregon State University, Corvallis, OR (June 1996). http://ace.orst.edu/info/extoxnet/pips/diuron.htm
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- New Jersey Department of Health, "Hazardous Substance Fact Sheet: Diuron," Trenton, NJ (April 1997). http://www.state.nj.us/health/eoh/rtkweb/0819.pdf
- Sax, N. I., Ed., "Dangerous Properties of Industrial Materials Report," 7, No. 5, 49-55 (1987)
- USEPA, "Health Advisory: Diuron," Washington DC, Office of Drinking Water (August 1987)

Dodecylbenzenesulfonic acid

D:1630

Use Type: Insecticide, Adjuvant, Biocide
CAS Number: 27176-87-0
Formula: $C_{18}H_{30}O_3S$
Synonyms: Acido dodecilbencenosulfonico (Spanish); Benzenesulfonic acid, dodecyl-; Benzenesulphonic acid, dodecyl-; Benzene sulfonic acid, dodecyl ester; Benzene sulphonic acid, dodecyl ester; DDBSA; Dodanic acid 83; Dodecyl benzenesulfonate; Dodecyl benzenesulphonate; *N*-Dodecyl benzenesulfonic acid; *N*-Dodecyl benzenesulphonic acid; Dodecylbenzenesulphonic acid; Laurylbenzenesulfonate; Laurylbenzenesulphonate; Laurylbenzenesulfonic acid; Laurylbenzenesulphonic acid; NANSA SSA; Pentine acid 5431; Richonic acid; Sulframin acid 1298
Trade Names: ACCOMPLISH®[C]; ACIDET®; ACIDISOL®; CALSOFT LAS 99®; E 7256®; ELFAN WA sulphonic acid®; NACCONOL 98 SA®; RHODACAL ABSA®
Chemical Class: Soap
EPA/OPP PC Code: 098002
California DPR Chemical Code: 941
HSDB Number: 6285
UN/NA & ERG Number: UN2584 (Alkyl sulfonic acids, liquid or Aryl sulfonic acids, liquid with more than 5 percent free sulfuric acid)/153
RTECS® Number: DB6600000
EC Number: 248-289-4
Uses: Dodecylbenzenesulfonic acid and its salts are used as degreasers in meat-cutting rooms. Also used as a laboratory chemical, to make detergents, and in electronically cleaning and pickling baths. Not listed for use in EU countries[115]. Approved for use in the U.S. and other countries. There are 30 global suppliers[97].
Regulatory Authority and Advisory Information: Toxicity (oral) Category: 3, CAUTION
Section 311 Hazardous Substances/RQ (same as CERCLA)
NIOSH Profile, "*Sulfonic Acids and Salts*," ARYL, SRC, 12/79
EPCRA Section 304 RQ: CERCLA, 1000 lb (454 kg)
WGK (German Aquatic Hazard Class): 2-Hazard to waters
Description: Dodecylbenzenesulfonic acid is a light yellow to brown liquid. Slight SO_2 odor. Molecular weight = 326.54; Specific gravity (H_2O:1) = 1.0 @ 25°C; Boiling point = 315°C; 204.5°C[86]; Freezing/Melting point = 10°C. Hazard Identification (based on NFPA-704 M Rating System): Health 3, Flammability 1, Reactivity 1. Soluble in water.
Incompatibilities: Corrosive liquid. Incompatible with oxidizers, chlorates, nitrates, peroxides, sulfuric acid, caustics, ammonia, aliphatic amines, alkanolamines, isocyanates, alkylene oxides, epichlorohydrin. May attack metals, forming flammable hydrogen gas.
Permissible Exposure Limits in Air: Protective Action Criteria (PAC) Ver. 27[89]
PAC-1: 2 mg/m^3
PAC-2: 21 mg/m^3
PAC-3: 130 mg/m^3
Routes of Entry: Inhalation.
Harmful Effects and Symptoms
Short Term Exposure: A corrosive. Contact with the eyes and skin can cause severe irritation and burns. Inhalation can irritate the respiratory tract. LD_{50} (oral, rat) = 650–900 mg/kg.
Long Term Exposure: Repeated dermal contact may cause dermatitis. Corrosive materials may affect the lungs or cause bronchitis with coughing, phlegm and/or shortness of breath.
Points of Attack: Lungs.
Medical Surveillance: Lung function tests. Consider chest x-ray following acute overexposure.
First Aid: If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least 15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately. If this chemical contacts the skin, remove contaminated clothing and wash immediately with soap and water. Seek medical attention immediately. If this chemical has been inhaled, remove from exposure, begin rescue breathing (using universal precautions) if breathing has stopped, and CPR if heart action has stopped. Transfer promptly to a medical facility. When this chemical has been swallowed, get medical attention. Give large quantities of water and induce vomiting. Do not make an unconscious person vomit. Do not induce vomiting when formulations containing petroleum solvents are ingested.
Personal Protective Methods: Wear protective gloves and clothing to prevent any reasonable probability of dermal and/or eye contact. Safety equipment suppliers/manufacturers can provide recommendations on the most protective glove/clothing material for your operation. All protective clothing (suits, gloves, footwear, headgear) should be clean, available each day, and put on before work. Contact lenses should not be worn when working with this chemical. Wear splash-proof chemical goggles and face shield unless full facepiece respiratory protection is worn. Employees should wash immediately with soap when skin is wet or contaminated. Provide emergency showers and eyewash.
Respirator Selection: SCBA >2 mg/m^3. Follow regulations in OSHA 29CFR1910.134 or European Standard EN149. Use a NIOSH/MSHA- or European Standard EN149-approved respirator; or use an approved supplied-air respirator with a full facepiece operated in the positive-pressure mode, or with a full facepiece, hood, or helmet in the continuous-flow mode; or use a NIOSH/MSHA- or European

Standard EN149-approved self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive-pressure mode.

Storage: Color Code-White: Corrosive or Contact Hazard; Store separately in a corrosion resistant location. Prior to working with DDBSA you should be trained on its proper handling and storage. Store in tightly closed containers in a cool, well-ventilated area away from metals. Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: Dodecylbenzenesulfonic acid requires a shipping label of "CORROSIVE." It usually falls in Hazard Class 8 and Packing Group II. The symbol "D" identifies proper shipping names which are appropriate for describing materials for domestic transportation but may be inappropriate for international transportation under the provisions of international regulations (e.g., IMO, ICAO). An alternate proper shipping name may be selected when either domestic or international transportation is involved.

Spill Handling: Evacuate and restrict persons not wearing protective equipment from area of spill or leak until clean up is complete. Ventilate area of spill or leak. Absorb liquids in vermiculite, dry sand, earth, peat, carbon, or a similar material and deposit in sealed containers. Keep this chemical out of a confined space, such as a sewer, because of the possibility of an explosion, unless the sewer is designed to prevent the build-up of explosive concentrations. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable.

Fire Extinguishing: This chemical may burn but does not easily ignite. Hazardous decomposition includes sulfur oxides and hydrogen sulfide. Use dry chemical, carbon dioxide; or alcohol foam extinguishers. Vapors are heavier than air and will collect in low areas. Vapors may travel long distances to ignition sources and flashback. Vapors in confined areas may explode when exposed to fire. Containers may explode in fire. Storage containers and parts of containers may rocket great distances, in many directions. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies. From a secure, explosion-proof location, use water spray to cool exposed containers. If cooling streams are ineffective (venting sound increases in volume and pitch, tank discolors, or shows any signs of deforming), withdraw immediately to a secure position. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- New Jersey Department of Health and Senior Services, "Hazardous Substance Fact Sheet, Dodecylbenzene sulfonic acid," Trenton, NJ (October 1996, rev. May 2003). http://www.state.nj.us/health/eoh/rtkweb/0822.pdf

Dodemorph acetate D:1650

Use Type: Fungicide

CAS Number: 31717-87-0

Formula: $C_{20}H_{39}NO_3$; $C_{18}H_{36}NO \cdot C_2H_4O_2$

Synonyms: Cyclododecyl-2,6-dimethylmorpholine acetate; 4-Cyclododecyl-2,6-dimethylmorpholine acetate; Cyclododecyl(4)-2,6-dimethylmorpholine acetate; *N*-Cyclododecyl-2,6-dimethylmorpholinium acetate; Morpholine, *N*-cyclododecyl-2,6-dimethyl-, acetate

Trade Names: CYCLOMORPH®; MELTATOX®; MILBAN®

Chemical Class: Morpholine mixture

EPA/OPP PC Code: 110401 (213600 and 268601 are old PC codes)

California DPR Chemical Code: 2120

HSDB Number: 1705

UN/NA & ERG Number: UN2588 (Pesticide, solid, poisonous, n.o.s.)/151; UN2902 (Pesticide, liquid, poisonous, n.o.s.)/151

RTECS® Number: QE0610000

EC Number: 250-778-2

Uses: A system fungicide, one of the most recently developed, that can be applied as soil treatments. They are slowly absorbed through the roots. Dodemorph acetate is used to inhibit rusts and mildews. Not currently registered for use in the U.S. Approved for use in some EU countries and Canada.

Regulatory Authority and Advisory Information: Acute Oral Category: 3, CAUTION

Description: Colorless solid. Commercial products may be dissolved in flammable organic solvents. Molecular weight = 338.5; Specific gravity (H_2O:1) = 0.93 @ 20°C; Boiling point = (decomposes); Freezing/Melting point = 42°C; Vapor pressure = Volatile; Flash point = 74°C; 37.2°C (Meltatox)[BASF]. Autoignition temperature = 328°C[BASF]; Henry's Law constant = 3×10^{-6} atm-m^3/mol @ 25°C (est). High solubility in water. Physical and toxicological properties may be affected by carrier solvents in commercial formulations.

Incompatibilities: Acetates are generally incompatible with nitrates. Moisture may cause hydrolysis or other forms of decomposition. Decomposes >155°C.

Determination in Air: Ionization. NIOSH IV Method#1450, Esters.[18].

Permissible Concentration in Water: Runoff from spills or fire control may cause water pollution.

Determination in Water: Log K_{ow} = >4.0. Values above 3.0 are likely to bioaccumulate in aquatic organisms.

Routes of Entry: Eyes, ingestion, inhalation, dermal and/or eye contact.

Harmful Effects and Symptoms

Short Term Exposure: Irritation of eyes, skin, digestive tract and respiratory tract. May be a skin sensitizer for some people. If ingested, may cause nausea, vomiting and diarrhea. Inhalation should be avoided. LD_{50} (oral, rat) = 2500; LD_{50} (dermal, rat) = >4000 mg/kg.

Long Term Exposure: May cause skin sensitization. May be a mutagen, may cause reproductive and fetal effects.

Points of Attack: Skin, reproductive system.

Medical Surveillance: Evaluation by a qualified allergist, including exposure history and testing, may help diagnose allergy. In addition to comprehensive initial medical and work histories emphasizing reproductive experience and menstrual history, patient should have physical examination and testing of genito-urinary tract, sperm count, motility and morphology. If required, other tests, such as serum testosterone, serum follicle stimulating hormone (FSH), and serum lutenizing hormone (LH), may be indicated.

First Aid: Give artificial respiration if victim is not breathing. *Do not* use mouth-to-mouth method if victim ingested or inhaled the substance; give artificial respiration with the aid of a pocket mask equipped with a one-way valve or other proper respiratory medical device. Administer oxygen if breathing is difficult. Remove and isolate contaminated clothing and shoes. In cases of contact with substance, immediately flush skin or eyes with running water for at least 20 minutes. For minor skin contact, avoid spreading material on unaffected skin. Keep victim warm and quiet. Effects of exposure (inhalation, ingestion or skin contact) to substance may be delayed. Ensure that medical personnel are aware of the material(s) involved and take precautions to protect themselves. *Do not induce vomiting when formulations containing petroleum solvents are ingested*. Otherwise, give large quantities of water and induce vomiting. Do not make an unconscious person vomit.

Personal Protective Methods: Applicators and other handlers must wear: Coveralls worn over long-sleeved shirt and long pants; Chemical-resistant gloves such as DuPont™ Tychem® suit fabrics, barrier laminate, or Viton®; Chemical-resistant footwear plus socks; Protective eye wear; Chemical-resistant headgear for overhead exposure; Chemical-resistant apron when cleaning equipment, mixing, or loading[83]. Agricultural Use/Engineering Controls: When handlers use closed systems, enclosed cabs, or aircraft in a manner that meets the requirements listed in the Worker Protection Standard (WPS) for agricultural pesticides, ***40 CFR 170.240(d)(4-6),*** the handler PPE requirements may be reduced or modified as specified in the Worker Protection Standard. Firefighters should wear NIOSH approved self-contained breathing apparatus and full protective clothing.

Respirator Selection: Wherever and whenever workplace conditions warrant respirator use, a respiratory protection program must be followed that meets one or more of the following government standards: OSHA's 29 CFR 1910.134, ANSI Z88.2, or European Standard EN 149.

Storage: Color Code-White: Corrosive or Contact Hazard; Store separately in a corrosion resistant location. Prior to working with this chemical you should be trained on its proper handling and storage. Store in tightly closed containers in a cool, well-ventilated area. Color Code-Blue: Health Hazard/Poison. Store in a secure poison location. Prior to working with this chemical you should be trained on its proper handling and storage. Store in tightly closed containers in a cool, well-ventilated area. Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: Pesticides, solid, toxic/poisonous, n.o.s require a shipping label of "poisonous materials" and fall in Hazard Class 6.1. Technical name required.

Spill Handling: First remove all sources of ignition. Evacuate persons not wearing protective equipment from area of spill or leak until clean up is complete. Ventilate area of spill or leak. Use water spray to reduce vapor. Absorb liquids in vermiculite, dry sand, earth, or a similar material and deposit in sealed containers. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable.

Fire Extinguishing: Hazardous decomposition includes toxic oxides of nitrogen and carbon. As an immediate precautionary measure, isolate spill or leak area in all directions for at least 50 meters/150 feet for liquids and at least 25 meters/75 feet for solids. *Fire involving storage or vehicular tanks:* isolate for 800 meters/0.5 mile in all directions; also, consider initial evacuation for 800 meters/0.5 mile in all directions. *On a small fire:* use dry chemical, CO_2, water spray or regular foam. *On a large fire:* use water spray, fog or regular foam. Do not scatter spilled material with high-pressure streams of water. Move containers from fire area if you can do it without risk. Dike fire-control water for later disposal. *Fire involving tanks:* from a secure, explosion-proof location, use water spray to cool exposed containers. If cooling streams are ineffective (venting sound increases in volume and pitch, tank discolors, or shows any signs of deforming), withdraw immediately to a secure position. Always stay away from tanks engulfed in fire. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode.

Disposal Method Suggested: Do not discharge into drains or sewers. Dispose of waste material as hazardous waste using a licensed disposal contractor to an approved landfill. Consult with environmental regulatory agencies for guidance on acceptable disposal practices. If allowed, incineration with effluent gas scrubbing is recommended. Containers must be disposed of properly by following package label directions or by contacting your local or federal environmental control agency, or by contacting your regional EPA office.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- United States National Library of Medicine, ChemIDplus Advanced, Bethesda, MD. http://chem.sis.nlm.nih.gov/chemidplus/rn/31717-87-0

Dodine D:1655

Use Type: Fungicide, Microbiocide

CAS Number: 2439-10-3

Formula: $C_{15}H_{33}N_3O_2$

Synonyms: Aceto de *N*-dodecilguanidina (Spanish); Caswell No. 419; Dodecylguanidine acetate; *N*-Dodecylguanidine acetate; Dodecylguanidine monoacetate; 1-Dodecylguanidinium acetate; Dodguadine; Dodin; Dodine acetate; Dodine, mixture with glyodin; Dodine monoacetate; Doguadine; ENT 16,436; Guanidine, dodecyl-, acetate; Guanidine, dodecyl-, monoacetate; Laurylguanidine acetate

Trade Names: AC 5223®; AMERICAN CYANAMID® 5223; APADODINE®; CARPENE®; CURITAN®; CYPREX®; CYPREX® 65W; CYTOX® 2160; DOQUADINE®; EFUZIN®; KARPEN®; MELPREX®; MELPREX® 65; MILPREX®; QUESTURAN®; Radspor L; SULGEN®; SYLLIT®; SYLLIT® 65; SYLLIT® 400SC, TEBULAN®; TSITREX®; VANDODINE®; VENTUROL®; VONDODINE®

Chemical Class: Guanidine

EPA/OPP PC Code: 044301

California DPR Chemical Code: 245

HSDB Number: 1709 as Cyprex

UN/NA & ERG Number: UN3077 (solid)/171; UN3082 (liquid)/171

RTECS® Number: MF1750000

EC Number: 219-459-5 [*Annex I Index No.:* 607-076-00-X]

Uses: Used to control black spot on apples, pears and pecans; brown rot and foliar diseases on peaches and nectarines, cherries, strawberries, black walnuts and sycamore trees. In industry, used as a biocide and preservative. May also be used to catalyze organic reactions.

U.S. Maximum Allowable Residue Levels for Dodine [40 CFR 180.172 (a)]: apple 5 ppm; cherry, sweet 5 ppm; cherry, tart 5 ppm; meat 0 ppm; milk 0 ppm; peach 5 ppm; pear 5 ppm; pecan 0.3 ppm; spinach 12 ppm; strawberry 5 ppm; walnut, black 0.3 ppm. ***Regional registration, as defined in section 180.1(n) [40 CFR 180.172 (b)]:*** in or on spinach, 12.0 ppm.

Human toxicity (long-term)[101]: Intermediate–28.00 ppb, Health Advisory

Fish toxicity (threshold)[101]: Low–140.71163 ppb, MATC (Maximum Acceptable Toxicant Concentration)

Regulatory Authority and Advisory Information: Health Advisory: Mutagen, Skin irritant/sensitizer

Acute Oral Category: 3, CAUTION

EPCRA Section 313 Form R *de minimis* concentration reporting level: 1.0%

European/International Regulations: Hazard Symbol: Xn, Xi, N; risk phrases: R22; R36/38; R50/53; safety phrases: S2; S26; S60; S61 (see Appendix 1)

Description: Colorless or white crystalline solid. Molecular weight = 287.44; Freezing/Melting point = 136°C; Vapor pressure = 2×10^{-7} mmHg @ 25°C. High solubility in water; solubility = 900 mg/L @ 20°C. High solubility in water.

Incompatibilities: An acidic organic salt; reacts and neutralizes bases and may generate heat. May not be compatible with nitrates. Moisture may cause hydrolysis or other forms of decomposition.

Determination in Air: Ionization. NIOSH IV Method#1450, Esters.[18].

Permissible Concentration in Water: Runoff from spills or fire control may cause water pollution.

Determination in Water: Log K_{ow} = <1.25. Unlikely to bioaccumulate in marine organisms.

Routes of Entry: Inhalation, ingestion, dermal and/or eye contact.

Harmful Effects and Symptoms

Short Term Exposure: Contact with eyes or skin may cause irritation, burns, and permanent eye injury. Poisonous if inhaled or ingested. May cause vomiting and diarrhea. LD_{50} (oral, rat) = 660–851 mg/kg; LD_{50} (dermal, rat) = >6000 mg/kg.

Long Term Exposure: May cause tumors. May be mutagenic and cause reproductive and fetal effects.

Points of Attack: Somatic cells in animals, DNA.

Medical Surveillance: In addition to comprehensive initial medical and work histories emphasizing reproductive experience and menstrual history, patient should have physical examination and testing of genito-urinary tract, sperm count, motility and morphology. If required, other tests, such as serum testosterone, serum follicle stimulating hormone (FSH), and serum lutenizing hormone (LH), may be indicated.

First Aid: If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least 15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately. If this chemical contacts the skin, remove contaminated clothing and wash immediately with soap and water. Seek medical attention immediately. If this chemical has been inhaled, remove from exposure, begin rescue breathing (using universal precautions) if breathing has stopped, and CPR if heart action has stopped. Transfer promptly to a medical facility. When this chemical has been swallowed, get medical attention. *Do not induce vomiting when formulations containing petroleum solvents are ingested*. Otherwise, give large quantities of water and induce vomiting. Do not make an unconscious person vomit.

Personal Protective Methods: Applicators and other handlers must wear: Coveralls worn over long-sleeved shirt and long pants; Chemical-resistant gloves such as DuPont™ Tychem® suit fabrics, barrier laminate, or Viton®; Chemical-resistant footwear plus socks; Protective eye wear; Chemical-resistant headgear for overhead exposure; Chemical-resistant apron when cleaning equipment, mixing, or loading[83]. Agricultural Use/Engineering Controls: When handlers use closed systems, enclosed cabs, or aircraft in a manner that meets the requirements listed in the Worker Protection Standard (WPS) for agricultural pesticides, ***40 CFR 170.240(d)(4-6),*** the handler PPE requirements may be reduced or modified as specified in the Worker Protection Standard. Firefighters should wear NIOSH approved self-contained breathing apparatus and full protective clothing.

Respirator Selection: Wherever and whenever workplace conditions warrant respirator use, a respiratory protection program must be followed that meets one or more of the following government standards: OSHA's 29 CFR 1910.134, ANSI Z88.2, or European Standard EN 149.

Storage: Color Code-Blue: Health Hazard/Poison. Store in a secure poison location. Prior to working with this chemical you should be trained on its proper handling and storage. Store in tightly closed containers in a cool, well-ventilated area. Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: This material may be classified as Environmentally hazardous substances, solid, n. o. s. It usually falls in Hazard Class 9.

Spill Handling: First remove all sources of ignition. Evacuate persons not wearing protective equipment from area of spill or leak until clean up is complete. Ventilate area of spill or leak. Isolate spill or leak area in all directions for at least 50 meters /150 feet. Increase, in the downwind direction, as necessary. Do not touch damaged containers or spilled material unless wearing appropriate protective clothing. Stop leak if you can do it without risk. Prevent entry into waterways, sewers, basements or confined areas. Cover with plastic sheet to prevent spreading. Absorb or cover with dry earth, sand or other non-combustible material and transfer to containers. Do not allow water to get inside containers. Absorb liquids in vermiculite, dry sand, earth, or a similar material and deposit in sealed containers. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable.

Fire Extinguishing: Hazardous decomposition includes toxic oxides of nitrogen and carbon and hydrogen chloride gas. As an immediate precautionary measure, isolate spill or leak area in all directions for at least 50 meters/150 feet for liquids and at least 25 meters/75 feet for solids. *Fire involving storage or vehicular tanks:* isolate for 800 meters/0.5 mile in all directions; also, consider initial evacuation for 800 meters/0.5 mile in all directions. *On a small fire:* use dry chemical, CO_2, water spray or regular foam. *On a large fire:* use water spray, fog or regular foam. Do not scatter spilled material with high-pressure streams of water. Move containers from fire area if you can do it without risk. Dike fire-control water for later disposal. *Fire involving tanks:* from a secure, explosion-proof location, use water spray to cool exposed containers. If cooling streams are ineffective (venting sound increases in volume and pitch, tank discolors, or shows any signs of deforming), withdraw immediately to a secure position. Always stay away from tanks engulfed in fire. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode.

Disposal Method Suggested: Do not discharge into drains or sewers. Dispose of waste material as hazardous waste using a licensed disposal contractor to an approved landfill. Consult with environmental regulatory agencies for guidance on acceptable disposal practices. If allowed, incineration with effluent gas scrubbing is recommended. Containers must be disposed of properly by following package label directions or by contacting your local or federal environmental control agency, or by contacting your regional EPA office.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- EXTOXNET, Extension Toxicology Network, "Pesticide Information Profile, Dodine," Oregon State University, Corvallis, OR (June 1996). http://extoxnet.orst.edu/pips/dodine.htm
- USEPA, Office of Pesticide Programs, Pesticide Residue Limits, "Dodine", 40 CFR 180.172. http://www.epa.gov/pesticides/food/viewtols.htm

DSMA D:1670

Use Type: Herbicide, Defoliant

CAS Number: 144-21-8

Formula: CH_3AsNa_2O

Synonyms: Arsonic acid, methyl-, disodium salt; Disodium methanearsenate; Disodium methyl arsenate; Disodium methyl-dioxido-oxoarsorane; Arrhenal; Arsinyl; Arsynal; Diarsen; Disodium methanearsonate; Disodium methylarsonate; Disodium monomethylarsonate; EPA-19713-45; Metharsan; Metharsinat; Methylarsonat disodny; Neo-Asycodile

Trade Names: ANSAR® 184; ANSAR 8100®; ANSAR DSMA® Liquid; CHIPCO CRAB KLEEN®; CRAB-3-RAD 100®; CRALO-E-RAD®; DAL-E-RAD 100®; DISOMEAR®; DI-TAC®; DMA 100®; JON-TROL®; METHAR®; METHAR 30®; SODAR; SOMAR®; STENOSINE®; TONARSAN®; TONARSIN®; VERSAR DSMA LQ®; WEED BROOM®

Chemical Class: Organoarsenic

EPA/OPP PC Code: 013802

California DPR Chemical Code: 251

HSDB Number: 1701

UN/NA&ERG Number: UN2994/151; UN2759/151

RTECS® Number: PA2275000

EC Number: 205-620-7

Uses: Used as a herbicide to control post-emergent grass weeds, including crab grass, in common grass lawns and established turf; for general non-crop weed control in cotton. Not actively registered for use in the U.S. or EU countries[115]. There are 15 global suppliers[97].

Fish toxicity (threshold): Highly toxic to acquatic organisms. LC$_{50}$ – *Oncorhynchus mykiss* (rainbow trout) –> 115.14 mg/l–96.0 h; EC50 – *Daphnia pulex* (Water flea) – 153 mg/l–48 h.

U.S. Maximum Allowable Residue Levels for Methanearsonic acid (calculated as As$_2$O$_3$) from application of the disodium and monosodium salts of methanearsonic acid [40 CFR 180.289]: in or on raw agricultural commodities as follows: citrus fruit, 0.35 ppm; cottonseed, 0.7 ppm; cottonseed hulls, 0.9 ppm. *Tolerances for total residues of combined arsenic (calculated as As)* **[***21 CFR 556.60***]**; in food as follows: (a) In edible tissues and in eggs of chickens and turkeys, in uncooked muscle tissue, 0.5 ppm; in uncooked edible byproducts, 2 ppm; in eggs, 0.5 ppm. (b) In edible tissues of swine in uncooked liver and kidney: 2 ppm; in uncooked muscle tissue and byproducts other than liver and kidney, 0.5 ppm.

Regulatory Authority and Advisory Information: Carcinogenicity[83]: EPA, Not likely to be carcinogenic to humans

Health Advisory: Nerve Toxin (S!), Mutagen, Developmental/Reproductive Toxin

Acute Oral Category: 2, WARNING

Air Pollutant Standard Set. Clean Air Act: List of high risk pollutants (Section 63.74) as arsenic compounds

Clean Water Act: Section 311 Hazardous Substances/RQ 40CFR117.3 (same as CERCLA, see below); Section 313 Water Priority Chemicals (57FR41331, 9/9/92); Toxic Pollutant (Section 401.15) as arsenic and compounds

RCRA, 40CFR261, Appendix 8 Hazardous Constituents, waste number D004

CERCLA Reportable Quantity (RQ): 1 lb (0.454 kg)

EPCRA Section 313 Form R *de minimis* concentration reporting level: 0.1%.

WGK (German Aquatic Hazard Class): Not assigned

Description: White crystalline solid or amber liquid. Odorless. Molecular weight = 183.93; Specific gravity (H$_2$O:1) = 1.04; Boiling point = (decomposes) 162.5°C; Freezing/Melting point = 135°C. Hazard Identification (based on NFPA-704 M Rating System): Health 3, Flammability 0, Reactivity 0. Highly soluble in water; solubility = >300 g/L @ 25°C.

Incompatibilities: Incompatible with strong acids; strong oxidizers; peroxides, bromine azide, bromine pentafluoride, bromine trifluoride; cesium acetylene carbide, chromium trioxide; nitrogen trichloride, silver nitrate. Decomposed by strong oxidizers or reducing agents. Forms highly toxic fumes on contact with acids or active metals (iron, aluminum, zinc). Hydrogen gas can react with inorganic arsenic to form highly toxic arsine gas. Mildly corrosive in the presence of moisture.

Permissible Exposure Limits in Air: NIOSH IDLH: 5 mg[As]/m^3

arsenic, organic compounds

OSHA PEL: 0.5 mg[As]/m^3 TWA

ACGIH TLV®[1]: 0.01 mg[As]/m^3 TWA; Confirmed Human Carcinogen; Biological Exposure Index (BEI): Determinant: Inorganic arsenic plus methylated metabolites in urine; Sampling Time: end of workweek; BEI = 35 μg[As]/L. The determinant may be present in biological specimens collected from subjects who have not been occupationally exposed, at a concentration which could affect interpretation of the result. Such background concentrations are incorporated in the BEI value.

Determination in Air: Filter collection followed by atomic absorption analysis. NIOSH 7900; OSHA ID105.

Permissible Concentration in Water: Federal Drinking Water Guidelines: EPA 10 μg/L; State Drinking Water Guidelines: Arizona 10 μg/L; Connecticut 10 μg/L

Determination in Water: Log K$_{ow}$ = –5.0. negative. Unlikely to bioaccumulate in marine organisms.

Routes of Entry: Ingestion, inhalation, dermal contact.

Harmful Effects and Symptoms

Short Term Exposure: Skin, eye, and respiratory tract irritant. Subacute poisoning by arsenicals causes salty taste, burning in throat and stomach, and intestinal pain. Acute toxicity indicated by headache, vomiting, stupor, convulsions, paralysis[86]. Symptoms of exposure include abnormally low blood pressure and rapid heart rate; fever and rapid breathing may occur. LD$_{50}$ (oral, rat) = 600 mg/kg; LD$_{50}$ (dermal, rabbit) = 236–325 mg/kg.

Long Term Exposure: May cause reproductive and fetal effects. Interferes with adenosine triphosphate (ATP) production and cell division. May be neurotoxic. Mee's lines of the nails are common. Trivalent arsenic compounds are corrosive to the skin. Arsenic trioxide and pentoxide are sensitizers/irritants.

Points of Attack: Gastrointestinal tract, particularly the large intestine, and the kidney, reproductive system, central nervous system, skin. Arsenic may cause skin damage or problems with circulatory systems, and may increase risk of getting cancer.

Medical Surveillance: In addition to comprehensive initial medical and work histories emphasizing reproductive experience and menstrual history, patient should have physical examination and testing of genito-urinary tract, sperm count, motility and morphology. If required, other tests, such as serum testosterone, serum follicle stimulating hormone (FSH), and serum lutenizing hormone (LH), may be indicated. Preliminary medical exam to detect chronic diseases of central nervous system, liver, heart, kidneys, lung and skin, as well as endocrinological or immunological disturbances, should protect susceptible individuals. Periodical medical exams of internal organs, skin and eyes are important to avoid chronic occupational intoxications. They should include lab and patch tests when necessary[83]. Evaluation by a qualified allergist, including exposure history and testing, may help diagnose allergy.

First Aid: If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least 15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately. If this chemical contacts the skin, remove contaminated clothing and wash immediately with soap and water. Seek medical attention immediately. If this chemical has been inhaled, remove from exposure, begin rescue breathing (using universal precautions, including resuscitation mask) if breathing has stopped and CPR if heart action has stopped. Transfer promptly to a medical facility. When this chemical has been swallowed, get medical attention. Give large quantities of water and induce vomiting. Do not make an unconscious person vomit. *Note to physician:* For severe poisoning BAL (British Anti-Lewisite, Dimercaprol, dithiopropanol ($C_3H_8OS_2$)) has been used to treat toxic symptoms of certain heavy metals poisoning – including arsenic. Although BAL is reported to have a large margin of safety, caution must be exercised, because toxic effects may be caused by excessive dosage. Most can be prevented by pre-medication with 1-ephedrine sulfate (CAS: 134-72-5).

Personal Protective Methods: Wear protective gloves and clothing to prevent any reasonable probability of dermal and/or eye contact. Safety equipment suppliers/manufacturers can provide recommendations on the most protective glove/clothing material for your operation. All protective clothing (suits, gloves, footwear, headgear) should be clean, available each day, and put on before work. Contact lenses should not be worn when working with this chemical. Wear dust-proof chemical goggles and face shield unless full facepiece respiratory protection is worn. Employees should wash immediately with soap when skin is wet or contaminated. Provide emergency showers and eyewash.

Note to physician: For severe poisoning BAL (British Anti-Lewisite, Dimercaprol, dithiopropanol ($C_3H_8OS_2$)) has been used to treat toxic symptoms of certain heavy metals poisoning – including arsenic. Although BAL is reported to have a large margin of safety, caution must be exercised, because toxic effects may be caused by excessive dosage. Most can be prevented by pre-medication with 1-ephedrine sulfate (CAS: 134-72-5). For milder poisoning *penicillamine (not penicillin)* has been used, both with mixed success. Side effects occur with such treatment and it is never a substitute for controlling exposure. It can only be done under strict medical care.

Respirator Selection: *at any concentrations above the NIOSH REL, or where there is no REL, at any detectable concentration:* SCBAF: Pd,Pp (APF = 10,000) (any self-contained breathing apparatus that has a full faceplate and is operated in a pressure-demand or other positive-pressure mode); or SaF: Pd,Pp: ASCBA (APF = 10,000) (any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary, self-contained breathing apparatus operated in a pressure-demand or other positive-pressure mode). *Escape:* GmFAg100 (APF = 50) [any air-purifying, full facepiece respirator (gas mask) with a chin-style, front- or back-mounted acid gas canister having an N100, R100, or P100 filter]; or SCBAE (any appropriate escape-type, self-contained breathing apparatus).

Storage: Color Code-Blue: Health Hazard/Poison. Store in a secure poison location. Prior to working with this chemical you should be trained on its proper handling and storage. Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: Disodium methanearsenate requires a shipping label of "poisonous materials." It usually falls in Hazard Class 6.1 and Packing Group II.

Spill Handling: First remove all sources of ignition. Evacuate persons not wearing protective equipment from area of spill or leak until clean up is complete. Collect powdered material in the most convenient and safe manner and deposit in sealed containers. Ventilate area after clean up is complete. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable.

Fire Extinguishing: Hazardous decomposition includes oxides of arsenic, nitrogen and carbon. Use any agent suitable for surrounding fire. Stay upwind; keep out of low areas. Wear self-contained breathing apparatus and full protective clothing. Move container from fire area, if you can do so without risk. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies. From a secure, explosion-proof location, use water spray to cool exposed containers. If cooling streams are ineffective (venting sound increases in volume and pitch, tank discolors, or shows any signs of deforming), withdraw immediately to a secure position. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode.

Disposal Method Suggested: Recycle any unused portion of the material for its approved use or return it to the manufacturer or supplier. Ultimate disposal of the chemical must consider: the material's impact on air quality; potential migration in soil or water; effects on animal, aquatic, and plant life; and conformance with environmental and public health regulations[83]. In accordance with 40CFR165, follow recommendations for the disposal of pesticides and pesticide containers. Containers must be disposed of properly by following package label directions or by contacting your local or federal environmental control agency, or by contacting your regional EPA office.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- Federal Register. (U.S. Government Printing Office, Supt. of Documents, Washington DC 20402) V.1- 1936- Volume(issue)/page/year: 54,7740,1989
- Fishel, Frederick M., Document PI-89, Pesticide Information Office, Florida Cooperative Extension Service, Institute of Food and Agricultural Sciences, University of Florida, Gainesville, FL, October 2005; Revised February 2011
- USEPA, Office of Prevention, and Toxic Substances, *Revised Reregistration Eligibility Decision for MSMA, DSMA, CAMA, and Cacodylic Acid*, EPA 738-R-06-021 Washington DC (August 10, 2006)

E

Endosulfan E:0100

Use Type: Insecticide, Acaricide

CAS Number: 115-29-7; 959-98-8 (*alpha*-isomer); 33213-65-9 (*beta*-isomer)

Formula: $C_9H_6Cl_6O_3S$

Synonyms: Benzoepin (in Japan); Endosulphan; Ensodulfan (Spanish); ENT 23,979; A,*β*-1,2,3,4,7,7-Hexachlorobiclo (2,2,1)hepten-5,6-bioxymethylenesulfite; 1,2,3,4,7,7-Hexachlorobiclo(2,2,1)hepten-5,6-bioxymethylenesulfite; Hexachlorohexahydromethano 2,4,3-benzodioxathiepin-3-oxide;6,7,8,9,10,10-Hexachloro-1,5,5a,6,9,9a-hexahydro-6,9-methano-2,4, 3-benzodioxathiepin-3-oxide; 1,4,5,6,7,7-Hexachloro-5-norborene-2,3-dimethanol cyclic sulfite; C,C'-(1,4,5,6,7,7-hexachloro-8,9,10-trinorborn-5-en-2,3-ylene)(dimethylsulphite) 6,7,8,9,10,10-hexachloro-1,5,5a,6,9,9a-hexahydro-6,9-methano-2,4,3-benzodioxathiepin3-oxide;6,9-Methano-2,4,3-benzodioxathiepin, 6,7,8,9,10,10-hexachloro-1,5,5a,6,9,9a-hexahydro-, 3-oxide; NCI-C00566; OMS570; Rasayansulfan; Sulfurous acid cyclic ester with 1,4,5,6,7,7-hexachloro-5-norborene-2,3-dimethanol

alpha-isomer*:* *α*-Benzoepin; Endosulfan-1; *α*-Endosulfan; Endosulfan-A; Endosulfan-*α*; 1,4,5,6,7,7-Hexachloro-5-norbornene-2,3-dimethanol, cyclic sulfite, *endo*-; 6,9-Methano-2,4,3-benzodioxathiepin, 6,7,8,9,10,10-hexachloro-1,5,5*α*,6,9,9*α*-hexahydro-, 3-oxide, (3, 5a*β*,6,9,9a. *β*)-; 5-Norbornene-2,3-dimethanol, 1,4,5,6,7,7-hexachloro-, cyclic sulfite, *endo-*

beta-isomer*:* *β*-Benzoepin; Endosulfan-2; Endosulfan, *beta*; *β*-Endosulfan; *β*-Ensodulfan (Spanish); 1,4,5,6,7, 7-Hexachloro-5-norbornene-2,3-dimethanol, cyclic sulfite, *exo*-; 6,9-Methano-2,4,3-benzodioxathiepin, 6,7,8,9,10, 10-hexachloro-1,5,5A,6,9,9A-hexahydro-, 3-oxide, (3*α*,5A *α*,6*β*,9*β*,9A*α*)-

Trade Names: AFIDEN®; BEOSIT®; BIO 5,462®; CHLORTHIEPIN®; CLEAN-CROP®; CRISUFAN®; CYCLODAN®; DE-PESTER®; DESTROY®; DEVISULPHAN®; DISSULFAN CE®; ENDOCEL® ENDOCIDE®; ENDOSOL®; END-O-SULFAN®; ENDOTAF®; ENDOX®; ENSURE®; E-Z FLO®; FMC 5462®; HEXASULFAN®; HILDAN®; HOE 2671®; INSECTO®; INSECTOPHENE®; KENDAN®; KERNTOX®; KOP-THIODAN®; MALIX®; MALUX; MAUX®; MOS-570; METHOFAN®; NCI-C00566; NIA 5462®, NIAGARA 5,462; NIAGARA 5,462®[C]; PHASER®; RASAYANSULFAN; ROCKY®; THIFOR®; THIDAN®; THIMUL®; THIODAN®; *α*-THIODAN®; *β*-THIODAN®; THIONEX; *α*-THIONEX®*;* *β*-THIONEX®; THIOKILL®; THIOFOR®; THIONEX®; THIOSULFAN®; THIOSULFAN THIONEL®; THISULFAN TIOVEL; TIONEL; TIOVEL®

Chemical class: Organochlorine; Cyclodiene

EPA/OPP PC Code: 079401; 079402 (*alpha*-isomer); 079403 (*beta*-isomer)

California DPR Chemical Code: 259

HSDB Number: 390

UN/NA & ERG Number: UN2761 (solid)/151

RTECS® Number: RB9275000 (*alpha*-isomer); RB9875200 (*beta*-isomer)

EC Number: 204-079-4 [*Annex I Index No.:* 602-052-00-5]

Uses: A U.S. EPA restricted Use Pesticide (RUP). Not approved for use in EU countries[115]. Globally banned as of April 29, 2010. Endosulfan was added to the list of Stockholm Convention Persistent Organic Pollutants (POPs): Annex A (Elimination). Endosulfan is a chlorinated hydrocarbon insecticide and acaricide of the cyclodiene subgroup which acts as a poison to a wide variety of insects and mites on contact. Although it may also be used as a wood preservative, it is used primarily on a wide variety of food crops including tea, coffee, fruits, and vegetables, as well as on rice, cereals, maize, sorghum, or other grains. Formulations of endosulfan include emsulsifiable concentrate, wettable powder, ultra-low volume (ULV) liquid, and smoke tablets. It is compatible with many other pesticides and may be found in formulations with dimethoate, malathion, methomyl, monocrotophos, pirimicarb, triazophos, fenoprop, parathion, petroleum oils, and oxine-copper. It is not compatible with alkaline materials. Technical endosulfan is made up of a mixture of two molecular forms (isomers) of endosulfan, the *alpha*- and *beta*-isomers.

U.S. Maximum Allowable Residue Levels for Endosulfan [40CFR 180.182(a)(1)]: Alfalfa, forage 0.3 ppm; alfalfa, hay 1.0 ppm; almond 0.3 ppm; almond, hulls 1.0 ppm; apple 1.0 ppm; apple, wet pomace 5.0 ppm; apricot 2.0 ppm; barley, grain 0.3 ppm; barley, straw 0.4 ppm; bean 2.0 ppm; blueberry 0.3 ppm; broccoli 3.0 ppm; Brussels sprouts 2.0 ppm; cabbage 4.0 ppm; carrot, roots 0.2 ppm; cattle, fat 13.0 ppm; cattle, liver 5.0 ppm; cattle, meat 2.0 ppm; cattle, meat byproducts, except liver 1.0 ppm; cauliflower 2.0 ppm; celery 8.0 ppm; cherry, sweet 2.0 ppm; cherry, tart 2.0 ppm; collards 2.0 ppm; corn, sweet, forage 12.0 ppm; corn, sweet, kernel plus cob with husks removed 0.2 ppm; corn, sweet, stover 14.0 ppm; cotton, gin byproducts 30.0 ppm; cotton, undelinted seed 1.0 ppm; eggplant 1.0 ppm; goat, fat 13.0 ppm; goat, liver 5.0 ppm; goat, meat 2.0 ppm; goat, meat byproducts, except liver 1.0 ppm; grape 2.0 ppm; hazelnut 0.2 ppm; hog, fat 13.0 ppm; hog, liver 5.0 ppm; hog, meat 2.0 ppm; hog, meat byproducts, except liver 1.0 ppm; horse, fat 13.0 ppm; horse, liver 5.0 ppm; horse, meat 2.0 ppm; horse, meat byproducts, except liver 1.0 ppm; kale 2.0 ppm; lettuce, head 11.0 ppm; lettuce, leaf 6.0 ppm; milk, fat 2.0 ppm; mustard greens 2.0 ppm; mustard, seed 0.2 ppm; nectarine 2.0 ppm; nut, macadamia 0.2 ppm; oat, grain 0.3 ppm; oat, straw 0.4 ppm; pea, succulent 2.0 ppm; peach 2.0 ppm; pear 2.0 ppm; pecan 0.2 ppm; pepper 2.0 ppm; pineapple 1.0 ppm; pineapple, process residue 20.0 ppm; plum 2.0 ppm; plum, prune 2.0 ppm; potato 0.2 ppm; rapeseed, seed 0.2 ppm; rye, grain 0.3 ppm; rye, straw 0.3 ppm; sheep, fat 13.0 ppm; sheep, liver 5.0 ppm; sheep, meat 2.0 ppm; sheep, meat byproducts, except liver 1.0 ppm; spinach 2.0 ppm; strawberry 2.0 ppm; sugarcane, cane 0.5 sweet potato, roots 0.15 tomato 1.0 ppm; turnip, roots 0.2 ppm; turnip, tops 2.0 ppm; vegetable, cucurbit, group 9 1.0 ppm; walnut 0.2 ppm; watercress 2.0 ppm; wheat, grain 0.3 ppm; wheat, straw 0.4 ppm. *Tolerances for the combined residues (alpha and beta isomers) and its metabolite endosulfan sulfate, 6,7,8,9,10,10-hexachloro-1,5,5a,6,9,9a-hexahydro-6,9-methano-2,4,3-benzodioxathiepin-3,3-dioxide* **[***40CFR 180.182(a)(2)***]:** in or on dried tea (reflecting <0.1 ppm residues in beverage tea) resulting from application of the insecticide to growing tea, 24 ppm.

Human toxicity (long-term) ***[101]:*** Intermediate–42.00 ppb, Health Advisory

Fish toxicity (threshold)[101]: Extra high–0.00446 ppb, MATC (Maximum Acceptable Toxicant Concentration)

Regulatory Authority and Advisory Information:

Carcinogenicity[83]: EPA, Not likely to be carcinogenic to humans; ACGIH, A4 Not classifiable as a human carcinogen.

Health Advisory: Mutagen, Developmental/Reproductive Toxin

Acute Oral Category: 1, DANGER–POISON

Endocrine disruptor: Known ED

Clean Water Act: Section 311 Hazardous Substances/RQ 40CFR117.3 (same as CERCLA, see below); Toxic Pollutant (Section 401.15)

EPA Hazardous Waste Number (RCRA No.): P050

Superfund/EPCRA 302 Extremely Hazardous Substances: TPQ = 10/10,000 lb (4.54/4,540 kg)

Superfund/EPCRA 40CFR302.4 RQ: CERCLA, 1 lb (0.454 kg)

U.S. DOT Regulated Marine Pollutant (49CFR172.101, Appendix B). Severe pollutant

List of Stockholm Convention POPs: Annex A (Elimination) all isomers

European/International Regulations: Hazard Symbol: T+, Xn, N; risk phrases: R21; R26/28; R50/53; safety phrases: S1/2; S28; S36/37; S45; S60; S61; S63. (CAS: 115-29-7)

WGK (German Aquatic Hazard Class): 3-Severe hazard to waters

alpha-isomer:

Clean Water Act: 40CFR423, Appendix A, Priority Pollutants; Toxic Pollutant (Section 401.15)

RCRA 40CFR268.48; 61FR15654, Universal Treatment Standards: Wastewater (mg/L), 0.023; Non-wastewater (mg/kg), 0.066

RCRA 40CFR264, Appendix 9; TSD Facilities Ground Water Monitoring List. Suggested test method(s) (PQL *u*g/L): 8080(0.1); 8250(10)

Superfund/EPCRA 40CFR302.4 RQ: CERCLA, 1 lb (0.454 kg)

U.S. DOT Regulated Marine Pollutant (49CFR172.101, Appendix B). Severe pollutant; as endosulfan

List of Stockholm Convention POPs: Annex A (Elimination) all isomers

WGK (German Aquatic Hazard Class): see above (CAS: 115-29-7)

beta-isomer:

Clean Water Act: 40CFR423, Appendix A, Priority Pollutants; Toxic Pollutant (Section 401.15)

RCRA 40CFR268.48; 61FR15654, Universal Treatment Standards: Wastewater (mg/L), 0.029; Non-wastewater (mg/kg), 0.13

RCRA 40CFR264, Appendix 9; TSD Facilities Ground Water Monitoring List. Suggested test method(s) (PQL *u*g/L): 8080(0.05)

Superfund/EPCRA 40CFR302.4 RQ: CERCLA, 1 lb (0.454 kg)

List of Stockholm Convention POPs: Annex A (Elimination) all isomers

U.S. DOT Regulated Marine Pollutant (49CFR172.101, Appendix B). Severe pollutant; as endosulfan

WGK (German Aquatic Hazard Class): see above (CAS: 115-29-7)

Description: Endosulfan, in pure form, is a colorless crystalline solid. The technical product is a light to dark brown waxy solid. It has a rotten egg or sulfur-like odor. Molecular weight = 406.93; Molecular weight = 1.745 @ 20°C: Freezing/Melting point = 406.91°C; Boiling point = decomposes; Freezing/Melting point = 70–100°C; 80°C (technical); 106.1°C (pure); 106°C (a); 212°C (b); Vapor pressure = 1.7×10^{-7} mmHg @ 20°C. Hazard Identification (based on NFPA-704 M Rating System): Health 3, Flammability 0, Reactivity 0. Very low solubility in water; solubility = 0.00001%

Incompatibilities: Strong acids, strong bases. Hydrolyzed by acids. Contact with alkalis forms toxic sulfur dioxide fumes. Corrosive to iron, especially in the presence of moisture.

Permissible Exposure Limits in Air: OSHA PEL: None

NIOSH REL: 0.1 mg/m^3 TWA [skin]

ACGIH TLV®[1]: 0.006 ppm/0.1 mg/m^3 TWA measured as inhalable fraction and vapor [skin]; not classifiable as a human carcinogen

115-29-7

Protective Action Criteria (PAC) Ver. 27[89]

PAC-1: 0.1 mg/m^3

PAC-2: 0.8 mg/m^3

PAC-3: 280 mg/m^3

Determination in Air: No test available

Permissible Concentration in Water: Federal Drinking Water Guidelines: 40 ppb[93]. State Drinking Water Guidelines: Arizona 74 μg/L; Maine 42 μg/L; Florida 42 μg/L The U.S. EPA recommends that the amount of endosulfan in rivers, lakes, and streams should not be more than 74 parts per billion (74 ppb). To protect freshwater aquatic life: 0.056 μg/L as a 24 hr average, never to exceed 0.22 μg/L. To protect saltwater aquatic life: 0.0087 μg/L as a 24 hr average, never to exceed 0.034 μg/L. To protect human health: 74.0 μg/L(6). Mexico(35) has set an MAC of 2 μg/L in estuaries and 0.2 μg/L in coastal waters. Kansas[61] has set a guideline of 74.0 μg/L for endosulfan in drinking water.

Determination in Water: EPA Method D3086. GC method with ECD for the determination of organochlorine pesticides in water and wastewater. Log K_{ow} = >4.0. Values at or above 3.0 are likely to bioaccumulate in marine organisms.

Routes of Entry: Inhalation, ingestion, eye and/or dermal and/or eye contact. Can be absorbed through the skin.

Harmful Effects and Symptoms

Short Term Exposure: Endosulfan may affect the central nervous system, blood, resulting in irritability, convulsions and renal failure. High-level exposure may result in death. The effects may be delayed. Ingestion of endosulfan may result in nausea, vomiting, and diarrhea. Dizziness, agitation, nervousness, tremor, incoordination, and convulsions may also occur. Central nervous system depression may terminate in respiratory failure. Contact with endosulfan may irritate or burn the skin, eyes, and mucous membranes. The probable oral lethal dose is 50 to 500 mg/kg, or 1 teaspoonful to 1 ounce for a 150 lb person. Death has occurred within 2 hours of heavy dust exposure during bagging operations. LD_{50} (oral, rat) = 18 mg/kg[83,USDA]; LD_{50} (dermal, rabbit) = 400 mg/kg.

Long Term Exposure: May cause tumors. Repeated exposure may cause brain damage, causing convulsions, loss of coordination, and memory loss. May cause liver and kidney damage. Studies of the effects of endosulfan on animals suggest that long-term exposure to endosulfan can also damage the kidneys, testes, and liver and may possibly affect the body's ability to fight infection. However, it is not known if these effects also occur in humans. The U.S. EPA does not know if children are more sensitive to endosulfan than adults. The U.S. EPA does not know if endosulfan can affect the ability of people to have children or if it causes birth defects. Large amounts of endosulfan damaged the testes of animals, but it is not known if this damaged their ability to reproduce. Some birth defects have been seen in the offspring of animals ingesting endosulfan during pregnancy

Points of Attack: Respiratory system, lungs, central nervous system, cardiovascular system, skin, eyes, plasma and red blood cell cholinesterase.

Medical Surveillance: Before employment and at regular times after that, the following are recommended: Plasma and red blood cell cholinesterase levels (tests for the enzyme poisoned by this chemical). If exposure stops, plasma levels return to normal in 1–2 weeks while red blood cell levels may be reduced for 1–3 months. When acetylcholinesterase enzyme levels are reduced by 25% or more below preemployment levels, risk of poisoning is increased, even if results are in lower ranges of "normal." Reassignment to work not involving organophosphate or carbamate pesticides is recommended until enzyme levels recover. If symptoms develop or overexposure occurs, repeat the above tests as soon as possible and get an exam of the nervous system. Also consider complete blood count and chest x-ray following acute overexposure. Do not drink any alcoholic beverages before or during use. Alcohol promotes absorption of organophosphates. Liver and kidney function tests. Examination of the nervous system. EEG.

First Aid: Speed in removing material from eyes and skin is of extreme importance. If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least 15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately. If this chemical contacts the skin, remove contaminated clothing and wash immediately with soap and water. Shampoo hair promptly if contaminated. Seek medical attention immediately. If this chemical has been inhaled, remove from exposure, begin rescue breathing (using universal precautions) if breathing has stopped, and CPR if heart action has stopped. Transfer promptly to a medical facility. When this chemical has been swallowed, get medical attention. Consult hospital or poison control center on use of antidotes. Transport to health care facility

Personal Protective Methods: Wear protective gloves and clothing to prevent any reasonable probability of dermal and/or eye contact. Safety equipment suppliers/manufacturers can provide recommendations on the most protective glove/clothing material for your operation. Viton or Neoprene™ materials are recommended. All protective clothing (suits, gloves, footwear, headgear) should be clean, available each day and put on before work. Contact lenses should not be worn when working with this chemical. Wear dust-proof chemical goggles and face shield unless full facepiece respiratory protection is worn. Employees should wash immediately with soap when skin is wet or contaminated. Provide emergency showers and eyewash. If used out of doors adequate emergency water should be available.

Respirator Selection: SCBA >0.1 mg/m^3. Follow regulations in OSHA 29CFR1910.134 or European Standard EN149. Use a NIOSH/MSHA- or European Standard EN149-approved respirator; or use an approved supplied-air respirator with a full facepiece operated in the positive-pressure mode, or with a full facepiece, hood, or helmet in the continuous-flow mode; or use a NIOSH/MSHA- or European Standard EN149-approved self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive-pressure mode. A dust respirator approved for pesticide use may be worn. An organic vapor respirator may be necessary if exposure to the solvent is significant.

Storage: Color Code-Blue: Health Hazard/Poison. Store in a secure poison location. Prior to working with this chemical you should be trained on its proper handling and storage. Store in a cool, dry, well-ventilated area, free of alkalis, acids, and acid fumes. Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: Endosulfan required label is "poisonous materials." It usually falls in Hazard Class 6.1 and Packing Group II. STN: 49-215-16.

Spill Handling: First remove all sources of ignition. Evacuate persons not wearing protective equipment from area of spill or leak until clean up is complete. In the case of spills, stay upwind; stay out of low areas. Use water spray to reduce vapors. Do not dry sweep. Do not touch spilled material; stop leak if you can do it without risk. *Small wet spills:* take up with sand or other noncombustible absorbent material and place into containers for later disposal. *Small dry spills*: with clean shovel place material into clean, dry container and cover; move containers from spill area. *Large spills*: dike far ahead of spill for later disposal. Ventilate area after clean up is complete. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable.

Fire Extinguishing: This chemical is a noncombustible solid. Use any extinguishing agent suitable for surrounding fire. Hazardous decomposition includes sulfur oxides and chlorine. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies. From a secure, explosion-proof location, use water spray to cool exposed containers. If cooling streams are ineffective (venting sound increases in volume and pitch, tank discolors, or shows any signs of deforming), withdraw immediately to a secure position. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode.

Disposal Method Suggested: A recommended method for disposal is burial 18 inches deep in non-cropland, away from water supplies, but bags can be burned. Large quantities should be incinerated at high temperature in a unit with effluent gas scrubbing. Consult with environmental regulatory agencies for guidance on acceptable disposal practices. Generators of waste containing this contaminant (≥100 kg/mo) must conform with EPA regulations governing storage, transportation, treatment, and waste disposal. In accordance with 40CFR165, follow recommendations for the disposal of pesticides and pesticide containers. Containers must be disposed of properly by following package label directions or by contacting your local or federal environmental control agency, or by contacting your regional EPA office.

References:

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- EXTOXNET, Extension Toxicology Network, “Pesticide Information Profile, Endosulfan,” Oregon State University, Corvallis, OR (June 1996). http://ace.orst.edu/info/extoxnet/pips/endosulf.htm
- USEPA, Office of Pesticide Programs, Pesticide Residue Limits, “ Endosulfan”, 40 CFR 180.182. http://www.epa.gov/pesticides/food/viewtols.htm
- New Jersey Department of Health and Senior Services, “Hazardous Substance Fact Sheet, Endosulfan,” Trenton, NJ (May 1999). http://www.state.nj.us/health/eoh/rtkweb/0824.pdf
- USEPA, Office of Prevention, Pesticides and Toxic Substances, “Reregistration Eligibility Decision for Endosulfan,” Washington, DC. (November 2002). http://www.epa.gov/REDs/endosulfan_red.pdf
- U.S. Department of Health and Human Services, Agency for Toxic Substances and Disease Control (ATSDR), “ToxFAQs for Endosulfan,” Atlanta, GA (February 2001). http://www.atsdr.cdc.gov/tfacts41.html
- USEPA, Endosulfan: Ambient Water Quality Criteria, Washington DC (1980)
- USEPA, Endosulfan, Health and Environmental Effects Profile No. 98, Washington DC, Office of Solid Waste (April 30, 1980)
- USEPA, “Chemical Profile: Endosulfan,” Washington DC, Chemical Emergency Preparedness Program (November 30, 1987)
- New York State Department of Health, “Chemical Fact Sheet: Endosulfan,” Albany, NY, Bureau of Toxic Substance Assessment (April 1986)

Endothall E:0110

Use Type: Herbicide, Algaecide

CAS Number: 145-73-3; 129-67-9 (disodium salt)

Formula: $C_8H_{10}NO_5PS$

Synonyms: 1,2-Dicarboxy 3,6-endoxocyclohexane; 3,6-Endooxohexahydrophthalic acid; Endothal (Great Britian); Endothal chlorophenoxy herbicide; Endothall technical; 3,6-Endoxohexahydrophthalic acid; 3,6-Epoxycyclohexane-1,2-dicarboxylic acid; 3,6-Endo-epoxy-1,2-cyclohexanedicarboxylic acid; Hexahydro-3,6-*endo*-oxyphthalic acid; 7-Oxabicyclo(2.2.1) heptane-2,3-dicarboxylic acid

Trade Names: ACCELERATE®; AQUATHOL®; DES-I-CATE®; HYDOUT®; HYDROTHAL-47®; HYDROTHOL®; NIAGARATHOL®; RIPENTHOL®; TRI-ENDOTHAL®

Chemical class: Dicarboxylic acid

EPA/OPP PC Code: 038901

California DPR Chemical Code: 5813

HSDB Number: 391

UN/NA & ERG Number: UN2811/154

RTECS® Number: RN7875000; RN8225000 (disodium salt)

EC Number: 205-660-5 [*Annex I Index No.:* 607-150-00-

1] (*145-73-3*); 204-959-8 [*Annex I Index No.:* 607-055-00-5] (*129-67-9*)

Uses: Endothall is used as a cotton defoliant and as a selective contact herbicide on both terrestrial and aquatic weeds. The potassium and amine salts of endothall are used as aquatic herbicides to control a variety of plants including plankton, pondweed, niad, coontail, milfoil, elodea, and algaes in water bodies and rice fields. Endothall is also used to control annual grass and broadleaf weeds in sugar beets, spinach and turf. It reduces sucker branch growth in hops. Endothall is a desiccant to aid the harvest of alfalfa, potatoes, clover, and cotton. Not approved for use in EU countries[115]. Approved for use in the U.S. and other countries. There are 24 global suppliers[97].

U.S. Maximum Allowable Residue Levels for Endothall from use of its mono-N,N-dimethylalkylamine salt wherein the alkyl Group the same as in the fatty acid of coconut oil [40 CFR 180.293(a)(1)]: in or on the following raw agricultural commodities: cotton, undelinted seed 0.1 ppm; hop, 0.1 ppm; potato 0.1 ppm; rice, grain 0.05 ppm (negligible); and rice, straw, 0.05 ppm (negligible). [*40 CFR 180.293(a)(2)*]: An interim tolerance of 0.2 ppm is established in potable water from use of its potassium, sodium, di-*N,N*-dimethylalkylamine, and mono-*N-N*-dimethylalkylamine salts as algicides or herbicides to control aquatic plants in canals, lakes, ponds, and other potential sources of potable water. *While petitions for tolerances for negligible residues are pending and until action is completed on these petitions, interim tolerances are established* **[***40 CFR 180.319***]:** in or on the following raw agricultural commodity: sugar beets.

Human toxicity (long-term)[101]: Very low–100.00 ppb, MCL (Maximum Contaminant Level)

Fish toxicity (threshold)[101]: Low–240.32545 ppb, MATC (Maximum Acceptable Toxicant Concentration)

Regulatory Authority and Advisory Information:

Acute Oral Category: 1, DANGER-Poison

Potential Ground Water Pollutant [California FAC Section 13145(d)/12811, active] dipotassium and mono (*N,N*-dimethyl alkylamine) salts.

EPA Hazardous Waste Number (RCRA No.): P088

Safe Drinking Water Act: MCL, 0.1 mg/L; MCLG, 0.1 mg/L; Regulated chemical (47 FR 9352)

Superfund/EPCRA 40CFR302.4 RQ: CERCLA, 1000 lb (454 kg)

European/International Regulations (*145-73-3; 129-67-9*): Hazard Symbol: T; risk phrases: R21; R25; R36/37/38; safety phrases: S1/2; S36/37/39; S45 (see Appendix 1)

Description: Endothall, when pure, is a white crystalline solid. The technical grade is a light brown liquid. Odorless. Molecular weight = 186.18; Specific gravity (H_2O:1) = 1.43; Freezing/Melting point = 144°C with conversion to the anhydride; Vapor pressure = 2×10^{-5} mmHg @ 25°C. Hazard Identification (based on NFPA-704 M Rating System): Health 3, Flammability 0, Reactivity 1. Highly soluble in water; solubility = 100% @ 20°C.

Incompatibilities: Undergoes slow hydrolysis in termperatures above 90°C. Reacts with strong oxidizers.

Permissible Exposure Limits in Air: Protective Action Criteria (PAC) Ver. 27[89]

disodium salt

PAC-1: 0.19 mg/m^3

PAC-2: 2 mg/m^3

PAC-3: 10 mg/m^3

Permissible Concentration in Water: Federal Drinking Water Standards: EPA 100 μg/L; Federal Drinking Water Guidelines: 50 μg/L; State Drinking Water Guidelines: Arizona 140 μg/L; Maine 50 μg/L. A no-observed-adverse effects-level (NOAEL) of 2 mg/kg/day has been determined by EPA. This gives a reference dose (or Acceptable Daily Intake (ADI)) of 0.02 mg/kg/day on the basis of which a lifetime health advisory of 0.14 mg/L (140 μg/L) was calculated.

Determination in Water: Log K_{ow} = <2.0. Unlikely to bioaccumulate in marine organisms.

Routes of Entry: Inhalation, ingestion, eye and/or dermal and/or eye contact. May be absorbed through the skin.

Harmful Effects and Symptoms

Short Term Exposure: Ingestion may cause severe vomiting with abdominal pain; inflammation of the gastrointestinal tract with erosion and hemorrhage; pulmonary edema; may cause hypotension and cardiovascular collapse. May be absorbed through the unbroken skin, causing irritation or burning sensation on abraded skin. May cause irritation of the eyes and respiratory tract. Effects of exposure may be delayed. Poisonous: approximate lethal dose (human) is about 2.5 teaspoonful. LD_{50} (oral, rat) = 38–50 mg/kg; LD_{50} (dermal, rat) = >1000 mg/kg.

Long Term Exposure: May cause reproductive and fetal effects. May cause kidney and liver damage. May cause skin sensitization.

Points of Attack: Reproductive cells. Skin, kidneys and liver.

Medical Surveillance: Preliminary medical exam to detect chronic diseases of central nervous system, liver, heart, kidneys, lung and skin, as well as endocrinological or immunological disturbances, should protect susceptible individuals. Periodical medical exams of internal organs, skin and eyes are important to avoid chronic occupational intoxications. They should include lab and patch tests when necessary[83]. In addition to comprehensive initial medical and work histories emphasizing reproductive experience and menstrual history, patient should have physical examination and testing of genito-urinary tract, sperm count, motility and morphology. If required, other tests, such as serum testosterone, serum follicle stimulating hormone (FSH), and serum lutenizing hormone (LH), may be indicated.

First Aid: If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least 15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately. If this chemical contacts the skin, remove contaminated clothing and wash immediately with soap and water. Seek medical attention immediately. If this chemical has been inhaled, remove from exposure, begin rescue breathing (using universal precautions) if breathing has stopped, and CPR if heart action has stopped.

Transfer promptly to a medical facility. When this chemical has been swallowed, get medical attention. Give large quantities of water and induce vomiting. Do not make an unconscious person vomit.

Personal Protective Methods: Wear rubber gloves for all handling. Wear protective gloves and clothing to prevent any reasonable probability of dermal and/or eye contact. Safety equipment suppliers/manufacturers can provide recommendations on the most protective glove/clothing material for your operation. All protective clothing (suits, gloves, footwear, headgear) should be clean, available each day, and put on before work. Contact lenses should not be worn when working with this chemical. Wear dust-proof chemical goggles and face shield unless full facepiece respiratory protection is worn. Employees should wash immediately with soap when skin is wet or contaminated. Provide emergency showers and eyewash. Wear hats, protective suits, and boots for all handling.

Respirator Selection: SCBA >0.19 mg/m^3 *disodium salt.* Follow regulations in OSHA 29CFR1910.134 or European Standard EN149. Use a NIOSH/MSHA- or European Standard EN149-approved respirator; or use an approved supplied-air respirator with a full facepiece operated in the positive-pressure mode, or with a full facepiece, hood, or helmet in the continuous-flow mode; or use a NIOSH/MSHA- or European Standard EN149-approved self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive-pressure mode.

Storage: Color Code-Blue: Health Hazard/Poison. Store in a secure poison location. Prior to working with endothall you should be trained on its proper handling and storage. Store in tightly closed containers in a cool, well-ventilated area. Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: Toxic, solids, organic, n.o.s. require a label of "poisonous materials." This material falls in Hazard Class 6.1 and Packing Group II.

Spill Handling: First remove all sources of ignition. Evacuate persons not wearing protective equipment from area of spill or leak until clean up is complete. Do not dry sweep. Use industrial vacuum. Collect powdered material in the most convenient and safe manner and deposit in sealed containers. Ventilate area after clean up is complete. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable.

Fire Extinguishing: Hazardous decomposition includes oxides of nitrogen, carbon, sulfur and phosphorus. *Fire involving storage or vehicular tanks:* isolate for 800 meters/0.5 mile in all directions; also, consider initial evacuation for 800 meters/0.5 mile in all directions. *Small fire:* dry chemical, carbon dioxide or water spray. *Large fire:* dry chemical, carbon dioxide, alcohol-resistant foam or water spray. Move containers from fire area if you can do it without risk. Dike fire-control water for later disposal; do not scatter the material. *Fire involving tanks or car/trailer loads:* fight fire from maximum distance or use unmanned hose holders or monitor nozzles. Do not get water inside containers. Cool containers with flooding quantities of water until well after fire is out. Withdraw immediately in the case of rising sound from venting safety devices or discoloration of tank. Always stay away from tanks engulfed in fire. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode.

Disposal Method Suggested: Small quantities may be disposed of by burial in soil which is rich in organic matter. Large quantities are best disposed of by incineration. Consult with environmental regulatory agencies for guidance on acceptable disposal practices. Generators of waste containing this contaminant (≥ 100 kg/mo) must conform with EPA regulations governing storage, transportation, treatment, and waste disposal. In accordance with 40CFR165, follow recommendations for the disposal of pesticides and pesticide containers. Containers must be disposed of properly by following package label directions or by contacting your local or federal environmental control agency, or by contacting your regional EPA office.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- EXTOXNET, Extension Toxicology Network, "Pesticide Information Profile, Endothall," Oregon State University, Corvallis, OR (September 1995). http://ace.orst.edu/info/extoxnet/pips/endothal.htm
- USEPA, Office of Pesticide Programs, Pesticide Residue Limits, "Endothall", 40 CFR 180.293 and 180.319, http://www.epa.gov/pesticides/food/viewtols.htm
- Sax, N. I., Ed., "Dangerous Properties of Industrial Materials Report," 8, No. 6, 51–56 (1988)
- USEPA, "Health Advisory: Endothall," Washington DC, Office of Drinking Water (August 1987)

Endrin E:0140

Use Type: Insecticide, Avicide
CAS Number: 72-20-8
Formula: $C_{12}H_8Cl_6O$
Synonyms: 2,7:3,6-Dimethanonaphth(2, 3-b)oxirene, 3,4,5,6,9,9-hexachloro-1a,2,2a,3,6,6a,7,7a-octahydro-,(*aα*,2. *β*,2*aβ*,2*aβ*,3*α*,6*α*,6*aβ*,7*β*,7*aα*)-; Endrina (Spanish); ENT 17,251; (1r, 4s, 4as, ss, 7r, 8r, 8ar)-1,2,3,4,10-Hexachloro-1,4,4a,5,6,7,8,8a-octahydro-6,7-epoxy-1,4:5,8-dimethano naphthalene;

Hexachloroepoxyoctahydro-endo,endo-dimethano napthalene; 1,2,3,4,10,10-Hexachloro-6,7-epoxy-1,4,4a,5,6,7,8,8a-octahydro-1,4-endo-endo-1,4,5,8-dimethanonaphthalene; NCI-C00157

Trade Names: COMPOUND 269®; EN 57®; ENDREX®; ENDRICOL®; ENDRIN CHLORINATED HYDROCARBON INSECTICIDE®; HEXADRIN®; MENDRIN®; NENDRIN®; OKTANEX®

Chemical class: Organochlorine

EPA/OPP PC Code: 041601

California DPR Chemical Code: 262

HSDB Number: 198

UN/NA & ERG Number: UN2761 (solid)/151

RTECS® Number: IO1575000

EC Number: 200-775-7 [*Annex I Index No.:* 602-051-00-X]

Uses: Not approved for use in EU countries[115]. A U.S. EPA restricted Use Pesticide (RUP). It is a persistent and acutely toxic insecticide. Endrin is an insecticide which has been used to control insects, rodents, and birds, mainly on field crops such as cotton, maize, sugarcane, rice, cereals, ornamentals, and other crops. It has also been used for grasshoppers in non-cropland and to control voles and mice in orchards. Once widely used in the U.S., most uses were canceled in 1980 and it has not been produced nor sold in the U.S. since 1986. It is not easily dissolved in water and can remain in the soil for more than 14 years.

Human toxicity (long-term)[101]: High–2.00 ppb, MCL (Maximum Contaminant Level)

Fish toxicity (threshold)[101]: Extra high–0.00440 ppb, MATC (Maximum Acceptable Toxicant Concentration)

Regulatory Authority and Advisory Information:

Carcinogenicity[83]: EPA Group D, Not classifiable as a human carcinogen; IARC, Group 3 not classifiable as to its carcinogenicity in humans

California Proposition 65 Chemical: Developmental/Reproductive toxin 5/15/98

Health Advisory: Mutagen, Developmental/Reproductive Toxin, Endocrine disruptor (S!)

Clean Water Act: Section 311 Hazardous Substances/RQ 40CFR117.3 (same as CERCLA, see below); 40CFR423, Appendix A, Priority Pollutants

EPA Hazardous Waste Number (RCRA No.): P051; D012

RCRA Toxicity Characteristic (Section 261.24), Maximum Concentration of Contaminants, regulatory level, 0.02 mg/L

RCRA 40CFR268.48; 61FR15654, Universal Treatment Standards: Wastewater (mg/L), 0.0028; Non-wastewater (mg/kg), 0.13

RCRA 40CFR264, Appendix 9; TSD Facilities Ground Water Monitoring List. Suggested test method(s) (PQL ug/L): 8080(0.1); 8250(10)

Safe Drinking Water Act: MCL, 0.0002 mg/L; MCLG, 0.002 mg/L; Regulated chemical (47 FR 9352)

Superfund/EPCRA 302 Extremely Hazardous Substances: TPQ = 500/10,000 lb (227/4,540 kg)

Superfund/EPCRA 40CFR302.4 RQ: CERCLA, 1 lb (0.454 kg)

U.S. DOT Regulated Marine Pollutant (49CFR172.101, Appendix B), severe pollutant

Mexico, Drinking Water Criteria, 0.07 mg/L

List of Stockholm Convention POPs: Annex A (Elimination)

European/International Regulations: Hazard Symbol: T+, N; risk phrases R24; R28; R50/53; safety phrases: S1/2; S21; S22; S36/37; S45; S60; S61 (see Appendix 1)

WGK (German Aquatic Hazard Class): 3-Severe hazard to waters

Description: Endrin is the common name of one member of the cyclodiene group of pesticides. It is a cyclic hydrocarbon having a chlorine-substituted, methano-bridge structure. Endrin is a white, crystalline solid. Commercial products may be in liquid forms: emulsifiable concentrates, wettable powders, etc. Molecular weight = 380.90; Specific gravity (H_2O:1) = 1.7 @ 20°C; Boiling point = (decomposes) 245°C; Freezing/Melting point = (decomposes) 200°C; Vapor pressure = 2×10^{-7} mmHg @ 20°C. *Mixture in xylene:* Flash point = 27°C. Explosive limits (*in xylene*): LEL = 1.1%; UEL = 7.0%. Hazard Identification (based on NFPA-704 M Rating System): Health 4, Flammability 1, Reactivity 0. Low solubility in water. Physical and toxicological properties may be affected by carrier solvents in commercial formulations.

Incompatibilities: Keep away from parathion, strong acids (forms explosive vapors), strong oxidizers. Slightly corrosive to metals. Toxic hydrogen chloride and phosgene may be generated when solution burns.

Permissible Exposure Limits in Air: OSHA PEL: 0.1 mg/m^3 TWA[skin]

NIOSH REL: 0.1 mg/m^3 TWA[skin]

ACGIH TLV®[1]: 0.1 mg/m^3 TWA[skin]; not classifiable as a human carcinogen

NIOSH IDLH: 2 mg/m^3

Protective Action Criteria (PAC) Ver. 27[89]

PAC-1: 1.8 mg/m^3
PAC-2: 20 mg/m^3
PAC-3: 2000 mg/m^3

DFG MAK: 0.1 mg/m^3, measured as the, inhalable fraction TWA; Peak Limitation Category II(8); [skin]; Pregnancy Risk Group C

Determination in Air: Collection by filter/chromosorb tube-102; workup with toluene; analysis by gas chromatography/electrochemical detection; NIOSH IV, Method #5519[18].

Permissible Concentration in Water: Federal Drinking Water Standards: EPA 2 μg/L; State Drinking Water Guidelines: Arizona 0.32 μg/L. To protect freshwater aquatic life: 0.0023 μg/L as a 24 hr average, never to exceed 0.18 μg/L. To protect saltwater aquatic life: 0.0023 μg/L as a 24 hr average, never to exceed 0.037 μg/L. To protect human health: 1.0 μg/L[6]. The U.S. EPA has derived a no-observed-adverse effects-level (NOAE) of 0.045 mg/kg/day on the basis of which they have arrived at a long-term health advisory of 16 μg/L and a lifetime health advisory of 0.32 μg/L. Acceptable Daily Intake (ADI) = 0.0002 mg/kg.

Determination in Water: EPA Method D3086. GC method with ECD for the determination of organochlorine pesticides in water and wastewater. Methylene chloride extraction followed by gas chromatography with electron capture or halogen-specific detection (EPA Method 608) or gas chromatography plus mass spectrometry (EPA Method 625). Log K_{ow} = >4.0. Values at or above 3.0 are likely to bioaccumulate in marine organisms.

Routes of Entry: Inhalation, skin absorption, ingestion, skin and/or eye contact. It is rapidly absorbed through the skin.

Harmful Effects and Symptoms: Endrin is extremely toxic. Symptoms appear between 20 minutes and 12 hours following exposure. There is evidence that this material may cause chromosomal damage. Doses of 1 mg/kg can cause symptoms. It is a suspected carcinogen. Also, it is a central nervous system depressant and hepatotoxin. Pregnant women are considered to be at special risk[83].

Short Term Exposure: *signs and symptoms of endrin exposure*: Signs and symptoms of acute exposure to endrin may be severe and include headache, dizziness, deafness, agitation, nervousness, tremors, frothing of the mouth, seizures, and coma. Convulsive episodes may alternate with periods of severe central nervous system depression. Nausea, vomiting, and diarrhea are common. Hypertension (high blood pressure), tachycardia (rapid heart rate), and cardiac arrhythmias (abnormal heart beating) may be noted. Respiratory depression may lead to respiratory arrest. Contact with the skin, eyes, and mucous membranes may result in redness and irritation. Victims often have an elevated temperature. Contact can irritate the skin and eyes and may affect vision. Inhalation can cause irritation of the respiratory tract. Exposure can cause headache, nausea, vomiting, diarrhea, loss of appetite, sweating and weakness, lightheadedness, dizziness, convulsions and unconciousness. Lower exposure can affect concentration, memory and muscle coordination. Endrin can cause death by respiratory arrest. Symptoms include headache, nausea, vomiting, dizziness, tremors, convulsions, loss of consciousness, rise in blood pressure, fever, frothing of the mouth, deafness, coma, and death. This material is extremely toxic. It is rapidly absorbed through the skin. Symptoms appear between 20 minutes and 12 hours after exposure. Doses of 1 mg/kg can cause symptoms. Also, it is a central nervous system depressant and hepatotoxin. Inhalation may cause irritation to nose and throat, and sudden convulsions, which may occur from 30 minutes to 10 hours after exposure. Recovery is usually rapid, but headache, dizziness, lethargy, weakness, and weight loss may persist to 2 to 4 weeks. Prolonged breathing or ingestion can result in an onset of symptoms in 3 hours at a dose of 1 mg per kg of body weight. Ingestion of 12 grams has caused death. Pregnant women are considered to be at special risk. LD_{50} (oral, rat) = 3 mg/kg; LD_{50} (dermal, rat) = 12 mg/kg.

Long Term Exposure: May cause tumors. Organochlorine pesticides are highly toxic to mammals and will accumulate in the tissues of living organisms. May damage the developing fetus. May damage the nervous system, causing numbness and weakness in the extremities. Repeated exposure may cause personality changes of depression, anxiety and/or irritability. May cause anorexia. High or repeated exposure may cause liver damage. Studies in animals confirm that endrin's main target is the nervous system. Birth defects, especially abnormal bone formation, have been seen in some animal studies.

Points of Attack: Respiratory system, lungs, central nervous system, cardiovascular system, skin, eyes, plasma and red blood cell cholinesterase.

Medical Surveillance: Comprehensive physical examination with emphasis on the genito-urinary tract analysis to include sperm count, motility and morphology. Other tests, such as serum testosterone, serum follicle stimulating hormone (FSH), and serum lutenizing hormone (LH), may be carried out if, in the opinion of a physician, they are indicated. Before employment and at regular times after that, the following are recommended: Plasma and red blood cell cholinesterase levels (tests for the enzyme poisoned by this chemical). If exposure stops, plasma levels return to normal in 1–2 weeks while red blood cell levels may be reduced for 1–3 months. When acetylcholinesterase enzyme levels are reduced by 25% or more below preemployment levels, risk of poisoning is increased, even if results are in lower ranges of "normal." Reassignment to work not involving organophosphate or carbamate pesticides is recommended until enzyme levels recover. If symptoms develop or overexposure occurs, repeat the above tests as soon as possible and get an exam of the nervous system. Also consider complete blood count and chest x-ray following acute overexposure. Do not drink any alcoholic beverages before or during use. Alcohol promotes absorption of organophosphates. Examination of the nervous system. Electroencephalogram (a test for abnormal seizure activity). Blood endrin level. Liver and kidney function tests.

First Aid: *Emergency life-support procedures*: Acute exposure to endrin may require decontamination and life support for the victims. Emergency personnel should wear protective clothing appropriate to the type and degree of contamination. Air-purifying or supplied-air respiratory equipment should also be worn, as necessary. Rescue vehicles should carry supplies such as plastic sheeting and disposable plastic bags to assist in preventing spread of contamination. *Inhalation exposure:* Move victims to fresh air. Emergency personnel should avoid self-exposure to endrin. Evaluate vital signs including pulse and respiratory rate, and note any trauma. If no pulse is detected, provide CPR. If not breathing, provide artificial respiration. If breathing is labored, administer oxygen or other respiratory support. Obtain authorization and/or further instructions from the local hospital for administration of an antidote or performance of other invasive procedures. Transport to a health care facility. *Dermal/eye exposure:* Remove victims from exposure. Emergency personnel should avoid self-exposure to endrin. Evaluate vital signs including pulse and respiratory rate, and note any trauma. If no pulse is detected, provide CPR. If not breathing, provide artificial respiration. If breathing is labored, administer oxygen or other respiratory support. Remove contaminated clothing as soon as possible. If eye exposure has occurred, eyes must be flushed with lukewarm water for at least 15 minutes. Wash exposed skin areas three times. Wash initially with soap and water, follow with an alcohol wash, then again with soap and water. Obtain authorization and/or further instructions from the local hospital for administration of an antidote or performance of other invasive procedures. Transport to a health care facility. *Ingestion exposure:* Evaluate vital signs including pulse and respiratory rate, and note any trauma. If no pulse is detected, provide CPR. If not breathing, provide artificial respiration. If breathing is labored, administer oxygen or other respiratory support. Obtain authorization and/or further instructions from the local hospital for administration of an antidote or performance of other invasive procedures. Vomiting may be induced with syrup of ipecac. If elapsed time since ingestion of endrin is unknown or suspected to be greater than 30 minutes, do not induce vomiting and transport to a health card facility ipecac should not be administered to children under 6 months of age.

Warning: Ingestion of endrin may result in sudden onset of seizures or loss of consciousness. Syrup of ipecac should be administered only if victims are alert, have an active gag-reflex, and show no signs of impending seizure or coma. If *ANY* uncertainty exists, transport to a health card facility. The following dosages of ipecac are recommended: children up to 1 year old, 10 mL (1/3 oz); children 1 to 12 years old, 15 mL (1/2 oz); adults, 30 mL (1 oz). Ambulate (walk) the victims and give large quantities of water. If vomiting has not occurred after 15 minutes, ipecac may be readministered. Continue to ambulate and give water to the victims. If vomiting has not occurred within 15 minutes after second administration of ipecac, administer activated charcoal. Activated charcoal may be administered if victims are conscious and alert. Use 15 to 30 g (0.5 to 1 oz) for children, 50 to 100 g (1-3/4 to 3-1/2 oz) for adults, with 125 to 250 mL (0.5 to 1 cup) of water. Promote excretion by administering a saline cathartic or sorbitol to conscious and alert victims. Children require 15 to 30 g (0.5 to 1 oz.) of cathartic; 50 to 100 g (1-3/4 to 3-1/2 oz.) is recommended for adults. Transport to a health care facility[83].

Personal Protective Methods: Wear protective gloves and clothing to prevent any reasonable probability of dermal and/or eye contact. Safety equipment suppliers/manufacturers can provide recommendations on the most protective glove/clothing material for your operation. All protective clothing (suits, gloves, footwear, headgear) should be clean, available each day, and put on before work. Contact lenses should not be worn when working with this chemical. Wear dust-proof chemical goggles and face shield unless full facepiece respiratory protection is worn. Employees should wash immediately with soap when skin is wet or contaminated. Provide emergency showers and eyewash.

Respirator Selection: SCBA >1.8 mg/m^3 NIOSH: 1 mg/m^3: Any air-purifying half-mask respirator with organic vapor cartridge(s) in combination with an N95, R95, or P95 filter. The following filters may also be used: N99, R99, P99, N100, R100, P100; or Sa (APF = 10) (any supplied-air respirator); 2 mg/m^3: Sa:Cf (APF = 25) (any supplied-air respirator operated in a continuous-flow mode); PaprOvHie (APF = 25) (any air-purifying full facepiece respirator equipped with an organic vapor cartridge in combination with a high-efficiency particulate filter); or CcrFOv100 (APF = 50) [any air-purifying full facepiece respirator equipped with organic vapor cartridge(s) in combination with an N100, R100, or P100 filter]; or GmFOv100 (APF = 50) [any air-purifying, full facepiece respirator (gas mask) with a chin-style, front- or back-mounted organic vapor canister having an N100, R100, or P100 filter]; or SCBAF (APF = 50) (any self-contained breathing apparatus with full facepiece); or SaF (APF = 50) (any supplied-air respirator with a full facepiece). *Emergency or planned entry into unknown concentrations or IDLH conditions:* SCBAF: Pd,Pp (APF = 10,000) (any self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode); or SaF: Pd,Pp: ASCBA (APF = 10,000) (any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary self-contained breathing apparatus operated in a pressure-demand or other positive-pressure mode). *Escape:* GmFOv100 (APF = 50) [any air-purifying, full facepiece respirator (gas mask) with a chin-style, front- or back-mounted organic vapor canister having an N100, R100, or P100 filter]; or SCBAE (any appropriate escape-type, self-contained breathing apparatus).

Storage: Color Code-Blue: Health Hazard/Poison. Store in a secure poison location. Prior to working with endrin you should be trained on its proper handling and storage. Before entering confined space where this chemical may be present, check to make sure that an explosive concentration does not exist. Store in tightly closed containers in a cool, well-ventilated area away from oxidizers and heat. Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: Organochlorine pesticides, liquid or solid require a “poisonous materials” label. They fall in Hazard Class 6.1. Endrin may be in Packing Group I.

Spill Handling: For leaks or spills, use water spray to disperse vapor and to flush spills. Liquid containing this material should be absorbed in vermiculite, dry sand, or earth. Do not touch spilled material; stop leak if you can do it without risk. Establish forced ventilation to keep levels below explosive limit. *Small dry spills*: collect powdered material in the most convenient and safe manner and deposit in sealed containers; move containers from spill area. *Large spills*: dike far ahead of spill for later disposal. Keep unnecessary people away; isolate hazard area and deny entry. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable.

Fire Extinguishing: Hazardous decomposition includes oxides of carbon and phosgene and hydrogen chloride gases. Endrin itself does not burn but it may be dissolved in a flammable liquid. *On a small fire:* use dry chemical, CO_2 or water spray. *On a large fire:* use water spray, fog or regular foam. Move containers from fire area if you can do it without risk. Dike fire-control water for later disposal; do not scatter the material. Use water spray or fog; do not use straight streams. *Fire involving storage or vehicular tanks:* isolate for 800 meters/0.5 mile in all directions; also, consider initial evacuation for 800 meters/0.5 mile in all directions. Fight fire from maximum distance or use unmanned hose holders or monitor nozzles. Do not get water inside containers. Cool containers with flooding quantities of water until well after fire is out. Withdraw immediately in the case of rising sound from venting safety devices or discoloration of tank. *Always* stay away from tanks engulfed in fire. For massive fire, use unmanned hose holders or monitor nozzles; if this is impossible, withdraw from area and let fire burn. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies.

Disposal Method Suggested: A disposal procedure recommended by the manufacturer consists of absorption, if necessary, and burial at least 18 inches deep; preferably in sandy soil in a flat or depressed location away from wells, livestock, children, wildlife, etc. Incineration is the recommended method. Consult with environmental regulatory agencies for guidance on acceptable disposal practices. Generators of waste containing this contaminant (≥100 kg/mo) must conform with EPA regulations governing storage, transportation, treatment, and waste disposal. In accordance with 40CFR165, follow recommendations for the disposal of pesticides and pesticide containers. Containers must be disposed of properly by following package label directions or by contacting your local or federal environmental control agency, or by contacting your regional EPA office.

References:

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- U.S. Department of Health and Human Services; Agency for Toxic Substances and Disease Registry, "ToxFAQs for Endrin," Atlanta, GA (September 1997). http://www.atsdr.cdc.gov/tfacts89.html
- New Jersey Department of Health and Senior Services, "Hazardous Substance Fact Sheet: Endrin," Trenton, NJ (December, 1998). http://www.state.nj.us/health/eoh/rtkweb/0825.pdf
- USEPA, Endrin: Ambient Water Quality Criteria, Washington DC (1980)
- USEPA, Reviews of the Environmental Effects of Pollutants: XIII, Endrin, Report EPA-600/1-79-005, Cincinnati, OH (1979)
- USEPA, Endrin, Health and Environmental Effects Profile No. 99, Washington DC, Office of Solid Waste (April 30, 1980)
- Sax, N. I., Ed., "Dangerous Properties of Industrial Materials Report," 1, No. 5, 55-57 (1981)
- USEPA, "Chemical Profile: Endrin," Washington DC, Chemical Emergency Preparedness Program (November 30, 1987)
- New York State Department of Health, "Chemical Fact Sheet: Endrin," Albany, NY, Bureau of Toxic Substance Assessment (August 1987)

EPN E:0170

Use Type: Insecticide

CAS Number: 2104-64-5

Formula: $C_{14}H_{14}NO_4PS$

Synonyms: ENT 17,798; *O*-Ester-*p*-nitrophenol with *O*-ethylphenyl phosphonothioate; Ethoxy-4-nitrophenoxyphenylphosphine sulfide; *O*-Ethyl-*O*-(4-nitrophenyl)-benzenethionophosphonate; Ethyl-*p*-nitrophenyl benzenethionophosphonate; Ethyl-*p*-nitrophenyl benzenethionophosphate; Ethyl-*p*-nitrophenyl benzenethiophosphonate; Ethyl-*p*-nitrophenyl phenylphosphonothioate; *O*-Ethyl-*O*-*p*-nitrophenyl phenylphosphonothioate; *O*-Ethyl-*O*-(4-nitrophenyl phenyl)phenylphosphonothioate; *O*-Ethyl-*O*-*p*-nitrophenyl phenylphosphonothioate; Ethyl-*p*-nitrophenyl thionobenzenephosphate; *O*-Ethyl phenyl-*p*-nitrophenylthiophosphonate; Thionobenzenephosphonic acid ethyl-*p*-nitrophenyl ester

Trade Names: NIAGARA®[C]; PIN®; SANTOX®; TRIPLE KILL T®[C]; VETO®[C]

Chemical class: Organophosphate

EPA/OPP PC Code: 041801

California DPR Chemical Code: 263

HSDB Number: 4049

UN/NA & ERG Number: UN2783 (solid)/152

RTECS® Number: TB1925000

EC Number: 218-276-8 [*Annex I Index No.:* 015-036-00-2]

Uses: Banned for use in the EU. All registered uses of EPN in the U.S. were canceled by the U.S. EPA on August 31, 1988. Effective June 9, 1993, the U.S. EPA announced the revocation of all tolerances for residues of the insecticide EPN in or on various agricultural commodities. These tolerances are listed in 40 CFR 180.119. There are 21 global suppliers[97].

Human toxicity (long-term)[101]: Extra high–0.07 ppb, Health Advisory

Fish toxicity (threshold)[101]: High–1.51635 ppb, MATC (Maximum Acceptable Toxicant Concentration)

Regulatory Authority and Advisory Information:
Carcinogenicity[83]: ACGIH, A4 Not classifiable as a human carcinogen.
Acute Oral Category: 1, DANGER–POISON
Health Advisory: Nerve Toxin, Developmental/Reproductive Toxin
U.S. DOT 49CFR172.101, Inhalation Hazard Chemical as organophosphates
Superfund/EPCRA 302 Extremely Hazardous Substances: TPQ = 100/10,000 lb (45.4/4,540 kg)
Superfund/EPCRA 40CFR302.4 RQ: EHS, 1 lb (0.454 kg)
European/International Regulations: Hazard Symbol: T+, N; risk phrases: R27/28; R50; R53; safety phrases: S1/2; S22; S36/37; S45; S60; S61 (see Appendix 1)

Description: EPN is a light yellow crystalline solid or liquid. A brown liquid above 36°C. Aromatic odor (as a pesticide). Molecular weight = 323.32; Specific gravity (H_2O:1) = 1.268 @ 25°C; Freezing/Melting point = 36°C; Vapor pressure = 3.4×10^{-7} mmHg @ 20°C. Hazard Identification (based on NFPA-704 M Rating System): Health 4, Flammability 1, Reactivity 0. Low solubility in water. Physical and toxicological properties may be affected by carrier solvents in commercial formulations.

Incompatibilities: Reaction with oxidizers. Contact with alkalies causes decomposition (hydrolysis) producing *p*-nitrophenol. In the presence of strong reducing agents such as hydrides, organophosphates form highly toxic and flammable phosphine gas. Contact with oxidizers can cause the release of toxic oxides of phosphorus.

Permissible Exposure Limits in Air: OSHA PEL: 0.5 mg/m^3 TWA [skin]
NIOSH REL: 0.5 mg/m^3 TWA [skin]
ACGIH TLV®[1]: 0.1 mg/m^3 TWA inhalable fraction [skin]; not classifiable as a human carcinogen (2000); BEI$_A$ issued as Acetylcholinesterase inhibiting pesticides.
NIOSH IDLH: 5 mg/m^3
Protective Action Criteria (PAC) Ver. 27[89]
PAC-1: 0.45 mg/m^3
PAC-2: 5 mg/m^3
PAC-3: 50 mg/m^3

Determination in Air: OSHA versatile sampler-2; Toluene/Acetone; Gas chromatography/Flame photometric detection for sulfur, nitrogen, or phosphorus; NIOSH IV Method #5600[18], Organophosphorus pesticides. Collection on a filter, workup with isooctane, Gas chromatography/Flame photometric detection for sulfur, nitrogen, or phosphorus; NIOSH IV, Method #5012[18].

Permissible Concentration in Water: State Drinking Water Standards: Florida 0.2 μg/L. Japan[35] has set an effluent maximum of 1 mg/L and an environmental water quality standard of zero.

Determination in Water: NIOSH Method 1657. The determination of organophosphorus pesticides in municipal and industrial wastewater by gas chromatography. Detection limit = 6.0 *n*g/L. Log K_{ow} = >4.0. Values at or above 3.0 are likely to bioaccumulate in marine organisms.

Routes of Entry: Inhalation, ingestion, skin absorption, skin and/or eye contact. Passes through the skin.

Harmful Effects and Symptoms: Organophosphates are highly toxic. Symptoms may develop rapidly, or there may be a delay of several hours following exposure before they become noticeable. The delay tends to be longer in the case of some compounds that dissolve fats, lipids, oils and non-polar solvents such as toluene. Symptoms may increase in severity for more than a single day and last for several days. In severe cases of organophosphate intoxication, respiratory failure may occur.

Short Term Exposure: an acetylcholinesterase inhibitor. EPN can affect the nervous system, causing convulsions and possible respiratory failure. Exposure may result in unconsciousness or death. The effects may be delayed. Medical observation is indicated. This material may be fatal is swallowed. It is poisonous if inhaled and extremely hazardous by dermal and/or eye contact. Repeated exposure may, without symptoms, be increasingly hazardous. The estimated fatal oral dose is 0.3 grams for a 150 lb (70 kg) person. Acute exposure to EPN may produce the following signs and symptoms: pinpoint pupils, blurred vision, headache, dizziness, muscle spasms, and profound weakness. Vomiting, diarrhea, abdominal pain, seizures, and coma may also occur. The heart rate may decrease following oral exposure or increase following dermal exposure. Hypertension (high blood pressure) is not uncommon. Respiratory symptoms include dyspnea (shortness of breath), respiratory depression and respiratory paralysis. Giddiness, slurred speech, confusion, and psychosis may also be observed. A rebuttable presumption against pesticide registration was issued for EPN on September 19, 1979 by EPA on the basis of neurotoxicity. Delayed pulmonary edema may occur after inhalation. LD_{50} (oral, rat) = 7–38 mg/kg; LD_{50} (dermal, rat) = 25 mg/kg.

Long Term Exposure: Cholinesterase inhibitor; cumulative effect is possible. EPN may damage the nervous system with repeated exposure, resulting in convulsions, respiratory failure. May cause liver damage. Neutoxic.

Points of Attack: Respiratory system, lungs, cardiovascular system, central nervous system, eyes, skin, blood cholinesterase. Neutoxic.

Medical Surveillance: Medical observation is recommended for 24 to 48 hours following breathing overexposure, as pulmonary edema may be delayed. Routine biological monitoring of pesticide applicators and field workers includes testing of plasma and red blood cell acetylcholinesterase levels (for enzyme poisoned by this chemical). These tests are normally accurate only if done within about two hours of exposure. If exposure stops, plasma levels return to normal in 1–2 weeks while red blood cell levels may be reduced for 1–3 months. When acetylcholinesterase enzyme levels are reduced by 25% or more below preemployment levels, risk of poisoning is increased, even if results are in lower ranges of "normal." Reassignment to work not involving organophosphate pesticides is recommended until enzyme levels recover. Do not drink any alcoholic beverages before or during use as it promotes absorption of organophosphates.

First Aid: **Treatment for organophosphate poisoning consists of thorough decontamination, cardiorespiratory support, and administration of the antidotes atropine and pralidoxime. In cases of severe poisoning, diazepam, an anticonvulsant, should also be administered. Antidotes should be administered as prevention even if the diagnosis is in doubt**. Speed in removing material from eyes and skin is of extreme importance. *Eyes:* Eye contact can cause dangerous amounts of these chemicals to be quickly absorbed through the mucous membrane into the bloodstream. Immediately and gently flush eyes with plenty of warm or cold water (NO hot water) for at least 15 minutes, occasionally lifting the upper and lower eyelids. Get medical aid immediately. *Skin:* Get medical aid. Dermal contact can cause dangerous amounts of these chemicals to be absorbed into the bloodstream. Wearing the appropriate PPE equipment and respirator for organophosphate pesticides, immediately flush skin with plenty of soap and water for at least 15 minutes while removing contaminated clothing and shoes. Shampoo hair promptly if contaminated. The removed, contaminated clothing and shoes should be double-bagged and left in Hot Zone for later disposal by hazardous materials experts. Skin may also be decontaminated with diluted hypochlorite solution. *Inhalation:* Get medical aid. Do not contaminate yourself. Wearing the appropriate PPE equipment and respirator for organophosphate pesticides, immediately remove the victim from the contaminated area to fresh air. If the victim is not breathing, administer artificial respiration. Do not use mouth-to-mouth method if victim ingested or inhaled the substance; give artificial respiration with the aid of a pocket mask equipped with a one-way valve or other proper respiratory medical device. If breathing is difficult, administer oxygen through bag/mask apparatus until medical help arrives. Do not leave victim unattended. *Ingestion:* Call poison control. Loosen all clothing. Never give anything by mouth to an unconscious person. If victim is *unconscious or having convulsions,* do nothing except keep victim warm. Get medical aid. Transfer promptly to a medical facility. In cases of ingestion, **do not induce vomiting**. If the victim is alert and asymptomatic, administer a slurry of activated charcoal at a dose of 1 g/kg (infant, child, and adult dose). A soda can and straw may be of assistance when offering charcoal to a child. *In some cases you may be specifically instructed by poison control to induce vomiting by way of 2 tablespoons of syrup of ipecac (adult) washed down with a cup of water*. Do NOT give activated charcoal before or with ipecac syrup

Note to physician or authorized medical personnel: Treat cases of respiratory compromise, coma, or excessive pulmonary secretions with respiratory support using protocols and techniques available and within the scope of training. Some cases may necessitate procedures such as endotracheal intubation or cricothyrotomy by properly trained and equipped personnel. When possible, atropine (see *Antidotes*, below) should be given under medical supervision. Patients who are comatose, hypotensive, or having seizures or cardiac arrhythmias should be treated according to advanced life support protocols. *Antidotes:* Two antidotes are administered to treat organophosphate poisoning. Atropine is a competitive antagonist of acetylcholine at muscarinic receptors and is used to control the excessive bronchial secretions which are often responsible for death. Pralidoxime relieves both the nicotinic and muscarine effects of organophosphate poisoning by regenerating acetylcholinesterase and can reduce both the bronchial secretions and the muscle weakness associated with poisoning. The initial intravenous dose of atropine in adults should be determined by the severity of symptoms: An initial adult dose of 1.0 to 2.0 mg or pediatric dose of 0.01 mg/kg (minimum 0.01 mg) should be administered intravenously. If intravenous access cannot be established, atropine may also be given intramuscularly, subcutaneously or via endotracheal tube. Doses should be repeated every 15 minutes until excessive secretions and sweating have been controlled. Once bronchial secretion has been controlled, atropine administration should be repeated whenever the secretions begin to recur. In seriously poisoned patients, very large doses may be required. Alterations of pulse rate and pupillary size should not be used as indicators of treatment adequacy. Pralidoxime should be administered as early in poisoning as possible as its efficacy may diminish when given more than 24 to 36 hours after exposure. Doses are as follows: adult 1.0 g; pediatric 25 to 50 mg/kg. The drug should be administered intravenously over 30 to 60 minutes, but in a life-threatening situation one-half of the total dose can be given per minute for a total administration time of 2 minutes. Treatment should begin to take effect within 40 minutes with a reduction in symptoms and the amount of atropine necessary to control bronchial secretion. The initial dose can be repeated in 1 hour and then every 8 to 12 hours until the patient is clinically well and no longer requires atropine. If intravenous access cannot be established, pralidoxime may also be given intramuscularly. Early administration of diazepam in addition to the combined atropine and pralidoxime treatment may help prevent the onset of seizures and potential brain and cardiac morphologic damage following high-level organophosphate poisoning.

Respirator Selection: SCBA > 0.45 mg/m^3. Wherever and whenever workplace conditions warrant respirator use, a respiratory protection program must be followed that meets one or more of the following government standards: OSHA's 29 CFR 1910.134, ANSI Z88.2, or European Standard EN 149.

Storage: Color Code-Blue: Health Hazard/Poison. Store in a secure poison location. Prior to working with this chemical, you should be trained on its proper handling and storage. Store in tightly closed containers in a cool, well- ventilated area away from strong bases. Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: Organophosphorus pesticides, solid or liquid (nonflammable), require a “poisonous materials” label. This chemical falls in Hazard Class 6.1.

Spill Handling: First remove all sources of ignition. Evacuate persons not wearing protective equipment from area of spill or leak until clean up is complete. Stay upwind; keep out of low areas. Ventilate area of spill or leak. Remove and isolate contaminated clothing at the site. Do not touch spilled material; stop leak if you can do so without risk. Use water spray to reduce vapors. *Small spills:* absorb with sand or other noncombustible absorbent material and place into containers for later disposal. *Large spills:* dike far ahead of spill for later disposal. Collect powdered material in the most convenient and safe manner and deposit in sealed containers. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable. Seek professional environmental engineering assistance from the U.S. EPA Environmental Response Team at (908) 548-8730 (24-hour response line).

Fire Extinguishing: Hazardous decomposition includes hydrogen chloride and oxides of phosphorus, sulfur, and nitrogen. May be fatal if inhaled, ingested or absorbed through skin. Inhalation or contact with some of these materials will irritate or burn skin and eyes. Vapors may cause dizziness or suffocation. *Small fires:* dry chemical, carbon dioxide; water spray; or foam. *Large fires:* water spray, fog, or foam. Stay upwind; keep out of low areas. Ventilate closed spaces before entering them. Firefighting gear (including SCBA) may not provide adequate protection. If exposure occurs, remove and isolate gear immediately and thoroughly decontaminate personnel. Wear positive-pressure breathing apparatus and special protective clothing. Remove and isolate contaminated clothing at the site. Move container from fire area if you can do so without risk. Fight fire from maximum distance. Dike fire control water for later disposal; do not scatter the material. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies. From a secure, explosion-proof location, use water spray to cool exposed containers. If cooling streams are ineffective (venting sound increases in volume and pitch, tank discolors, or shows any signs of deforming), withdraw immediately to a secure position. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode.

Disposal Method Suggested: Destruction by alkali hydrolysis or incineration. Containers must be disposed of properly by following package label directions or by contacting your local or federal environmental control agency, or by contacting your regional EPA office. Extra care must be exercised as the material in an organic solvent is highly flammable.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- Pesticide Management Education Program, "EPN Tolerance Revocation 5/93," Cornell University, Ithaca, NY (May 1993) http://pmep.cce.cornell.edu/profiles/insect-mite/ddt-famphur/epn/epn-rev-tol.html
- USEPA, "Chemical Profile: EPN," Washington DC, Chemical Emergency Preparedness Program (November 30, 1987)
- Agency for Toxic Substances and Disease Registry, U.S. Department of Health and Human Services, Public Health Service, "Managing Hazardous Materials Incidents," Atlanta, GA (June 2003)
- New Jersey Department of Health and Senior Services, "Hazardous Substance Fact Sheet, EPN," Trenton, NJ (May 1999). http://www.state.nj.us/health/eoh/rtkweb/0829.pdf

EPTC E:0185

Use Type: Herbicide

CAS Number: 759-94-4

Formula: $C_9H_{19}NOS$

Synonyms: Carbamic acid, dipropylthio-, *S*-ethyl ester; Carbamothioic acid, dipropyl-, *S*-ethyl ester; Caswell No. 435; dipropylcarbamothioic acid *S*-ethyl ester; *N,N*-dipropylthiocarbamic acid *S*-ethyl ester; Ethyl di-*N*-propylthiolcarbamate; *S*-Ethyl dipropylcarbamothioate; Ethyl *N,N*-dipropylthiocarbamate; Ethyl dipropylthiocarbamate; *S*-Ethyl dipropylthiocarbamate; *S*-Ethyldipropylthiocarbamate; *S*-Ethyl-*N,N*-di-*N*-propylthiocarbamate; Ethyl *N,N*-di-*N*-propylthiolcarbamate; Ethyl *N,N*-dipropylthiolcarbamate; FDA 1541; NSC 40486

Trade Names: ALIROX®; EPTAM®; EPTAM® 6E; EPTAM 2.3G (granular, 2.3% by weight); EPTAM 10G (granular, 10% by weight); ERADICANE®; GENEP® EPTC; R-1608®; SHORTSTOP®; STAUFFER® R 1608; TORBIN®

Chemical class: Thiocarbamate

EPA/OPP PC Code: 041401

California DPR Chemical Code: 264

HSDB Number: 394 as EPTAM

UN/NA & ERG Number: UN2902/151

RTECS® Number: FA4550000

EC Number: 212-073-7 [*Annex I Index No.:* 006-030-00-0]

Uses: Some formulations are Restricted Group Pesticides (RUP). EPTC is a pre-emergence and early post-emergence herbicide used to control the growth of germinating annual weeds, including broadleaves, grasses, and sedges. It is used in every region of the United States in the production of a wide variety of food crops. The heaviest usage is in the Corn Belt, Northeastern and Mid-Atlantic states, Coastal and Northern Great Plains and in the Pacific Northwest on corn, potatoes, sweet potatoes, dry beans, peas, alfalfa, and snap beans. EPTC is also used on home-grown vegetables and ornamentals. Not approved for use in EU countries[115]. Registered for use in the U.S. and other countries.

U.S. Maximum Allowable negligible (N) Residue Levels for EPTC S-ethyl dipropylthiocarbamate [40 CFR 180.117]: in or on the following raw agricultural commodities: almonds, hulls 0.1 ppm (N); asparugus 0.1 ppm (N); beans, castor 0.1 ppm (N); cotton, forage 0.1 ppm (N); cottonseed 0.1 ppm (N); flaxseed 0.1 ppm (N); fruits, citrus 0.1 ppm (N); fruits, small 0.1 ppm (N); grain crops 0.1 ppm (N); grasses, forage 0.1 ppm (N); legumes, forage 0.1 ppm (N); nuts 0.1 ppm (N); pineapples 0.1 ppm (N); safflower, seed 0.1 ppm (N); strawberries 0.1 ppm (N); sunflower, seed 0.1 ppm (N); vegetables, fruiting 0.1 ppm (N); vegetables, leafy 0.1 ppm (N); vegetables, root crop 0.1 ppm (N); vegetables, seed and pod 0.1 ppm (N). (N) = negligible amount of residue.

Human toxicity (long-term)[101]: Very low–175.00 ppb, Health Advisory

Fish toxicity (threshold)[101]: Very low–1848.27939 ppb, MATC (Maximum Acceptable Toxicant Concentration)

Regulatory Authority and Advisory Information:

Carcinogenicity[83]: EPA, Not likely to be carcinogenic to humans.

California Proposition 65 Chemical: Developmental/Reproductive toxin (4/27/1999)

Acute Oral Category: 3, CAUTION

Health Advisory: Nerve Toxin, Mutagen, Developmental toxin (TRI)

Potential Ground Water Pollutant [California FAC Section 13145(d)/12811, active]

EPA Hazardous Waste Number (RCRA No.): U390

RCRA Universal Treatment Standards: Wastewater (mg/L), 0.003; Non-wastewater (mg/kg), 1.4

EPCRA Section 313 Form R *de minimus* concentration reporting level: 1.0%

European/International Regulations: Hazard Symbol: Xn; risk phrases: R22; R50/53; safety phrases: S2; S23 (see Appendix 1)

Description: Light yellow liquid or yellow granular material. Commercial products may be in the form of dusts, sprays, solutions, wettable powder suspensions or emulsions. Molecular weight = 189.35; Specific gravity (H_2O:1) = 0.995 @ 20°C; Boiling point = 127.22°C at 20 mmHg[88]; Vapor pressure = 0.034 mmHg @ 35°C[88]; 2.4×10^{-2} mmHg @ 25°C[83,USDA]; Flash point = 115°C. Low solubility in water; solubility = <1 mg/mL@ 22.5°C[88]; 370 ppm. Physical and toxicological properties may be affected by carrier solvents in commercial formulations.

Incompatibilities: Reacts violently with powerful oxidizers such as calcium hypochlorite. Slowly decomposes in water, forming carbon disulfide and propyl amine; this decomposition is accelerated by the presence of acids. Flammable gases are generated by the combination of thiocarbamates with aldehydes, nitrides, and hydrides. Thiocarbamates are incompatible with acids, peroxides, and acid halides.

Determination in Water: Log K_{ow} = >3.0. Values at or above 3.0 are likely to bioaccumulate in marine organisms.

Routes of Entry: Inhalation, ingestion, dermal and/or eye contact.

Harmful Effects and Symptoms

Short Term Exposure: Some thiocarbamates may react with recently ingested alcohol or alcohol-containing products including wine, medications, and cold remedies such as cough-syrups. Low toxicity. Concentrated solutions are slightly corrosive to eyes and mucous membranes. Dust inhalation can cause irritation of the respiratory system with sneezing. Eye contact can cause irritation, watering, pain, and inflammation of the eyelids. Dermal contact can cause irritation and minor ulceration. Ingestion can cause nausea, vomiting, fever, muscle twitching, seizure, rapid respiration, slow heart beat. Severe exposure may result in death. LD_{50} (oral, rat) = 900–1000 mg/kg; LD_{50} (dermal, rat) = >3000 mg/kg.

Long Term Exposure: A cholinesterase inhibitor. A neurotoxin.

Points of Attack: Respiratory system, central nervous system, cardiovascular system, skin, eyes.

Medical Surveillance: Preliminary medical exam to detect chronic diseases of central nervous system, liver, heart, kidneys, lung and skin, as well as endocrinological or immunological disturbances, should protect susceptible individuals. Periodical medical exams of internal organs, skin and eyes are important to avoid chronic occupational intoxications. They should include lab and patch tests when necessary[83]. Comprehensive physical examination with emphasis on the genito-urinary tract analysis to include sperm count, motility and morphology. Other tests, such as serum testosterone, serum follicle stimulating hormone (FSH), and serum lutenizing hormone (LH), may be carried out if, in the opinion of a physician, they are indicated. Medical observation is recommended for 24 to 48 hours following breathing overexposure, as pulmonary edema may be delayed. Cigarette smoking may exacerbate pulmonary injury and should be discouraged for at least 72 hours following exposure. Before employment and at regular times after that, the following are recommended: If symptoms develop or overexposure occurs, repeat the above tests as soon as possible and get an exam of the nervous system. Also consider complete blood count and chest x-ray following acute overexposure

First Aid: If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least 15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately. If this chemical contacts the skin, remove contaminated clothing and wash immediately with soap and water. Seek medical attention immediately. If this chemical has been inhaled, remove from exposure, begin rescue breathing (using universal precautions) if breathing has stopped, and CPR if heart action has stopped. Transfer promptly to a medical facility. When this chemical has been swallowed, get medical attention. If victim is conscious and able to swallow, have victim drink 4 to 8 ounces of water.

Do not induce vomiting. *Note to physician or authorized medical personnel*: Medical observation is recommended for 24 to 48 hours following breathing overexposure, as pulmonary edema may be delayed. As first aid for pulmonary edema, a doctor or authorized paramedic might consider administering a corticosteroid spray. Cigarette smoking may exacerbate pulmonary injury and should be discouraged for at least 72 hours following exposure.

Personal Protective Methods: Reacts with the following absorbent materials: Cellulose-Based; Mineral- and Clay-Based; Dirt/Earth[88]. Wear protective gloves and clothing to prevent any reasonable probability of dermal and/or eye contact. Safety equipment suppliers/manufacturers can provide recommendations on the most protective glove/clothing material for your operation. All protective clothing (suits, gloves, footwear, headgear) should be clean, available each day, and put on before work. Contact lenses should not be worn when working with this chemical. Wear splash-proof chemical goggles and face shield unless full facepiece respiratory protection is worn. Employees should wash immediately with soap when skin is wet or contaminated. Provide emergency showers and eyewash.

Respirator Selection: *At any detectable concentration:* SCBAF: Pd,Pp (APF = 10,000) (any NIOSH/MSHA- or European Standard EN 149-approved self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode); or SaF: Pd,Pp: ASCBA (APF = 10,000) (any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary, self-contained breathing apparatus operated in a pressure-demand or other positive-pressure mode). *Escape:* 100F (APF = 50) (any air-purifying, full facepiece respirator with an N100, R100, or P100 filter k-mounted organic vapor canister having a high-efficiency particulate filter); or SCBAE (any appropriate escape-type, self-contained breathing apparatus).

Storage: Color Code-Blue: Health Hazard/Poison. Store in a secure poison location. Prior to working with EPTC you should be trained on its proper handling and storage. Store in tightly closed containers in a cool, well-ventilated area away from alkalies. A regulated, marked area should be established where this chemical is handled, used, or stored in compliance with OSHA Standard 1910.1045. Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: Pesticides, liquid, toxic, n.o.s., require a shipping label of "poisonous materials." This material falls in DOT Hazard Class 6.1. Technical name required.

Spill Handling: Evacuate and restrict persons not wearing protective equipment from area of spill or leak until clean up is complete. Ventilate area of spill or leak. Absorb liquids in vermiculite, dry sand, earth, peat, carbon, or a similar material and deposit in sealed containers. Keep this chemical out of a confined space, such as a sewer, because of the possibility of an explosion, unless the sewer is designed to prevent the build-up of explosive concentrations. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable.

Fire Extinguishing: A combustible liquid. Hazardous decomposition includes oxides of nitrogen, sulfur, and carbon. *On a small fire:* use dry chemical, CO_2 or water spray. *On a large fire:* use water spray, fog or regular foam. Move containers from fire area if you can do it without risk. Dike fire-control water for later disposal; do not scatter the material. Use water spray or fog; do not use straight streams. *Fire involving storage or vehicular tanks:* isolate for 800 meters/0.5 mile in all directions; also, consider initial evacuation for 800 meters/0.5 mile in all directions. Fight fire from maximum distance or use unmanned hose holders or monitor nozzles. Do not get water inside containers. Cool containers with flooding quantities of water until well after fire is out. Withdraw immediately in the case of rising sound from venting safety devices or discoloration of tank. ALWAYS stay away from tanks engulfed in fire. For massive fire, use unmanned hose holders or monitor nozzles; if this is impossible, withdraw from area and let fire burn. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies. a pressure-demand or other positive-pressure mode.

Disposal Method Suggested: Land burial is acceptable for small quantities. Larger quantities can be incinerated. EPTC is combustible and could be incinerated. Recommendable method: Incineration. Peer-review: Incineration in a unit with effluent gas scrubbing is recommendable for large amounts. Containers must be disposed of properly by following package label directions or by contacting your local or federal environmental control agency, or by contacting your regional EPA office. Consult with environmental regulatory agencies for guidance on acceptable disposal practices. Generators of waste containing this contaminant (≥100 kg/mo) must conform with EPA regulations governing storage, transportation, treatment, and waste disposal.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- EXTOXNET, Extension Toxicology Network, "Pesticide Information Profile, EPTC," Oregon State University, Corvallis, OR (June 1996). http://extoxnet.orst.edu/pips/eptc.htm

- USEPA, “Reregistration Eligibility Decision (RED), Facts EPTC” Office of Prevention, Pesticides and Toxic Substances, Washington DC (September 1999). http://www.epa.gov/REDs/factsheets/0064fact.pdf

Esfenvalerate E:0207

Use Type: Insecticide
CAS Number: 66230-04-4
Formula: $C_{25}H_{22}ClNO_3$
Synonyms: Benzeneacetic acid, 4-chloro-*α*-(1-methylethyl)-, cyano(3-phenoxyphenyl)methyl ester, [*s*-(R*,R*)]-; [*s*-(R*,R*)]-4-Chloro-*α*-(1-methylethyl)benzeneacetic acid, cyano (3-phenoxyphenyl)methyl ester; *s*-(R*,R*)-Cyano(3-phenoxyphenyl) methyl 4-chloro-2-(1-methylethyl) benzene-; Fenvalerate; A-*α*; (*S*)-*α*-Cyano-3-phenoxybenzyl (*S*)-2-(4-chlorophenyl)isovalerate; *s*-Fenvalerate; (*S*)-*α*-Cyano-3-phenoxybenzyl (*S*)-2-(4-chlorophenyl)-3-methylbutyrate
Trade Names: AMERICARE®; ASANA®; ASANA-XL®; ASANA® DPX-YB656-84; ENFORCER®; EVERCIDE®; HALMARK®; OMS-3023®; S-1844®; S-5602 ALPHA®; SUMI-ALFA®; SUMI-ALPHA®; SS-PYDRIN®; SUMICIDIN A-ALPHA®
Chemical class: Pyrethroid
EPA/OPP PC Code: 109303
California DPR Chemical Code: 2321
HSDB Number: 6625
UN/NA & ERG Number: UN3352 (liquid)/151; UN3349 (solid)/151
EC Number: [*Annex I Index No.*: 608-058-00-4]
Uses: A U.S. EPA restricted Use Pesticide (RUP). Esfenvalerate is a synthetic insecticide used to control a wide range of pests such as moths, flies, beetles, and other insects. It is used on vegetable crops (soya beans, sugar cane), tree fruit, cotton, maize, sorghum and nut crops, and non-crop lands. It also is used on a wide variety of household pests. It is usually mixed with a wide variety of other types of pesticides such as carbamate compounds or organophosphates and has the naturally occurring compound fenvalerate for use in the U.S. Esfenvalerate is almost identical to fenvalerate. Much of the data for fenvalerate is applicable to the pesticide esfenvalerate because the two compounds contain the same components. The only differences in the two products are the relative proportions of the four separate constituents (isomers). Esfenvalerate has become the preferred compound because it requires lower application rates than fenvalerate, is less chronically toxic, and is a more powerful insecticide.
U.S. Maximum Allowable Residue Levels for Esfenvalerate [40 CFR 180.533 (a)]: artichoke, globe 1 ppm; beet, sugar, dried pulp 2.5 ppm; beet, sugar, roots 0.5 ppm; beet, sugar, tops 5 ppm; egg 0.03 ppm; kiwifruit 0.5 ppm; kohlrabi 2 ppm; lettuce, head 5 ppm; mustard greens 5 ppm; poultry, fat 0.3 ppm; poultry, liver 0.03 ppm; poultry, meat 0.03 ppm; poultry, meat-by-products, except liver 0.3 ppm; sorghum, forage 10 ppm; sorghum, grain, grain 5 ppm; sorghum, grain, stover 10 ppm.
Human toxicity (long-term)[101]: Very low–140.00 ppb, Health Advisory
Fish toxicity (threshold)[101]: Extra high–0.00338 ppb, MATC (Maximum Acceptable Toxicant Concentration)
Regulatory Authority and Advisory Information:
Carcinogenicty: EPA Group E, evidence of non-carcinogenicity for humans.
Health Advisory: Endocrine disruptor (S!)
European/International Regulations: Hazard Symbol: T, Xi, N; risk phrases: R23/25; R43; R50/53; safety phrases: S1/2; S24; S36/37/39; S45; S60; S61 (see Appendix 1)
Description: Viscous yellow or amber liquid or white or amber crystalline solid. Molecular weight = 419.9; Specific gravity (H_2O:1) = 1.175 @ 25°C; Boiling point = 160°C; Freezing/Melting point = 59.7°C; Vapor pressure = 1.1×10^{-8} mmHg @ 20°C; 0.037 mmHg @ 25°C. Soluble in water; solubility = <1 ppm @ 20°C.
Incompatibilities: Oxidizers (chlorates, nitrates, peroxides, permanganates, perchlorates, chlorine, bromine, fluorine, etc); strong acids. Moisture may cause hydrolysis/decomposition
Permissible Exposure Limits in Air: NIOSH(2) IDLH = 5,000 ppm
OSHA PEL: 5 mg/m^3 TWA
NIOSH REL: 5 mg/m^3 TWA
ACGIH TLV®[1]: 5 mg/m^3 TWA
STEL set by HSE(33) = 10 mg/m^3.
Determination in Air: Filter; none; Gravimetric; NIOSH IV[18] [Particulates NOR; #0500 (total), #0600 (respirable)]. Collection by impinger or fritted bubbler, analysis by gas-liquid chromatography/ultraviolet. See NIOSH IV, Method #5008[18]. (pyrethrum)
Permissible Concentration in Water: Acceptable Daily Intake (ADI) = 0.02 mg/kg as pyrethroid.
Determination in Water: Collection by impinger or fritted bubbler, analysis by gas-liquid chromatography/ultraviolet. See NIOSH IV, Method #5008[18]. Log K_{ow} = >6.0. Values above 3.0 are likely to bioaccumulate in aquatic organisms.
Routes of Entry: Inhalation, absorbed through the skin.
Harmful Effects and Symptoms
Short Term Exposure: Pyrethroids can affect you when breathed in and by passing through your skin. Irritates the eyes and respiratory tract. High exposure can affect the nervous system, causing headache, nausea, vomiting, fatigue, and restlessness, rhinorrhea (discharge of thin nasal mucous). Highly toxic. May cause nausea, vomiting and abdominal pain if ingested. LD_{50} (oral, rat) = 90–450 mg/kg; LD_{50} (dermal, rat) = >5 g/kg.
Long Term Exposure: High or repeated exposure can cause lung allergy (with cough, wheezing and/or shortness of breath) or hay fever symptoms (sneezing, runny or stuffy nose). Allergic “pneumonia” can also occur with cough, chest pain, breathing difficulty and abnormal chest x-ray. Repeated attacks may lead to permanent scarring. Skin sensitizer; allergy may also develop with rash and itching, even with lower exposures. Dermal contact can cause rash with redness, blisters and intense itching. A

severe generalized allergy can occur with weakness and collapse. May cause endocrine effects. May cause tumors.

Points of Attack: Respiratory system, skin (sensitizer), central nervous system.

Medical Surveillance: Before beginning employment and at regular times after that, the following are recommended: Employees should be screened for history of certain medical conditions which might place the employee at increased risk from pyrethroid exposure. Chronic respiratory disease: In persons with chronic respiratory disease, especially asthma, the inhalation of pyrethroids might cause exacerbation of symptoms due to their sensitizing properties. Lung function tests. These may be normal if the person is not having an attack at the time of the test. Consider chest x-ray if lung symptoms are present. Skin disease: Pyrethroids can cause dermatitis which may be allergic in nature. Persons with pre-existing skin disorders may be more susceptible to the effects of this agent. Evaluation by a qualified allergist, including exposure history and testing, may help diagnose allergy. Any employee developing the above-listed conditions should be referred for further medical examination[9].

First Aid: If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least 15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately. If this chemical contacts the skin, remove contaminated clothing and wash immediately with soap and water. Seek medical attention immediately. If this chemical has been inhaled, remove from exposure, begin rescue breathing (using universal precautions) if breathing has stopped, and CPR if heart action has stopped. Transfer promptly to a medical facility. When this chemical has been swallowed, get medical attention. *Do not induce vomiting when formulations containing petroleum solvents are ingested*. Otherwise, give large quantities of water and induce vomiting. Do not make an unconscious person vomit.

Personal Protective Methods: Applicators and other handlers must wear: Coveralls worn over long-sleeved shirt and long pants; Chemical-resistant gloves such as DuPont™ Tychem® suit fabrics, barrier laminate, or Viton®; Chemical-resistant footwear plus socks; Protective eye wear; Chemical-resistant headgear for overhead exposure; Chemical-resistant apron when cleaning equipment, mixing, or loading[83]. Agricultural Use/Engineering Controls: When handlers use closed systems, enclosed cabs, or aircraft in a manner that meets the requirements listed in the Worker Protection Standard (WPS) for agricultural pesticides, 40 CFR 170.240(d)(4-6), the handler PPE requirements may be reduced or modified as specified in the Worker Protection Standard. Firefighters should wear NIOSH approved self-contained breathing apparatus and full protective clothing.

Respirator Selection: NIOSH/OSHA *for pyrethrum*: *50 mg/m³:* CcrOv95 (APF = 10) [any air-purifying half-mask respirator equipped with an organic vapor cartridge(s) in combination with an N95, R95, or P95 filter. The following filters may also be used: N99, R99, P99, N100, R100, P100]; or Sa (APF = 10) (any supplied-air respirator). *125 mg/m³:* Sa:Cf (APF = 25) (any supplied-air respirator operated in a continuous-flow mode); or PaprOvHie (APF = 25) (any air-purifying full facepiece respirator equipped with an organic vapor cartridge in combination with a high-efficiency particulate filter). *250 mg/m³:* CcrFOv100 (APF = 50) [any air-purifying full facepiece respirator equipped with organic vapor cartridge(s) in combination with an N100, R100, or P100 filter]; or PaprTOvHie (APF = 50) [any powered, air-purifying respirator with a tight-fitting face-piece and organic vapor cartridge(s) in combination with a high-efficiency particulate filter]; or SCBAF (APF = 50) (any self-contained breathing apparatus with full facepiece); or SaF (APF = 50) (any supplied-air respirator with a full facepiece). *5000 mg/m³:* SaF:Pd,Pp (APF = 2000) (any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode). *Emergency or planned entry into unknown concentrations or IDLH conditions:* SCBAF:Pd,Pp (APF = 10,000) (any self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode); or SaF:Pd,Pp:ASCBA (APF = 10,000) (any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary self-contained breathing apparatus operated in a pressure-demand or other positive-pressure mode). *Escape:* GmFOv100 (APF = 50) [any air-purifying, full facepiece respirator (gas mask) with a chin-style, front- or back-mounted organic vapor canister having an N100, R100, or P100 filter]; or SCBAE (any appropriate escape-type, self-contained breathing apparatus). *Note:* Substance reported to cause eye irritation or damage; may require eye protection.

Storage: Color Code-Blue: Health Hazard/Poison. Store in a secure poison location at temperature <35°C and away from alkaline materials. Prior to working with this chemical you should be trained on its proper handling and storage. Store in tightly closed containers in a cool, well-ventilated area. Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: This material is a toxic pesticide and should be labeled "poisonous materials." It falls into Hazard Class 6.1. PG III.

Spill Handling: First remove all sources of ignition. Evacuate persons not wearing protective equipment from area of spill or leak until clean up is complete. Ventilate area of spill or leak. Use water spray to reduce vapor. Absorb liquids in vermiculite, dry sand, earth, or a similar material and deposit in sealed containers. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations.

If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable.

Fire Extinguishing: Hazardous decomposition includes hydrogen chloride and oxides of sulfur. *On a small fire:* use dry chemical, CO_2 or water spray. *On a large fire:* use water spray, fog or regular foam. Move containers from fire area if you can do it without risk. Dike fire-control water for later disposal; do not scatter the material. Use water spray or fog; do not use straight streams. *Fire involving storage or vehicular tanks:* isolate for 800 meters/0.5 mile in all directions; also, consider initial evacuation for 800 meters/0.5 mile in all directions. Fight fire from maximum distance or use unmanned hose holders or monitor nozzles. Do not get water inside containers. Cool containers with flooding quantities of water until well after fire is out. Withdraw immediately in the case of rising sound from venting safety devices or discoloration of tank. ALWAYS stay away from tanks engulfed in fire. For massive fire, use unmanned hose holders or monitor nozzles; if this is impossible, withdraw from area and let fire burn. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies.

Disposal Method Suggested: Incineration would be an effective disposal procedure where permitted. If an efficient incinerator is not available, the product should be mixed with large amounts of combustible material and contact with the smoke should be avoided. In accordance with 40CFR165, follow recommendations for the disposal of pesticides and pesticide containers.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- EXTOXNET, Extension Toxicology Network, “Pesticide Information Profile, Esfenverate,” Oregon State University, Corvallis, OR (June 1996). http://extoxnet.orst.edu/pips/esfenval.htm
- USEPA, Office of Pesticide Programs, Pesticide Residue Limits, “Esfenvalerate”, 40 CFR 180.533. http://www.epa.gov/pesticides/food/viewtols.htm

Ethalfluralin E:0225

Use Type: Herbicide

CAS Number: 55283-68-6

Formula: $C_{13}H_{14}F_3N_3O_4$

Synonyms: Benzenamine, *N*-ethyl-*N*-(2-methyl-2-propenyl)-2,6-dinitro-4-(trifluoromethyl)-; *N*-Ethyl-*N*-(2-methyl-2-propenyl)-2,6-dinitro-4-(trifluoromethyl)benzenamine

Trade Names: COMPOUND 94961®; COBEX®; EL 161®; ETHALFLURLIN®; SOMILAN®; SONALAN®; SONALEN®

Chemical class: 2,6-; Fluorodinitrotoluidine

EPA/OPP PC Code: 113101

California DPR Chemical Code: 2166

HSDB Number: 7545

UN/NA & ERG Number: UN3077(solid)/171; UN1596 (Dinitroanilines)/153

RTECS® Number: XU6200000

EC Number: 259-564-3

Uses: Ethalfluralin is a selective herbicide used for the pre-emergence control of annual grasses and broadleaf weeds in certain food and feed crops. Ethalfluralin may be used in growing a variety of grain, seed, and cucurbit crops. The greatest amounts of ethalfluralin are used in growing soybeans, dry beans, and sunflower seeds. Ethalfluralin is used only outdoors, in agriculture; no residential uses were registered. Not used in EU countries[115]. Registered for use in the U.S.

U.S. Maximum Allowable Residue Levels for Ethalfluralin [40 CFR 180.416(a)]: bean, dry, seed 0.05 ppm; canola, seed 0.05 ppm; peanut 0.05 ppm; pea, dry, seed 0.05 ppm; safflower, seed 0.05 ppm; soybean 0.05 ppm; sunflower, seed 0.05 ppm; vegetable, cucurbit, group 9, 0.05 ppm.

Regulatory Authority and Advisory Information:

Carcinogenicty: EPA. Group C, Possible human carcinogen

Health Advisory: Mutagen, Developmental/Reproductive Toxin, Skin irritant/sensitizer.

Description: Yellow-orange crystalline solid. Mild amine odor. Commercial products an mixtures may contain flammable carriers (such as xylene); these may be red-orange liquids with a mild aromatic odor. Molecular weight = 333.26; Specific gravity (H_2O:1) = 1.15; Boiling point = [decomposes; may be dangerous above 200°C (solid); 70°C (liquid)]; Freezing/Melting point = 55–58°C; Vapor pressure = 9×10^{-8} mmHg @ 25°C. Hazard Identification (based on NFPA-704 M Rating System): Health 3, Flammability 1, Reactivity 1. Very slightly soluble in water; solubility = 0.35 ppm. @ 25°C. Physical and toxicological properties may be affected by carrier solvents in commercial formulations.

Incompatibilities: Sensitive to heat. Dintroanilines can be explosive and are strong oxidizers. Contact with reducing agents, other strong oxidizers or, nitrosylsulfuric acid may cause fire or explosion.

Determination in Air: Filter; none; Gravimetric; NIOSH IV [Particulates NOR; #0500 (total), #0600 (respirable)][18].

Determination in Water: Log K_{ow} = >5. Values above 3.0 are likely to bioaccumulate in aquatic organisms.

Routes of Entry: Absorbed through the skin. Inhalation, ingestion.

Harmful Effects and Symptoms

Short Term Exposure: Corrosive. Eye or dermal contact may cause severe irritation and serious damage. May be absorbed through the skin. Inhalation of vapor or mists should be avoided. Harmful if swallowed. May cause nausea and vomiting. May cause shortness of breath (dyspnea). LD_{50} (oral, rat) = 3000 to >5000[83] mg/kg; LD_{50} (dermal, rabbit) = >2 g/kg.

Long Term Exposure: May cause loss of appetite and anorexia nervosa. Ethalfluralin has caused birth defects in laboratory animals.

Medical Surveillance: Preliminary medical exam to detect chronic diseases of central nervous system, liver, heart, kidneys, lung and skin, as well as endocrinological or immunological disturbances, should protect susceptible individuals. Periodical medical exams of internal organs, skin and eyes are important to avoid chronic occupational intoxications. They should include lab and patch tests when necessary[83]. Contact physician if poisoning is suspected or if redness, itching, or a burning sensation develops in the eyes or skin. May cause sensitization.

First Aid: If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least 15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately. If this chemical contacts the skin, remove contaminated clothing and wash immediately with soap and water. Seek medical attention immediately. If this chemical has been inhaled, remove from exposure, begin rescue breathing (using universal precautions) if breathing has stopped, and CPR if heart action has stopped. Transfer promptly to a medical facility. When this chemical has been swallowed, get medical attention. Give large quantities of water and induce vomiting. Do not make an unconscious person vomit. Evaluation by a qualified allergist, including exposure history and testing, may help diagnose allergy.

Personal Protective Methods: Dinitroanilines react with cellulose-based and expanded polymeric absorbents[88]. Prevent any reasonable probability of dermal and/or eye contact. Wear protective eye wear/goggles or face shield and protective clothing such as coveralls over long- sleeved shirt and full length pants; impermeable, chemical-resistant gloves when handling this product[83]. Safety equipment suppliers/manufacturers can provide recommendations on the most protective glove/clothing material (such as DuPont™ Viton® gloves and Tychem® suit fabrics) for your operation. All protective clothing (suits, gloves, footwear, headgear) should be clean, available each day, and put on before work. Contact lenses should not be worn when working with this chemical. Wear dust-proof chemical goggles and face shield unless full facepiece respiratory protection is worn. Employees should wash immediately with soap when skin is wet or contaminated. Provide emergency showers and eyewash.

Respirator Selection: Follow regulations in OSHA 29CFR1910.134 or European Standard EN149. Use a NIOSH/MSHA- or European Standard EN149-approved respirator; or use an approved supplied-air respirator with a full facepiece operated in the positive-pressure mode, or with a full facepiece, hood, or helmet in the continuous-flow mode; or use a NIOSH/MSHA- or European Standard EN149-approved self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive-pressure mode.

Storage: (1) Color Code-Yellow Stripe: Reactivity Hazard; Store separately in a area isolated from flammables, combustibles, or other yellow-coded materials. (2) Color Code-Blue: Health Hazard/Poison. Store in a secure poison location. Prior to working with this chemical you should be trained on its proper handling and storage. Before entering confined space where this chemical may be present, check to make sure that an explosive concentration does not exist. Store in tightly closed containers in a cool, well-ventilated area away from oxidizers, strong acids, strong bases and other incompatible materials listed above. Metal containers involving the transfer of this chemical should be grounded and bonded. Drums must be equipped with self-closing valves, pressure vacuum bungs, and flame arresters. Use only non-sparking tools and equipment, especially when opening and closing containers of this chemical. If this material contains a flammable carrier, sources of ignition, such as smoking and open flames, are prohibited where this chemical is used, handled, or stored in a manner that could create a potential fire or explosion hazard. Wherever this chemical is used, handled, manufactured, or stored, use explosion-proof electrical equipment and fittings. Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: This material may be classified as Environmentally hazardous substances, solid, n. o. s. It usually falls in Hazard Class 9.

Spill Handling: For dinitroaniline solids, isolate spill or leak area in all directions for at least 50 meters /150 feet. Increase, in the downwind direction, as necessary. *If tank, rail car or tank truck is involved in spill*, isolate for 800 meters/0.5 mile in all directions; also, consider initial evacuation for 800 meters/0.5 mile in all directions. Do not touch damaged containers or spilled material unless wearing appropriate protective clothing. Stop leak if you can do it without risk. Prevent entry into waterways, sewers, basements or confined areas. Cover with plastic sheet to prevent spreading. Absorb or cover with dry earth, sand or other non-combustible material and transfer to containers. Do not allow water to get inside containers.

Fire Extinguishing: This chemical is a combustible solid but does not readily ignite. Liquid formulations may be combustible or flammable. Moderate heat causes decomposition that produces toxic vapors, including hydrogen chloride, oxides of nitrogen and carbon, and fluorine. As an immediate precautionary measure, isolate spill or leak area in all directions for at least 50 meters/150 feet for liquids and at least 25 meters/75 feet for solids. *Fire involving storage or vehicular tanks:* isolate for 800 meters/0.5 mile in all directions; also, consider initial evacuation for 800 meters/0.5 mile in all directions. *On a small fire:* use dry chemical, CO_2, water spray or regular foam. *On a large fire:* use water spray, fog or regular foam. Do not scatter spilled material with high-pressure streams of water. Move containers from fire area if you can do it without risk. Dike fire-control water for later disposal. *Fire involving tanks:* from a secure, explosion-proof location, use water spray to cool exposed containers. If cooling streams are ineffective (venting sound increases in volume and pitch, tank discolors, or shows any signs of deforming), withdraw immediately to a secure position. Always stay away from tanks engulfed in fire. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode.

Disposal Method Suggested: Do not discharge into drains or sewers. Dispose of waste material as hazardous waste using a licensed disposal contractor to an approved landfill. Contact a licensed disposal facility about surplus and non-recyclable solutions. Burn in a chemical incinerator equipped with an afterburner and scrubber. Extra care must be exercised as the material in an organic solvent is highly flammable. Consult with environmental regulatory agencies for guidance on acceptable disposal practices. Incineration with effluent gas scrubbing is recommended. Containers must be disposed of properly by following package label directions or by contacting your local or federal environmental control agency, or by contacting your regional EPA office. Do not reuse container.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- USEPA, "Reregistration Eligibility Decision (RED), Ethalfluralin" Office of Prevention, Pesticides and Toxic Substances, Washington DC (March 1995). http://www.epa.gov/REDs/2260.pdf

Ethametsulfuron-methyl E:0228

Use Type: Herbicide

CAS Number: 97780-06-8

Formula: $C_{14}H_{16}N_6O_6S$

Synonyms: Benzoic acid, 2-[((((4-ethoxy-6-(methylamino)-1,3,5-triazin-2-yl)amino)carbonyl)amino)sulfonyl]-, methyl ester; Methyl 2-[((((4-ethoxy-6-(methylamino)-1,3,5-triazin-2-yl)amino)carbonyl)amino)sulfonyl] benzoate; Methyl 2-[(4-ethoxy-6-methylamino-1,3,5-triazin-2-yl)carbamoylsulfamoyl] benzoate

Trade Names: A-7881®; DPX-A 7881® (application withdrawn); MUSTER®

Chemical class: Triazinylsulfonylurea; Sulfonylurea; Nicotinanilide; Carboxamide

EPA/OPP PC Code: 129091

UN/NA & ERG Number: UN3077(solid)/171

Uses: Plant growth inhibitor. Pending in EU countries[115]. Registered for use in the U.S.

Regulatory Authority and Advisory Information:
Carcinogenicity[83]: EPA, Unclassifiable
Health Advisory: Developmental/Reproductive toxin (S!).

Description: White to tan crystalline solid. Molecular weight = 410.41; Specific gravity (H_2O:1) = 1.47; Boiling point = 315°C; Freezing/Melting point = 192–194C°; Vapor pressure = extremely low. Low to moderate solubility in water; solubility = 52 mg/L.

Permissible Exposure Limits in Air: based on manufacturer recommendations: 5 mg/m^3, 8 and 12 hour TWA, respirable dust; 10 mg/m^3, 8 and 12 hour TWA, total dust[BayerCropScience].

Determination in Water: Log K_{ow} = <1. Unlikely to bioaccumulate in marine organisms.

Routes of Entry: Inhalation, dermal contact, ingestion.

Harmful Effects and Symptoms: Human health effects from the sulfonylurea herbicides at low environmental doses or at biomonitored levels from low environmental exposures are unknown. The sulfonylurea herbicides are generally of low toxicity in mammalian studies. Animal studies showed low acute toxicity and little chronic, reproductive, or developmental toxicity or teratogenic effects. Developmental or teratogenic effects tended only to occur at high or maternally toxic doses. At high sublethal, chronic oral doses, such nonspecific effects as weight loss and anemia were observed. Some chemical-specific effects were noted at high doses in animals[96].

Short Term Exposure: May cause skin and eye irritation. Moderately poisonous if ingested or inhaled. LD_{50} (oral, rat) = >5 g/kg.; LD_{50} (dermal, rat) = >2 g/kg.

Long Term Exposure: May cause reproductive problems.

Medical Surveillance: Preliminary medical exam to detect chronic diseases of central nervous system, liver, heart, kidneys, lung and skin, as well as endocrinological or immunological disturbances, should protect susceptible individuals. Periodical medical exams of internal organs, skin and eyes are important to avoid chronic occupational intoxications. They should include lab and patch tests when necessary[83]. Before beginning employment and at regular times after that, for those with frequent or potentially high exposures, the following is recommended: Lung function tests. Consider chest x-ray following acute overexposure. Evaluation by a qualified allergist. Examination of the nervous system. Urinary levels of the sulfonylurea herbicides reflect recent exposure. There is very limited information on the biomonitoring of sulfonylurea herbicides or their metabolites. Detection of the metabolites may reflect exposure to more than one particular sulfonylurea herbicide or from exposure to environmental degradation products. The urinary metabolites dimethoxypyrimidine and dimethylpyrimidine can be used as non-specific markers of exposure to the pyrimidinylsulfonylureas, a group that includes bensulfuron-methyl, halosulfuron, primisulfuron-methyl, and sulfosulfon. The urinary metabolite methoxymethyl triazine can be used as a non-specific marker of exposure to the triazinylsulfonylureas, a group that includes chlorosulfuron, prosulfuron, and triasulfuron[96]. May cause kidney problems.

Points of Attack: Kidneys, liver, lungs and skin

First Aid: If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least 15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately. If this chemical contacts the skin, remove contaminated clothing and wash immediately with soap and water. Seek medical attention immediately. If this chemical has been inhaled, remove from exposure, begin rescue breathing (using universal precautions) if breathing has stopped, and CPR if heart action has stopped. Transfer promptly to a medical facility. When this chemical has been swallowed, get medical attention. Give large quantities of water or milk and induce vomiting. Do not make an unconscious person vomit.

Personal Protective Methods: Applicators and other handlers must wear: Coveralls worn over long-sleeved shirt and long pants; Chemical-resistant gloves such as DuPont™ Tychem® suit fabrics, barrier laminate, or Viton®; Chemical-resistant footwear plus socks; Protective eye wear; Chemical-resistant headgear for overhead exposure; Chemical-resistant apron when cleaning equipment, mixing, or loading[83]. Agricultural Use/Engineering Controls: When handlers use closed systems, enclosed cabs, or aircraft in a manner that meets the requirements listed in the Worker Protection Standard (WPS) for agricultural pesticides, 40 CFR 170.240(d)(4-6), the handler PPE requirements may be reduced or modified as specified in the Worker Protection Standard. Firefighters should wear NIOSH approved self-contained breathing apparatus and full protective clothing.

Respirator Selection: Specific respirator(s) have not been recommended by NIOSH. However, based on potential carcinogenicity, and where the potential exists for exposure, the following might be considered: *At any detectable concentration:* SCBAF: Pd,Pp (APF = 10,000) (any MSHA/NIOSH/MSHA- or European Standard EN 149-approved self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode); or SaF: Pd,Pp: ASCBA (APF = 10,000) (any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary, self-contained breathing apparatus operated in a pressure-demand or other positive-pressure mode). *Escape:* 100F (APF = 50) (any air-purifying, full facepiece respirator with an N100, R100, or P100 filter) or SCBAE (any appropriate escape-type, self-contained breathing apparatus).

Storage: Color Code-Blue: Health Hazard/Poison. Store in a secure poison location. Store in a refrigerator and protect from exposure to oxidizers or moisture[52]. A regulated, marked area should be established where this chemical is handled, used, or stored in compliance with OSHA Standard 1910.1045. Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: This material may be classified as Environmentally hazardous substances, solid, n. o. s. It usually falls in Hazard Class 9.

Spill Handling: Evacuate and restrict persons not wearing protective equipment from area of spill or leak until clean up is complete. Dampen spilled material with alcohol to avoid dust. Collect powdered material in the most convenient and safe manner and deposit in sealed containers. Ventilate area of spill or leak after clean up is complete. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable.

Fire Extinguishing: Hazardous decomposition includes oxides of nitrogen, sulfur and carbon. As an immediate precautionary measure, isolate spill or leak area in all directions for at least 50 meters/150 feet for liquids and at least 25 meters/75 feet for solids. *Fire involving storage or vehicular tanks:* isolate for 800 meters/0.5 mile in all directions; also, consider initial evacuation for 800 meters/0.5 mile in all directions. *On a small fire:* use dry chemical, CO_2, water spray or regular foam. *On a large fire:* use water spray, fog or regular foam. Do not scatter spilled material with high-pressure streams of water. Move containers from fire area if you can do it without risk. Dike fire-control water for later disposal. *Fire involving tanks:* from a secure, explosion-proof location, use water spray to cool exposed containers. If cooling streams are ineffective (venting sound increases in volume and pitch, tank discolors, or shows any signs of deforming), withdraw immediately to a secure position. Always stay away from tanks engulfed in fire. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode.

Disposal Method Suggested: Do not discharge into drains or sewers. Dispose of waste material as hazardous waste using a licensed disposal contractor to an approved landfill. Consult with environmental regulatory agencies for guidance on acceptable disposal practices. Incineration would be an effective disposal procedure where permitted. If an efficient incinerator is not available, the product should be mixed with large amounts of combustible material and contact with the smoke should be avoided. In accordance with 40CFR165, follow recommendations for the disposal of pesticides and pesticide containers. Containers must be disposed of properly by following package label directions or by contacting your local or federal environmental control agency, or by contacting your regional EPA office.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- United States National Library of Medicine, ChemIDplus Advanced, Bethesda, MD. http://chem.sis.nlm.nih.gov/chemidplus/rn/97780-06-8

Ethephon E:0245

Use Type: Plant growth regulator

CAS Number: 16672-87-0

Formula: $C_2H_6ClO_3P$

Synonyms: CEP; 2-CEPA; (2-Chloroethyl)phosphonic acid; Chlorethephon; 2-Chlorethylphosphonic acid; 2-Chloroethanephosphonic acid; Ethefon; Ethephon; Phosphonic acid, (2-chloroethyl)-

Trade Names: AMCHEM® 68-250; ARVEST®; BASE® 250; BOLL'D®; BROMEFLOR®; BROMOFLOR®; CAMPOSAN®; CEPHA®; CEPHA® 10LS; CERONE®; CHIPCO® FLOREL PRO; ETHEPON®; ETHEL®; ETHEVERSE®; ETHREL®; FINISH®; FLORDIMEX®; FLOREL®; G-996®; KAMPOSAN®; PREP®; ROLL-FRUCT®; TERPAL® (with mepiquat chloride); T-EXTRA®; TOMATHREL®

Chemical class: Organophosphate

EPA/OPP PC Code: 099801

California DPR Chemical Code: 1626

HSDB Number: 2618

UN/NA & ERG Number: UN2928/154

RTECS® Number: SZ7100000

EC Number: 240-718-3 [*Annex I Index No.:* 015-514-00-4]

Uses: Ethephon is a plant growth regulator used to promote fruit ripening, abscission, flower induction, and other responses. It is registered for use on a number of food, feed and nonfood crops (rubber plants, flax), greenhouse nursery stock, and outdoor residential ornamental plants, but is used primarily on cotton. Ethephon is applied to plant foliage by either ground or aerial equipment. It also may be applied by hand sprayer to certain home garden vegetables and ornamentals. Use practice limitations include prohibitions against applying ethephon through any type of irrigation system; feeding or grazing livestock in treated areas; and treating within 2 to 60 days of harvest, depending on the crop.

U.S. Maximum Allowable Residue Levels for Ethephon (40 [CFR 180.300(a)]: Apple 5.0 ppm; apple, juice 10.0 ppm; barley, bran 5.0 ppm; barley, grain 2.0 ppm; barley, straw 10.0 ppm; blackberry 30.0 ppm; blueberry 20.0 ppm; cantaloupe 2.0 ppm; cattle, fat 0.02 ppm; cattle, kidney 1.0 ppm; cattle, meat 0.02 ppm; cattle, meat byproducts, except kidney 0.2 ppm; cherry 10.0 ppm; coffee, bean, green 0.5 ppm; cotton, gin byproducts 180.0 ppm; cotton, undelinted seed 6.0 ppm; cucumber 0.1 egg 0.002 ppm; goat, fat 0.02 ppm; goat, kidney 1.0 ppm; goat, meat 0.02 ppm; goat, meat byproducts, except kidney 0.2 ppm; grape 2.0 ppm; grape, raisin 12.0 ppm; hazelnut 0.80 ppm; hog, fat 0.02 ppm; hog, kidney 1.0 ppm; hog, meat 0.02 ppm; hog, meat byproducts, except kidney 0.2 ppm; horse, fat 0.02 ppm; horse, kidney 1.0 ppm; horse, meat 0.02 ppm; horse, meat byproducts, except kidney 0.2 ppm; milk 0.01 ppm; nut, macadamia 0.5 ppm; pepper 30.0 ppm; pineapple 2.0 ppm; poultry, fat 0.02 ppm; poultry, liver 0.05 ppm; poultry, meat 0.01 ppm; poultry, meat byproducts, except liver 0.01ppm; sheep, fat 0.02 ppm; sheep, kidney 1.0 ppm; sheep, meat 0.02 ppm; sheep, meat byproducts, except kidney 0.2 ppm; sugarcane, molasses 1.5 ppm; tomato 2.0 ppm; walnut 0.5 ppm; wheat, bran 5.0 ppm; wheat, germ 5.0 ppm; wheat, grain 2.0 ppm; wheat, middlings 5.0 ppm; wheat, shorts 5.0 ppm; wheat, straw 10.0 ppm. ***A tolerance with regional registration, as defined in 180.1(n)*** **[CFR 180.300(c)]:** sugarcane 0.1 ppm.

Human toxicity (long-term)[101]: Very low–126.0 ppb, Health Advisory

Fish toxicity (threshold)[101]: Very low–26627.94738 ppb, MATC (Maximum Acceptable Toxicant Concentration)

Regulatory Authority and Advisory Information:

Carcinogenicity[83]: EPA Group D, Not classifiable as a human carcinogen

Toxicity (oral) Category 3, Slightly Toxic (human fatal >30 gm.); however some formulations may be in toxicity category I, Danger or category II, Warning for primary eye and/or skin irritation.

Health Advisory: Nerve Toxin

European/International Regulations: Hazard Symbol: Xn, C, H, N; risk phrases: R20/21; R34; R52/53; safety phrases: S1/2; S26; S28; S36/37/39; S45; S61 (see Appendix 1)

WGK (German Aquatic Hazard Class): 2-Hazard to waters

Description: Ethephon is a white to tan powder. Commercial product is a white, waxy solid. Commercial products may be available as aqueous solutions or soluble concentrates. Molecular weight = 144.49; Specific gravity (H_2O:1) = 1.2; 1.65; Boiling point = (decomposes) 265°C; Freezing/Melting point = 73–74°C; Vapor pressure = 1.1×10^{-7} mmHg @ 20°C; <0.01 mmHg @ 20°C. High solubility in water; solubility = <1 kg/L. Physical and toxicological properties may be affected by carrier solvents in commercial formulations.

Incompatibilities: Hygroscopic. Solutions are highly acidic. May cause corrosion of metals, especially when moisture is present. Contact with flammable material may cause fire and explosions. Contact with combustible or oxidizable materials may form heat-, shock-, and friction-sensitive explosive mixtures. Static electricity may also cause explosions. Keep away from all acids, especially dibasic organic acids, ammonium compounds, antimony sulfide, arsenic trioxide, metal sulfides, powdered metals, calcium aluminum hydride, cyanides, manganese dioxide, phosphorus, selenium, sulfur, thiocyanates, zinc

Determination in Water: Log K_{ow} = –0.22[83,USDA]. Unlikely to bioaccumulate in marine organisms.

Harmful Effects and Symptoms: Ethephon is an organophosphonate or salt of a phosphonic acid. Unlike organophosphates, it may not inhibit activity of the enzyme acetylcholinesterase, whcih is essential for transmission of nerve signals in animals and insects. Nevertheless, the metal ions may act as a neurotoxin.

Short Term Exposure: Highly corrosive. Because this material has a low vapor pressure and volatility, significant inhalation of vapors is unlikely at ordinary temperatures. Delayed pulmonary edema may occur after inhalation. LD_{50} (oral, rat) = >3 g/kg; LD_{50} (dermal, rabbit) = >5 g/kg.

Long Term Exposure: A cholinesterase inhibitor. A neurotoxin. May cause heart problems.

Points of Attack: Central nervous system, cardiovascular system, skin, eyes.

Medical Surveillance: Medical observation is recommended for 24 to 48 hours following breathing overexposure, as pulmonary edema may be delayed. Cigarette smoking may exacerbate pulmonary injury and should be discouraged for at least 72 hours following exposure. Routine biological monitoring of pesticide applicators and field workers includes testing of plasma and red blood cell acetylcholinesterase levels (for enzyme poisoned by this chemical). These tests are normally accurate only if done within about two hours of exposure. If exposure stops, plasma levels return to normal in 1–2 weeks while red blood cell levels may be reduced for 1–3 months. When acetylcholinesterase enzyme levels are reduced by 25% or more below preemployment levels, risk of poisoning is increased, even if results are in lower ranges of “normal.” Reassignment to work not involving organophosphate pesticides is recommended until enzyme levels recover. Do not drink any alcoholic beverages before or during use as it promotes absorption of organophosphates.

First Aid: If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least 15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately. If this chemical contacts the skin, remove contaminated clothing and wash immediately with soap and water. Seek medical attention immediately. If this chemical has been inhaled, remove from exposure, begin rescue breathing (using universal precautions) if breathing has stopped, and CPR if heart action has stopped. Transfer promptly to a medical facility. When this chemical has been swallowed, get medical attention. If victim is conscious and able to swallow, have victim drink 4 to 8 ounces of water. Do not induce vomiting. *Note to physician or authorized medical personnel*: Medical observation is recommended for 24 to 48 hours following breathing overexposure, as pulmonary edema may be delayed. As first aid for pulmonary edema, a doctor or authorized paramedic might consider administering a corticosteroid spray. Cigarette smoking may exacerbate pulmonary injury and should be discouraged for at least 72 hours following exposure.

Respirator Selection: Wherever and whenever workplace conditions warrant respirator use, a respiratory protection program must be followed that meets one or more of the following government standards: OSHA's 29 CFR 1910.134, ANSI Z88.2, or European Standard EN 149.

Storage: (1) Color Code-White: Corrosive or Contact Hazard; Store separately in a corrosion resistant location. Prior to working with this chemical you should be trained on its proper handling and storage. (2) Color Code-Yellow Stripe: Reactivity Hazard; Store separately in a area isolated from flammables, combustibles, or other yellow-coded materials. Store in tightly closed containers in a cool, well-ventilated area. Prior to working with this chemical you should be trained on its proper handling and storage. Before entering confined space where this chemical may be present, check to make sure that an explosive concentration does not exist. Store in tightly closed containers in a cool, well-ventilated area away from oxidizers, strong acids, strong bases and other incompatible materials listed above. Metal containers involving the transfer of this chemical should be grounded and bonded. Drums must be equipped with self-closing valves, pressure vacuum bungs, and flame arresters. Use only non-sparking tools and equipment, especially when opening and closing containers of this chemical. If this material contains a flammable carrier, sources of ignition, such as smoking and open flames, are prohibited where this chemical is used, handled, or stored in a manner that could create a potential fire or explosion hazard. Wherever this chemical is used, handled, manufactured, or stored, use explosion-proof electrical equipment and fittings. Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: Ethephon, labeled “poisonous materials, Corrosive Material.” This chemical falls in Hazard Class 6.1. Label 6.1, 8. Technical name required.

Spill Handling: First remove all sources of ignition. Evacuate persons not wearing protective equipment from area of spill or leak until clean up is complete. Stay upwind; keep out of low areas. Ventilate area of spill or leak. Remove and isolate contaminated clothing at the site. Do not touch spilled material; stop leak if you can do so without risk. Use water spray to reduce vapors. *Small spills:* absorb with sand or other noncombustible absorbent material and place into containers for later disposal. *Large spills:* dike far ahead of spill for later disposal. Collect powdered material in the most convenient and safe manner and deposit in sealed containers. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable. Seek professional environmental engineering assistance from the U.S. EPA Environmental Response Team at (908) 548-8730 (24-hour response line).

Fire Extinguishing: Decomposure starts above 250°C, releasing oxides of nitrogen, sulfur, carbon and phosphorus.

May be fatal if inhaled, ingested or absorbed through skin. Inhalation or contact with some of these materials will irritate or burn skin and eyes. Vapors may cause dizziness or suffocation. *Fire involving storage or vehicular tanks:* isolate for 800 meters/0.5 mile in all directions; also, consider initial evacuation for 800 meters/0.5 mile in all directions. *Small fire:* dry chemical, carbon dioxide or water spray. *Large fire:* dry chemical, carbon dioxide, alcohol-resistant foam or water spray. Move containers from fire area if you can do it without risk. Dike fire-control water for later disposal; do not scatter the material. *Fire involving tanks or car/trailer loads:* fight fire from maximum distance or use unmanned hose holders or monitor nozzles. Do not get water inside containers. Cool containers with flooding quantities of water until well after fire is out. Withdraw immediately in the case of rising sound from venting safety devices or discoloration of tank. Always stay away from tanks engulfed in fire. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode.

Disposal Method Suggested: Destruction by alkali hydrolysis or incineration. Containers must be disposed of properly by following package label directions or by contacting your local or federal environmental control agency, or by contacting your regional EPA office.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- EXTOXNET, Extension Toxicology Network, “Pesticide Information Profile, Ethephon,” Oregon State University, Corvallis, OR (September 1995). http://extoxnet.orst.edu/pips/ethephon.htm
- USEPA, “Reregistration Eligibility Decision (RED), Ethephon” Office of Prevention, Pesticides and Toxic Substances, Washington DC (April 1995). http://www.epa.gov/REDs/0382.pdf
- USEPA, Office of Pesticide Programs, Pesticide Residue Limits, “Ethephon”, 40 CFR 180.300. http://www.epa.gov/pesticides/food/viewtols.htm

Ethion E:0260

Use Type: Insecticide, Acaricide

CAS Number: 563-12-2

Formula: $C_9H_{22}O_4P_2S_4$

Synonyms: Bis(*S*-(Diethoxyphosphinothioyl)mercapto)methane; ENT 24,105; Ethyl methylene phosphorodithioate; Etion (Spanish); Methanedithiol, *S,S*-diester with *O,O*-diethyl phosphorodithioate acid; *S,S'*-Methylene *O,O,O′,O′*-tetraethyl phosphorodithioate; Phosphorodithioic acid, *O,O*-diethyl ester, *S,S*-diester with methanedithiol; STCC 4921565; *O,O,O′,O′*-Tetraethyl *S,S'*-methylenebis(dithiophosphate); *O,O,O′,O′*-Tetraethyl *S,S′*-methylenebisphosphordithioate; Tetraethyl *S,S′*-methylene bis(phosphorothiolothionate); *O,O,O′,O′*-Tetraethyl *S,S′*-methylene di(phosphorodithioate); a,*S′*-Methylene *O,O,O′,O′*-tetraethyl ester phosphorodithioic acid

Trade Names: AC 3422®; EACITHION®; EAQUA ETHION®; EBLADAN®; ECOMMANDO INSECTICIDE CATTLE EAR TAG®; EDRASTIC®; EEMBATHION®; EETHANOX®; EETHIOL®; EETHODAN®; EETHOPAZ®; EFMC-1240®; EFOSFATOXE®; EFOSFONO 50®; EHYLEMOX®; EITOPAZ®; EKWIT®[C]; EMITKILL®; ENAGATA®; ENIA 1240®[C]; ENIAGARA 1240®[C]; ENIALATE®; EPHOSPHOTOX E®; EPROKIL®[C]; ERHODIACIDE®; ERHODOCIDE®; ERODOCID®; ERP-THION®; ESENTRY®[C]; ESOPRATHION®; ETAFETHION®; EVEGFRUFOSMITE®; EVEGFRU FOSMITE®

Chemical class: Organophosphate

EPA/OPP PC Code: 058401

California DPR Chemical Code: 268

HSDB Number: 399

UN/NA & ERG Number: UN3018 (liquid)/152

RTECS® Number: TE4550000

EC Number: 209-242-3 [*Annex I Index No.:* 015-047-00-2]

Uses: Not approved for use in EU countries[115]. Not registered for use in the U.S. There are 33 global suppliers[97]. Ethion is an organophosphate pesticide used to kill aphids, mites, scales, thrips, leafhoppers, maggots, and foliar feeding larvae. It may be used on a wide variety of food, fiber, and ornamental crops, including greenhouse crops, lawns, and turf. Ethion is a preharvest topical insecticide used primarily for spraying on citrus fruits, deciduous fruits, apples, nuts and cotton. It is also used as a cattle dip for ticks and as a treatment for buffalo flies. It is mixed with oil and sprayed on dormant trees to kill eggs and scales. It is available in dust, emulsifiable concentrate, emulsifiable solution, granular, and wettable powder formulations.

U.S. Maximum Allowable Residue Levels for Ethion [40 CFR 180.173]: cattle, meat-by-products 1.0 ppm; cattle, fat 2.5 ppm; cattle, meat (fat basis) 0.5 ppm; citrus fruits 2.0 ppm; citrus pulp, dehydrated 10.0 ppm; goat, fat 0.2 ppm; goat, meat byproducts 0.2 ppm; goat, meat 0.2 ppm; hog, fat 0.2 ppm; hog, meat byproducts 0.2 ppm; hog, meat 0.2 ppm; horse, fat 0.2 ppm; horse, meat byproducts 0.2 ppm; horse, meat 0.2 ppm; milk fat (residues in milk) 0.5 ppm; raisins 4.0 ppm; sheep, fat 0.2 ppm; sheep, meat byproducts 0.2 ppm; sheep, meat 0.2 ppm; tea, dried 10.0 ppm.

Human toxicity (long-term)[101]: High–3.50 ppb, Health Advisory

Fish toxicity (threshold)[101]: Intermediate–18.38485 ppb, MATC (Maximum Acceptable Toxicant Concentration)

Regulatory Authority and Advisory Information:

Carcinogenicity[83]: EPA Group E, evidence of noncarcinogenicity for humans

Health Advisory: Nerve Toxin, Mutagen

Acute Oral Category: 1, DANGER–POISON

U.S. DOT 49CFR172.101, Inhalation Hazard Chemical as organophosphates

Clean Water Act: Section 311 Hazardous Substances/RQ 40CFR117.3 (same as CERCLA, see below)

Superfund/EPCRA 302 Extremely Hazardous Substances: TPQ = 1000 lb (454 kg)

Superfund/EPCRA 40CFR302.4 RQ: CERCLA, 10 lb (4.54 kg)

European/International Regulations: Hazard Symbol: T, Xn, N; risk phrases: R21; R25; R50/53; safety phrases: S1/2; S25; S36/37; S45; S60; S61 (see Appendix 1)

Description: Ethion is a colorless to amber-colored liquid. The technical product has a very disagreeable odor. Molecular weight = 384.48; Specific gravity (H_2O:1) = 1.31 @ 20°C; Boiling point = decomposes above 164°C; Freezing/Melting point = –13 to –12°C; Vapor pressure = 0.0000015 mmHg @ 20°C; Flash point = 176°C; LEL (Lower Explosive Limit) = 28,000 ppm. Hazard Identification (based on NFPA-704 M Rating System): Health 3, Flammability 1, Reactivity 0. Practically insoluble in water; solubility = 0.0001%.

Incompatibilities: Incompatible with alkaline formulations and strong acids. Violent decomposition in temperatures above 164°C. Mixtures with magnesium may be explosive. In the presence of strong reducing agents such as hydrides, organophosphates form highly toxic and flammable phosphine gas. Contact with oxidizers can cause the release of toxic oxides of phosphorus.

Permissible Exposure Limits in Air:

OSHA PEL: None

NIOSH REL: 0.4 mg/m^3 [skin]

ACGIH TLV®[1]: 0.05 mg/m^3 TWA, inhalable fraction and vapor [skin]; not classifiable as a human carcinogen; BEI$_A$ issued as Acetylcholinesterase inhibiting pesticides.

Protective Action Criteria (PAC) Ver. 27[89]

PAC-1: 1.2 mg/m^3
PAC-2: 13 mg/m^3
PAC-3: 38 mg/m^3

Determination in Air: OSHA versatile sampler-2; Toluene/Acetone; Gas chromatography/Flame photometric detection for sulfur, nitrogen, or phosphorus; NIOSH IV, Method #5600, Organophosphorus Pesticide[18].

Permissible Concentration in Water: State Drinking Water Guidelines: California 4 μg/L; Florida 35 μg/L

Determination in Water: Log K_{ow} = >5.0. Values at or above 3.0 are likely to bioaccumulate in marine organisms.

Routes of Entry: Inhalation, dermal contact, and ingestion.

Harmful Effects and Symptoms

Short Term Exposure: Organic phosphorus insecticides are absorbed by the skin, as well as by the respiratory and gastrointestinal tracts. They are cholinesterase inhibitors. Symptoms may include nausea, vomiting, abdominal cramps, diarrhea, excessive salivation, headache, giddiness, weakness, muscle twitching, difficult breathing, blurring or dimness of vision, and loss of muscle coordination. Death may occur from failure of the respiratory center, paralysis of the respiratory muscles, intense bronchoconstriction, or all three. This material is very toxic; the probable oral lethal dose for humans is 50–500 mg/kg, which is between one teaspoonful and one ounce for a 150 lb person. Delayed pulmonary edema may occur after inhalation. LD_{50} (oral, rat) = <20 mg/kg; LD_{50} (dermal, rat) = 100 mg/kg.

Long Term Exposure: Cholinesterase inhibitor; cumulative effect is possible. Ethion may damage the nervous system with repeated exposure, resulting in convulsions, respiratory failure. May cause liver damage.

Points of Attack: Respiratory system, lungs, central nervous system, cardiovascular system, skin, eyes, plasma and red blood cell cholinesterase. Neurotoxin.

Medical Surveillance: Medical observation is recommended for 24 to 48 hours following breathing overexposure, as pulmonary edema may be delayed. Routine biological monitoring of pesticide applicators and field workers includes testing of plasma and red blood cell acetylcholinesterase levels (for enzyme poisoned by this chemical). These tests are normally accurate only if done within about two hours of exposure. If exposure stops, plasma levels return to normal in 1–2 weeks while red blood cell levels may be reduced for 1–3 months. When acetylcholinesterase enzyme levels are reduced by 25% or more below preemployment levels, risk of poisoning is increased, even if results are in lower ranges of "normal." Reassignment to work not involving organophosphate pesticides is recommended until enzyme levels recover. Do not drink any alcoholic beverages before or during use as it promotes absorption of organophosphates.

First Aid: **Treatment for organophosphate poisoning consists of thorough decontamination, cardiorespiratory support, and administration of the antidotes atropine and pralidoxime. In cases of severe poisoning, diazepam, an anticonvulsant, should also be administered. Antidotes should be administered as prevention even if the diagnosis is in doubt**. Speed in removing material from eyes and skin is of extreme importance. *Eyes:* Eye contact can cause dangerous amounts of these chemicals to be quickly absorbed through the mucous membrane into the bloodstream. Immediately and gently flush eyes with plenty of warm or cold water (NO hot water) for at least 15 minutes, occasionally lifting the upper and lower eyelids. Get medical aid immediately. *Skin:* Get medical aid. Dermal contact can cause dangerous amounts of these chemicals to be absorbed into the bloodstream. Wearing the appropriate PPE equipment and respirator for organophosphate pesticides, immediately flush skin with plenty of soap and water for at least 15 minutes while removing contaminated clothing and shoes. Shampoo hair promptly if contaminated. The removed, contaminated clothing and shoes should be double-bagged and left in Hot Zone for later disposal by hazardous materials experts. Skin may also be decontaminated with diluted hypochlorite solution. *Inhalation:* Get medical aid. Do not contaminate yourself. Wearing the appropriate PPE equipment and respirator for organophosphate pesticides, immediately remove the victim from the contaminated area to fresh air. If the victim is not breathing, administer artificial respiration. Do not use mouth-to-mouth method if victim ingested or inhaled the substance; give artificial respiration with the aid of a pocket mask equipped with a one-way valve or other proper respiratory medical device. If breathing is difficult, administer oxygen through bag/mask apparatus until medical help arrives. Do not leave victim unattended. *Ingestion:* Call poison control. Loosen all clothing. Never give anything by mouth to an unconscious person. If victim is *unconscious or having convulsions,* do nothing except keep victim warm. Get medical aid. Transfer promptly to a medical facility. In cases of ingestion, **do not induce vomiting**. If the victim is alert and asymptomatic, administer a slurry of activated charcoal at a dose of 1 g/kg (infant, child, and adult dose). A soda can and straw may be of assistance when offering charcoal to a child. *In some cases you may be specifically instructed by poison control to induce vomiting by way of 2 tablespoons of syrup of ipecac (adult) washed down with a cup of water*. Do NOT give activated charcoal before or with ipecac syrup

Note to physician or authorized medical personnel: Treat cases of respiratory compromise, coma, or excessive pulmonary secretions with respiratory support using protocols and techniques available and within the scope of training. Some cases may necessitate procedures such as endotracheal intubation or cricothyrotomy by properly trained and equipped personnel. When possible, atropine (see *Antidotes*, below) should be given under medical supervision. Patients who are comatose, hypotensive, or having seizures or cardiac arrhythmias should be treated according to advanced life support protocols. *Antidotes:* Two antidotes are administered to treat organophosphate poisoning. Atropine is a competitive antagonist of acetylcholine at muscarinic receptors and is used to control the excessive bronchial secretions which are often responsible for death. Pralidoxime relieves both the nicotinic and muscarine effects of organophosphate poisoning by regenerating acetylcholinesterase and can reduce both the bronchial secretions and the muscle weakness associated with poisoning. The initial intravenous dose of atropine in adults should be determined by the severity of symptoms: An initial adult dose of 1.0 to 2.0 mg or pediatric dose of 0.01 mg/kg (minimum 0.01 mg) should be administered intravenously. If intravenous access cannot be established, atropine may also be given intramuscularly, subcutaneously or via endotracheal tube. Doses should be repeated every 15 minutes until excessive secretions and sweating have been controlled. Once bronchial secretion has been controlled, atropine administration should be repeated whenever the secretions begin to recur. In seriously poisoned patients, very large doses may be required. Alterations of pulse rate and pupillary size should not be used as indicators of treatment adequacy. Pralidoxime should be administered as early in poisoning as possible as its efficacy may diminish when given more than 24 to 36 hours after exposure. Doses are as follows: adult 1.0 g; pediatric 25 to 50 mg/kg. The drug should be administered intravenously over 30 to 60 minutes, but in a life-threatening situation one-half of the total dose can be given per minute for a total administration time of 2 minutes. Treatment should begin to take effect within 40 minutes with a reduction in symptoms and the amount of atropine necessary to control bronchial secretion. The initial dose can be repeated in 1 hour and then every 8 to 12 hours until the patient is clinically well and no longer requires atropine. If intravenous access cannot be established, pralidoxime may also be given intramuscularly. Early administration of diazepam in addition to the combined atropine and pralidoxime treatment may help prevent the onset of seizures and potential brain and cardiac morphologic damage following high-level organophosphate poisoning.

Personal Protective Methods: Wear protective gloves and clothing to prevent any reasonable probability of dermal and/or eye contact. Safety equipment suppliers/manufacturers can provide recommendations on the most protective glove/clothing material for your operation. One recommendation is the use of DuPont™ Tychem® suit fabrics[88]. All protective clothing (suits, gloves, footwear, headgear) should be clean, available each day, and put on before work. Contact lenses should not be worn when working with this chemical. Wear splash-proof chemical goggles and face shield unless full facepiece respiratory protection is worn. Employees should wash immediately with soap when skin is wet or contaminated. Provide emergency showers and eyewash.

Respirator Selection: SCBA >1.2 mg/m^3. Engineering controls should be used wherever feasible to maintain airborne concentrations of this chemical below the prescribed exposure limit. Respirators and protective equipment are less effective than engineering controls, and should be used only in non-routine or emergency situations which may result in exposure concentrations in excess of the TWA environmental limit. *At any concentrations above the NIOSH REL, or where there is no REL, at any detectable concentration:* SCBAF: Pd,Pp (APF = 10,000) (any NIOSH/MSHA- or European Standard EN 149-approved self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode); or SaF: Pd,Pp: ASCBA (APF = 10,000) (any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary, self-contained breathing apparatus operated in a pressure-demand or other positive-pressure mode).

Storage: Color Code-Blue: Health Hazard/Poison. Store in a secure poison location. Prior to working with this chemical you should be trained on its proper handling and storage. Where possible, automatically transfer material from other storage containers to process containers. Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: Organophosphorus pesticides, solid or liquid (nonflammable), require a "poisonous materials" label. This chemical falls in Hazard Class 6.1.

Spill Handling: First remove all sources of ignition. Evacuate persons not wearing protective equipment from area of spill or leak until clean up is complete. Stay upwind; keep out of low areas. Ventilate area of spill or leak. Remove and isolate contaminated clothing at the site. Do not touch spilled material; stop leak if you can do so without risk. Use water spray to reduce vapors. *Small spills:* absorb with sand or other noncombustible absorbent material and place into containers for later disposal. *Large spills:* dike far ahead of spill for later disposal. Collect powdered material in the most convenient and safe manner and deposit in sealed containers. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable. Seek professional environmental engineering assistance from the U.S. EPA Environmental Response Team at (908) 548-8730 (24-hour response line).

Fire Extinguishing: Hazardous decomposition includes phosphine gase and oxides of phosphorus, sulfur, and nitrogen. Combustible; burns easily when ignited. May be fatal if inhaled, ingested or absorbed through skin. Inhalation or contact with some of these materials will irritate or burn skin and eyes. Vapors may cause dizziness or suffocation. *Small fires:* dry chemical, carbon dioxide; water spray; or foam. *Large fires:* water spray, fog, or foam. Stay upwind; keep out of low areas. Ventilate closed spaces before entering them. Firefighting gear (including SCBA) may not provide adequate protection. If exposure occurs, remove and isolate gear immediately and thoroughly decontaminate personnel. Wear positive-pressure breathing apparatus and special protective clothing. Remove and isolate contaminated clothing at the site. Move container from fire area if you can do so without risk. Fight fire from maximum distance. Dike fire control water for later disposal; do not scatter the material. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies. From a secure, explosion-proof location, use water spray to cool exposed containers. If cooling streams are ineffective (venting sound increases in volume and pitch, tank discolors, or shows any signs of deforming), withdraw immediately to a secure position. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode.

Disposal Method Suggested: Destruction by alkali hydrolysis or incineration. Containers must be disposed of properly by following package label directions or by contacting your local or federal environmental control agency, or by contacting your regional EPA office.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- EXTOXNET, Extension Toxicology Network, "Pesticide Information Profile, Ethion," Oregon State University, Corvallis, OR (June 1996). http://ace.orst.edu/info/extoxnet/pips/ethion.htm
- USEPA, Office of Pesticide Programs, Pesticide Residue Limits, "Ethion", 40 CFR 180.173. http://www.epa.gov/pesticides/food/viewtols.htm
- Department of Health and Human Resources, Agency for Toxic substances and Disease Registry, "ToxFAQs for Ethion," Atlanta, GA (February 2001). http://www.atsdr.cdc.gov/tfacts152.html
- New Jersey Department of Health and Senior Services, "Hazardous Substance Fact Sheet: Ethion," Trenton, NJ (December 1998). http://www.state.nj.us/health/eoh/rtkweb/0837.pdf
- USEPA, S,S'-Methylene-O,O,O',O'-Tetraethyl Phosphorodithioate, Health and Environmental Effects Profile No. 127, Washington DC, Office of Solid Waste (April 30, 1980)
- Agency for Toxic Substances and Disease Registry, U.S. Department of Health and Human Services, Public Health Service, "Managing Hazardous Materials Incidents," Atlanta, GA (June 2003)
- Sax, N. I., Ed., "Dangerous Properties of Industrial Materials Report," 4, No. 1, 69-74 (1984) and 7, No. 1, 9-37 (1987)
- USEPA, "Chemical Profile: Ethion," Washington DC, Chemical Emergency Preparedness Program (November 30, 1987)

Ethofumesate E:0265

Use Type: Herbicide

CAS Number: 26225-79-6

Formula: $C_{13}H_{18}O_5S$

Synonyms: 5-Benzofuranol, 2-ethoxy-2,3-dihydro-3,3-dimethyl-, methanesulfonate (+)-; 2-Ethoxy-2,3-dihydro-3,3-dimethyl-5-benzofuranyl methanesulfonate,(+)-; 2-ethoxy-2,3-dihydro-3,3-dimethylbenzofuran-5-yl methanesulfonate

Trade Names: BATAMIX PROGRESS®; BETANAL®; ETHOSAT® 500; KEMIRON®; NORTRON®; NC-8438®; POWERTWIN®; PROGRASS®; PROGRESS®; TANDEM®; TORERO®

Chemical class: Benzofuran

EPA/OPP PC Code: 110601

California DPR Chemical Code: 1900

HSDB Number: 7451

UN/NA & ERG Number: UN3077(solid)/171

RTECS® Number: DF7716500

EC Number: 247-525-3 [*Annex I Index No.:* 607-314-00-2]

Uses: A major use is to control weeds in sugar beet crops.

U.S. Maximum Allowable Residue Levels for Ethofumesate and its metabolites 2-hydroxy-2,3-dihydro-3,3-dimethyl-5-benzofuranyl methanesulfonate and 2,3-dihydro-3,3-dimethyl-2-oxo-5-benzofuranyl methanesulfonate (both calculated as the parent compound)

[40 CFR 180.345(a)(1)]: in or on the following raw agricultural commodities: beet, sugar, roots 0.1 ppm; beet, sugar, tops 1.00 ppm; cattle, fat 0.05 ppm; cattle, meat byproducts 0.05 ppm; cattle, meat 0.05 ppm; goat, fat 0.05 ppm; goat, meat byproducts 0.05 ppm; goat, meat 0.05 ppm; grass, straw 1 ppm; hog, fat 0.05 ppm; hog, meat byproducts 0.05 ppm; hog, meat 0.05 ppm; horse, fat 0.05 ppm; horse, meat byproducts 0.05 ppm; horse, meat 0.05 ppm; sheep, fat 0.05 ppm; sheep, meat byproducts 0.05 ppm; and sheep, meat 0.05 ppm. [*40 CFR 180.345(a)(2)*] in or on the following processed feeds when present therein as a result of application of the herbicide to the growing crops: sugar beet molasses 0.5 ppm.

Human toxicity (long-term)[101]: Very low–2800.00 ppb, Health Advisory

Fish toxicity (threshold)[101]: Intermediate–58.73095 ppb, MATC (Maximum Acceptable Toxicant Concentration)

Regulatory Authority and Advisory Information:

Carcinogenicity[83]: EPA Group D, Not classifiable as a human carcinogen

Acute Oral Category: 3, CAUTION

Potential Ground Water Pollutant [California FAC Section 13145(d)/12811, active]

European/International Regulations: Hazard Symbol: N; risk phrases: R51/53; safety phrases: S2; S61 (see Appendix 1)

Description: Colorless to white crystalline solid. Commercial formulations include flowable concentrate, emulsifiable concentrate, and granular products. Mild aromatic odor. Molecular weight = 286.33; Freezing/Melting point = 71°C; Boiling point = (decomposes); Specific gravity (H_2O:1) = 1.25 @ 20°C; Vapor pressure = 4.9×10^{-6} mmHg @ 20°C; 8.6×10^{-7} mmHg @ 25°C; Flash point = 80°C. Hazard Identification (based on NFPA-704 M Rating System): Health 1, Flammability 1, Reactivity 0. Soluble in water; solubility = 110 ppm @ 25°C. Physical and toxicological properties may be affected by the carrier solvents used in commercial formulations.

Determination in Air: Filter; none; Gravimetric; NIOSH IV [Particulates NOR; #0500 (total), #0600 (respirable)][18].

Determination in Water: Log K_{ow} = >2.5–<3.0. Values above 3.0 are likely to bioaccumulate in aquatic organisms.

Routes of Entry: Inhalation; ingestion; dermal and/or eye contact.

Harmful Effects and Symptoms

Short Term Exposure: May irritate eyes, skin, and respiratory tract. May be harmful if inhaled. May be harmful if swallowed. LD_{50} (oral, rat) = <1200 mg/kg; LD_{50} (dermal, rat) = >1200 mg/kg.

Long Term Exposure: Possible eye problems.

Points of Attack: Liver, kidney, cornea.

Medical Surveillance: Preliminary medical exam to detect chronic diseases of central nervous system, liver, heart, kidneys, lung and skin, as well as endocrinological or immunological disturbances, should protect susceptible individuals. Periodical medical exams of internal organs, skin and eyes are important to avoid chronic occupational intoxications. They should include lab and patch tests when necessary[83].

First Aid: If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least 15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately. If this chemical contacts the skin, remove contaminated clothing and wash immediately with soap and water. Seek medical attention immediately. If this chemical has been inhaled, remove from exposure, begin rescue breathing (using universal precautions) if breathing has stopped, and CPR if heart action has stopped. Transfer promptly to a medical facility. When this chemical has been swallowed, get medical attention. Give large quantities of water and induce vomiting. Do not make an unconscious person vomit.

Personal Protective Methods: Applicators and other handlers must wear: Coveralls worn over long-sleeved shirt and long pants; Chemical-resistant gloves such as DuPont™ Tychem® suit fabrics, barrier laminate, or Viton®; Chemical-resistant footwear plus socks; Protective eye wear; Chemical-resistant headgear for overhead exposure; Chemical-resistant apron when cleaning equipment, mixing, or loading[83]. Agricultural Use/Engineering Controls: When handlers use closed systems, enclosed cabs, or aircraft in a manner that meets the requirements listed in the Worker Protection Standard (WPS) for agricultural pesticides, 40 CFR 170.240(d)(4-6), the handler PPE requirements may be reduced or modified as specified in the Worker Protection Standard. Firefighters should wear NIOSH approved self-contained breathing apparatus and full protective clothing.

Respirator Selection: Wherever and whenever workplace conditions warrant respirator use, a respiratory protection program must be followed that meets one or more of the following government standards: OSHA's 29 CFR 1910.134, ANSI Z88.2, or European Standard EN 149.

Storage: Color Code-Blue: Health Hazard/Poison. Store in a secure poison location. Prior to working with this chemical you should be trained on its proper handling and storage. Store in tightly closed containers in a cool, well-ventilated area. Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: This material may be classified as Environmentally hazardous substances, solid, n. o. s. It usually falls in Hazard Class 9.

Spill Handling: First remove all sources of ignition. Evacuate persons not wearing protective equipment from area of spill or leak until clean up is complete. Ventilate area of spill or leak. Use water spray to reduce vapor. Absorb liquids in vermiculite, dry sand, earth, or a similar material and deposit in sealed containers. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be

properly trained and equipped. OSHA 1910.120(q) may be applicable.

Fire Extinguishing: Hazardous decomposition includes toxic oxides of carbon and sulfur. As an immediate precautionary measure, isolate spill or leak area in all directions for at least 50 meters/150 feet for liquids and at least 25 meters/75 feet for solids. *Fire involving storage or vehicular tanks:* isolate for 800 meters/0.5 mile in all directions; also, consider initial evacuation for 800 meters/0.5 mile in all directions. *On a small fire:* use dry chemical, CO_2, water spray or regular foam. *On a large fire:* use water spray, fog or regular foam. Do not scatter spilled material with high-pressure streams of water. Move containers from fire area if you can do it without risk. Dike fire-control water for later disposal. *Fire involving tanks:* from a secure, explosion-proof location, use water spray to cool exposed containers. If cooling streams are ineffective (venting sound increases in volume and pitch, tank discolors, or shows any signs of deforming), withdraw immediately to a secure position. Always stay away from tanks engulfed in fire. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode.

Disposal Method Suggested: Do not discharge into drains or sewers. Dispose of waste material as hazardous waste using a licensed disposal contractor to an approved landfill. Consult with environmental regulatory agencies for guidance on acceptable disposal practices. If allowed, incineration with effluent gas scrubbing is recommended. Containers must be disposed of properly by following package label directions or by contacting your local or federal environmental control agency, or by contacting your regional EPA office.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- United States National Library of Medicine, ChemIDplus Advanced, Bethesda, MD. http://chem.sis.nlm.nih.gov/chemidplus/rn/26225-79-6

Ethoprophos E:0270

Use Type: Nematicide, Insecticide

CAS Number: 13194-48-4

Formula: $C_8H_{19}O_2PS_2$

Synonyms: AI3-27318; Caswell No. 434C; ENT 27,318; Ethoprop; *O*-Ethyl *S,S*-dipropyl dithiophosphate; *O*-Ethyl *S,S*-dipropyl phosphorodithioate; Phosethoprop; Phosphorodithioic acid, *O*-ethyl *S,S*-dipropyl ester

Trade Names: AI3-27318®; CASWELL No. 434C®; JOLT®[C]; MENAP®; MOBIL V-C 9-104®; MOCAP®[C]; MOCAP 10G®[C]; PHOSETHOPROP®; ROVOKIL®; V-C 9-104®[C]; V-C CHEMICAL V-C 9-104®[C]; VIRGINIA-CAROLINA VC 9-104®

Chemical class: Organophosphate

EPA/OPP PC Code: 041101

California DPR Chemical Code: 404

HSDB Number: 1715

UN/NA & ERG Number: UN3018 (liquid)/152

RTECS® Number: TE4025000

EC Number: 236-152-1[*Annex I Index No.:* 015-107-00-8]

Uses: Ethoprop is used as a pre-plant soil application to control wireworms and nematodes in potatoes, sugar cane, sweet potatoes, and tobacco, with lesser usage on corn (field and sweet), beans (lima and snap), cucumbers, and cabbage. In addition, it is used to treat pineapples, bananas, and plantains, as well as field-grown ornamentals and non-bearing citrus trees, and commercial turf. Roughly 60% of ethoprop is applied to potatoes.

U.S. Maximum Allowable Residue Levels for Ethoprop (40 [CFR 180.262 (a)]: in or on the following raw agricultural commodities: banana 0.02 ppm; bean, lima 0.02 ppm; bean, snap 0.02 ppm; cabbage 0.02 ppm; corn, fodder 0.02 ppm; corn, forage 0.02 ppm; corn, fresh (including sweet K = CWHR) 0.02 ppm; corn, grain 0.02 ppm; cucumber 0.02 ppm; peanut 0.02 ppm; peanut, hay 0.02 ppm; pineapple 0.02 ppm; potato 0.02 ppm; sugarcane 0.02 ppm; and sweet potato 0.02 ppm.

Human toxicity (long-term)[101]: Intermediate–12.45550 ppb, CHCL (Chronic Human Carcinogen Level)

Fish toxicity (threshold)[101]: Extra high–0.47783 ppb, MATC (Maximum Acceptable Toxicant Concentration)

Regulatory Authority and Advisory Information:

Carcinogenicity[83]: EPA, Likely to be carcinogenic to humans.

California Proposition 65 Chemical: Cancer (2/27/01)

Acute Oral Category: 1, DANGER–POISON

Health Advisory: Nerve Toxin; Very toxic by inhalation and in contact with the skin (EU).

U.S. DOT 49CFR172.101, Inhalation Hazard Chemical as organophosphates

Potential Ground Water Pollutant [California FAC Section 13145(d)/12811, active]

Superfund/EPCRA 302 Extremely Hazardous Substances: TPQ = 1000 lb (454 kg)

Superfund/EPCRA 40CFR302.4 RQ: EHS, 1 lb (0.454 kg)

EPCRA Section 313 Form R *de minimus* concentration reporting level: 1.0%

U.S. DOT Regulated Marine Pollutant (49CFR172.101, Appendix B)

US DOT 49CFR172.101, Inhalation Hazardous Chemical as organophosphates

European/International Regulations: Hazard Symbol: T+, N; risk phrases: R25; R26/27; R43; R50/53; safety phrases: S1/2; S27/28; S36/37/39; S45; S60; S61 (see Appendix 1)

WGK (German Aquatic Hazard Class): 3-Severe hazard to waters

Description: Ethoprophos is a pale yellow liquid. Commercial products can also range from dry granular to emulsifiable concentrates. Molecular weight = 242.34; Specific gravity (H_2O:1) = 1.094 @ 25°C; Boiling point = 88–91°C; Freezing/Melting point = –13°C; Vapor pressure = 3.8×10^{-4} mmHg @ 26°C; Flash point = 140°C. Hazard Identification (based on NFPA-704 M Rating System): Health 3, Flammability 1, Reactivity 0. Highly soluble in water; solubility = 675–> 1000 ppm @ 20°C. Physical and toxicological properties may be affected by carrier solvents in commercial formulations.

Incompatibilities: In the presence of strong reducing agents such as hydrides, organophosphates form highly toxic and flammable phosphine gas. Contact with oxidizers can cause the release of toxic oxides of phosphorus. Keep away from alkaline materials.

Permissible Exposure Limits in Air: Protective Action Criteria (PAC) Ver. 27[89]

PAC-1: 2.4 mg/m^3
PAC-2: 26 mg/m^3
PAC-3: 26 mg/m3

Determination in Air: OSHA versatile sampler-2; Toluene/ Acetone; Gas chromatography/Flame photometric detection for sulfur, nitrogen, or phosphorus; NIOSH Method IV Method #5600, Organophosphorus pesticides[18].

Permissible Concentration in Water: State Drinking Water Guidelines: Florida 0.7 μg/L.

Determination in Water: NIOSH Method 1657. The determination of organophosphorus pesticides in municipal and industrial wastewater by gas chromatography. Detection limit = 6.0 ng/L. Log K_{ow} = >3.0. Values above 3.0 are likely to bioaccumulate in aquatic organisms.

Determination in Soil: Soil Adsorption Index (K_{oc}) = 70

Routes of Entry: Inhalation, dermal and eye contact. Ingestion.

Harmful Effects and Symptoms: Organophosphates are highly toxic. Symptoms may develop rapidly, or there may be a delay of several hours following exposure before they become noticeable. The delay tends to be longer in the case of some compounds that dissolve fats, lipids, oils and non-polar solvents such as toluene. Symptoms may increase in severity for more than a single day and last for several days. In severe cases of organophosphate intoxication, respiratory failure may occur.

Short Term Exposure: Highly toxic by inhalation and skin/ eye contact. Symptoms are similar to parathion and may include nausea, vomiting, abdominal cramps, diarrhea, excessive salivation, headache, giddiness, weakness, muscle twitching, difficult breathing, blurring or dimness of vision, and loss of muscle coordination. Death may occur from failure of the respiratory center, paralysis of the respiratory muscles, intense bronchoconstriction, or all three. This material is extremely toxic; the probable oral lethal dose for humans is 5–50 mg/kg, or between 7 drops and 1 teaspoonful for a 150 lb person. It is a cholinesterase inhibitor which affects the nervous system. Delayed pulmonary edema may occur after inhalation. LD_{50} (oral, rat) = 34[83,USDA] mg/kg; LD_{50} (dermal, rat) = 60 mg/kg.

Long Term Exposure: Cholinesterase inhibitor; cumulative effect is possible. This chemical may damage the nervous system with repeated exposure, resulting in convulsions, respiratory failure. May cause liver damage. Neutoxic. May cause skin sensitization.

Points of Attack: Respiratory system, lungs, central nervous system, cardiovascular system, skin, eyes, plasma and red blood cell cholinesterase. Neutoxic.

Medical Surveillance: Medical observation is recommended for 24 to 48 hours following breathing overexposure, as pulmonary edema may be delayed. Routine biological monitoring of pesticide applicators and field workers includes testing of plasma and red blood cell acetylcholinesterase levels (for enzyme poisoned by this chemical). These tests are normally accurate only if done within about two hours of exposure. If exposure stops, plasma levels return to normal in 1–2 weeks while red blood cell levels may be reduced for 1–3 months. When acetylcholinesterase enzyme levels are reduced by 25% or more below preemployment levels, risk of poisoning is increased, even if results are in lower ranges of "normal." Reassignment to work not involving organophosphate pesticides is recommended until enzyme levels recover. Do not drink any alcoholic beverages before or during use as it promotes absorption of organophosphates. Evaluation by a qualified allergist, including exposure history and testing, may help diagnose allergy.

First Aid: **Treatment for organophosphate poisoning consists of thorough decontamination, cardiorespiratory support, and administration of the antidotes atropine and pralidoxime. In cases of severe poisoning, diazepam, an anticonvulsant, should also be administered. Antidotes should be administered as prevention even if the diagnosis is in doubt**. Speed in removing material from eyes and skin is of extreme importance. *Eyes:* Eye contact can cause dangerous amounts of these chemicals to be quickly absorbed through the mucous membrane into the bloodstream. Immediately and gently flush eyes with plenty of warm or cold water (NO hot water) for at least 15 minutes, occasionally lifting the upper and lower eyelids. Get medical aid immediately. *Skin:* Get medical aid. Dermal contact can cause dangerous amounts of these chemicals to be absorbed into the bloodstream. Wearing the appropriate PPE equipment and respirator for organophosphate pesticides, immediately flush skin with plenty of soap and water for at least 15 minutes while removing contaminated clothing and shoes. Shampoo hair promptly if contaminated. The removed, contaminated clothing and shoes should be double-bagged and left in Hot Zone for later disposal by hazardous materials experts. Skin may also be decontaminated with diluted hypochlorite solution. *Inhalation:* Get medical aid. Do not contaminate yourself. Wearing the appropriate PPE equipment and respirator for organophosphate pesticides, immediately remove the victim from the contaminated area to fresh air. If the victim is not breathing, administer artificial respiration. Do not use mouth-to-mouth method if victim ingested or inhaled the substance; give artificial respiration with the aid of a pocket mask equipped with a one-way valve or other proper respiratory medical device. If breathing is difficult, administer oxygen through bag/mask apparatus until medical help arrives. Do not leave victim unattended. *Ingestion:* Call poison control. Loosen all clothing. Never give anything by mouth to an unconscious person. If victim is *unconscious or having convulsions,* do nothing except keep victim warm. Get medical aid. Transfer promptly to a medical facility. In cases of ingestion, **do not induce vomiting**. If the victim is alert and asymptomatic, administer a slurry of activated charcoal at a dose of 1 g/kg (infant, child, and adult dose). A soda can and straw may be of assistance when offering charcoal to a child. *In some cases you may be specifically instructed by poison control to induce vomiting by way of 2 tablespoons of syrup of ipecac (adult) washed down with a cup of water*. Do NOT give activated charcoal before or with ipecac syrup.

Note to physician or authorized medical personnel: Treat cases of respiratory compromise, coma, or excessive pulmonary secretions with respiratory support using protocols and techniques available and within the scope of training. Some cases may necessitate procedures such as endotracheal intubation or cricothyrotomy by properly trained and equipped personnel. When possible, atropine (see *Antidotes*, below) should be given under medical supervision. Patients who are comatose, hypotensive, or having seizures or cardiac arrhythmias should be treated according to advanced life support protocols. *Antidotes:* Two antidotes are administered to treat organophosphate poisoning. Atropine is a competitive antagonist of acetylcholine at muscarinic receptors and is used to control the excessive bronchial secretions which are often responsible for death. Pralidoxime relieves both the nicotinic and muscarine effects of organophosphate poisoning by regenerating acetylcholinesterase and can reduce both the bronchial secretions and the muscle weakness associated with poisoning. The initial intravenous dose of atropine in adults should be determined by the severity of symptoms: An initial adult dose of 1.0 to 2.0 mg or pediatric dose of 0.01 mg/kg (minimum 0.01 mg) should be administered intravenously. If intravenous access cannot be established, atropine may also be given intramuscularly, subcutaneously or via endotracheal tube. Doses should be repeated every 15 minutes until excessive secretions and sweating have been controlled. Once bronchial secretion has been controlled, atropine administration should be repeated whenever the secretions begin to recur. In seriously poisoned patients, very large doses may be required. Alterations of pulse rate and pupillary size should not be used as indicators of treatment adequacy. Pralidoxime should be administered as early in poisoning as possible as its efficacy may diminish when given more than 24 to 36 hours after exposure. Doses are as follows: adult 1.0 g; pediatric 25 to 50 mg/kg. The drug should be administered intravenously over 30 to 60 minutes, but in a life-threatening situation one-half of the total dose can be given per minute for a total administration time of 2 minutes. Treatment should begin to take effect within 40 minutes with a reduction in symptoms and the amount of atropine necessary to control bronchial secretion. The initial dose can be repeated in 1 hour and then every 8 to 12 hours until the patient is clinically well and no longer requires atropine. If intravenous access cannot be established, pralidoxime may also be given intramuscularly. Early administration of diazepam in addition to the combined atropine and pralidoxime treatment may help prevent the onset of seizures and potential brain and cardiac morphologic damage following high-level organophosphate poisoning.

Personal Protective Methods: Wear protective gloves and clothing to prevent any reasonable probability of dermal and/or eye contact. Safety equipment suppliers/manufacturers can provide recommendations on the most protective glove/clothing material for your operation. One recommendation is the use of DuPont^{TM} Tychem® suit fabrics[88]. All protective clothing (suits, gloves, footwear, headgear) should be clean, available each day, and put on before work. Contact lenses should not be worn when working with this chemical. Wear splash-proof chemical goggles and face shield unless full facepiece respiratory protection is worn. Employees should wash immediately with soap when skin is wet or contaminated. Provide emergency showers and eyewash.

Respirator Selection: SCBA = >2.4 mg/m^3. Engineering controls should be used wherever feasible to maintain airborne concentrations of this chemical below the prescribed exposure limit. Respirators and protective equipment are less effective than engineering controls, and should be used only in non-routine or emergency situations which may result in exposure concentrations in excess of the TWA environmental limit. *At any concentrations above the NIOSH REL, or where there is no REL, at any detectable concentration:* SCBAF: Pd,Pp (APF = 10,000) (any NIOSH/MSHA- or European Standard EN 149-approved self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode); or SaF: Pd,Pp: ASCBA (APF = 10,000) (any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary, self-contained breathing apparatus operated in a pressure-demand or other positive-pressure mode).

Storage: Color Code-Blue: Health Hazard/Poison. Store in a secure poison location. Prior to working with this chemical you should be trained on its proper handling and storage. Where possible, automatically transfer material from other storage containers to process containers. Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: Organophosphorus pesticides, solid or liquid (nonflammable), require a "poisonous materials" label. This chemical falls in Hazard Class 6.1.

Spill Handling: First remove all sources of ignition. Evacuate persons not wearing protective equipment from area of spill or leak until clean up is complete. Stay upwind; keep out of low areas. Ventilate area of spill or leak. Remove and isolate contaminated clothing at the site. Do not touch spilled material; stop leak if you can do so without risk. Use water spray to reduce vapors. *Small spills:* absorb with sand or other noncombustible absorbent material and place into containers for later disposal. *Large spills:* dike far ahead of spill for later disposal. Collect powdered material in the most convenient and safe manner and deposit in sealed containers. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable. Seek professional environmental engineering assistance from the U.S. EPA Environmental Response Team at (908) 548-8730 (24-hour response line).

Fire Extinguishing: Hazardous decomposition includes oxides of phosphorus, sulfur, and nitrogen. May be fatal if inhaled, ingested or absorbed through skin. Inhalation or contact with some of these materials will irritate or burn skin and eyes. Vapors may cause dizziness or suffocation. *Small fires:* dry chemical, carbon dioxide; water spray; or foam. *Large fires:* water spray, fog, or foam. Stay upwind; keep out of low areas. Ventilate closed spaces before entering them. Firefighting gear (including SCBA) may not provide adequate protection. If exposure occurs, remove and isolate gear immediately and thoroughly decontaminate personnel. Wear positive-pressure breathing apparatus and special protective clothing. Remove and isolate contaminated clothing at the site. Move container from fire area if you can do so without risk. Fight fire from maximum distance. Dike fire-control water for later disposal; do not scatter the material. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies. From a secure, explosion-proof location, use water spray to cool exposed containers. If cooling streams are ineffective (venting sound increases in volume and pitch, tank discolors, or shows any signs of deforming), withdraw immediately to a secure position. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode.

Disposal Method Suggested: Destruction by alkali hydrolysis or incineration. Containers must be disposed of properly by following package label directions or by contacting your local or federal environmental control agency, or by contacting your regional EPA office.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- EXTOXNET, Extension Toxicology Network, "Pesticide Information Profile," Oregon State University, Corvallis, OR
- N. J. Department of Health and Senior Services, "Hazardous Substance Fact Sheet, Ethoprophos," Trenton, NJ (April 2002). http://www.state.nj.us/health/eoh/rtkweb/2395.pdf
- Sax, N. I., Ed., "Dangerous Properties of Industrial Materials Report," 2, No. 4, 85-88 (1982)
- USEPA, "Chemical Profile: Ethoprophos," Washington DC, Chemical Emergency Preparedness Program (November 30, 1987)
- Agency for Toxic Substances and Disease Registry, U.S. Department of Health and Human Services, Public Health Service, "Managing Hazardous Materials Incidents," Atlanta, GA (June 2003)

Ethoxyquin E:0295

Use Type: Insecticide, Fungicide, Plant growth regulator, Ingredient in other products

CAS Number: 91-53-2

Formula: $C_{14}H_{19}NO$

Synonyms: 1,2-Dihydro-6-ethoxy-2,2,4-trimethylquinoline; 1,2-Dihydro-2,2,4-trimethyl-6-ethoxyquinoline; 6-Ethoxy-1,2-dihydro-2,2,4-trimethyl quinoline; Ethoxyquine; 6-Ethoxy-2,2,4-trimethyl-1,2-dihydroquinoline; 2,2,4-Trimethyl-6-ethoxy-1,2-dihydroquinoline

Trade Names: CHEMLEY®[C]; DECCOQUIN 305®; EMQ®; EQ®; NIFLEX®; NIX-SCALD®[C]; SANTOFLEX A®; SANTOFLEX AW®; SANTOQUIN®; SANTOQUINE®; STOP-SCALD®

Chemical class: Quinoline

EPA/OPP PC Code: 055501

California DPR Chemical Code: 269

HSDB Number: 400

UN/NA & ERG Number: UN3082 (liquid)/171

RTECS® Number: VB8225000

EC Number: 202-075-7 [*Annex I Index No.:*613-014-00-2]

Uses: Used for preharvest or postharvest preservation of color in apples and pears. It is used as an antioxidant to preserve color in paprika and ground and powdered chili. Ethoxyquin is also a chemical preservative used in animal feed to prevent ingredients from reacting with oxygen and becoming rancid. It has been known to cause birth defects in pet birds and dogs. Not approved for use in EU countries[115]. Registered for use in the U.S.

U.S. Maximum Allowable Residue Levels for ethoxyquin [40 CFR 180.178]: preharvest and postharvest residues, apple 3.0 ppm; pear 3.0 ppm.

Regulatory Authority and Advisory Information:
Acute Oral Category: 3, CAUTION
Health Advisory: Mutagen
European/International Regulations: Hazard Symbol: Xn; risk phrases: R22; safety phrases: S2; S24 (see Appendix 1)
WGK (German Aquatic Hazard Class): 2-Hazard to waters

Description: Transparent yellow or brown viscous liquid. Molecular weight = 217.32; Specific gravity (H_2O:1) = 1.032 @ 25°C; Boiling point = 124°C; 150°C @ 2 mmHg (decomposes); Freezing/Melting point = –20°C; Specific gravity (H_2O:1) = 1.029 @ 25°C; Vapor pressure = 2.56×10^{-4} mmHg @ 25°C Flash point = 143°C(oc). Hazard Identification (based on NFPA-704 M Rating System): Health 2, Flammability 1, Reactivity 0. Practically insoluble in water; solubility = <1 mg/L @ 25°C.

Incompatibilities: Polymerization can occur on contact with strong light and/or water. Decomposes in temperatures above 150°C. Keep away from oxidizers (chlorates, nitrates, peroxides, permanganates, perchlorates, chlorine, bromine, fluorine, etc); strong acids.

Determination in Air: No occupational or safety limits found.

Determination in Water: Log K_{ow} = >3.0. Values above 3.0 are likely to bioaccumulate in aquatic organisms.

Routes of Entry: Inhalation, ingestion, eye and/or dermal and/or eye contact.

Harmful Effects and Symptoms

Short Term Exposure: This chemical can irritate skin, eyes and respiratory tract. Harmful if swallowed. May cause reversible liver problems. Overexposure may cause irritation of the gastrointestinal tract. May affect central nervous system and behavior causing respiratory problems, convulsions, coma, loss of voluntary muscle control; lack of balance and coordination; drowsiness. LD_{50} (oral, rat) = 800–>1725 mg/kg.

Long Term Exposure: May cause dermatitis. Possible blood, bladder, liver and kidney toxin. May be a skin sensitizer; causing allergic skin reaction. May affect metabolism, blood, resulting in a change in clotting factor. May be mutagenic.

Points of Attack: Skin, lungs, liver, kidney.

Medical Surveillance: With ethoxyquin, if symptoms develop or overexposure is suspected, the following may be useful: liver and kidney function tests; routine blood analysis. Evaluation by a qualified allergist, including exposure history and testing, may help diagnose allergy.

First Aid: If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least 15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately. If this chemical contacts the skin, remove contaminated clothing and wash immediately with soap and water. Seek medical attention immediately. If this chemical has been inhaled, remove from exposure, begin rescue breathing (using universal precautions) if breathing has stopped, and CPR if heart action has stopped. Transfer promptly to a medical facility. When this chemical has been swallowed, get medical attention. Give large quantities of water and induce vomiting. Do not make an unconscious person vomit.

Personal Protective Methods: Applicators and other handlers must wear: Coveralls worn over long-sleeved shirt and long pants; Chemical-resistant gloves such as DuPont™ Tychem® suit fabrics, barrier laminate, or Viton®; Chemical-resistant footwear plus socks; Protective eye wear; Chemical-resistant headgear for overhead exposure; Chemical-resistant apron when cleaning equipment, mixing, or loading[83]. Agricultural Use/Engineering Controls: When handlers use closed systems, enclosed cabs, or aircraft in a manner that meets the requirements listed in the Worker Protection Standard (WPS) for agricultural pesticides, 40 CFR 170.240(d)(4-6), the handler PPE requirements may be reduced or modified as specified in the Worker Protection Standard. Firefighters should wear NIOSH approved self-contained breathing apparatus and full protective clothing.

Respirator Selection: Wherever and whenever workplace conditions warrant respirator use, a respiratory protection program must be followed that meets one or more of the following government standards: OSHA's 29 CFR 1910.134, ANSI Z88.2, or European Standard EN 149.

Storage: Color Code-Blue: Health Hazard/Poison. Store in a secure, locked poison location. Prior to working with this chemical you should be trained on its proper handling and storage. Store in tightly closed containers in a cool, well-ventilated area. Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: This material may be classified as Environmentally hazardous substances, solid, n. o. s. It usually falls in Hazard Class 9.

Spill Handling: First remove all sources of ignition. Evacuate persons not wearing protective equipment from area of spill or leak until clean up is complete. Ventilate area of spill or leak. Use water spray to reduce vapor. Absorb liquids in vermiculite, dry sand, earth, or a similar material and deposit in sealed containers. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable.

Fire Extinguishing: Hazardous decomposition includes toxic oxides of nitrogen and carbon. As an immediate precautionary measure, isolate spill or leak area in all directions for at least 50 meters/150 feet for liquids and at least 25 meters/75 feet for solids. *Fire involving storage or vehicular tanks:* isolate for 800 meters/0.5 mile in all directions; also, consider initial evacuation for 800 meters/0.5 mile in all directions. *On a small fire:* use dry chemical, CO_2, water spray or regular foam. *On a large fire:* use water spray, fog or regular foam. Do not scatter spilled material with high-pressure streams of water. Move containers from fire area if you can do it without risk. Dike fire-control water for later disposal. *Fire involving tanks:* from a secure, explosion-proof location, use water spray to cool exposed containers. If cooling streams are ineffective (venting sound increases in volume and pitch, tank discolors, or shows any signs of deforming), withdraw immediately to a secure position. Always stay away from tanks engulfed in fire. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode.

Disposal Method Suggested: Do not discharge into drains or sewers. Dispose of waste material as hazardous waste using a licensed disposal contractor to an approved landfill. Consult with environmental regulatory agencies for guidance on acceptable disposal practices. If allowed, incineration with effluent gas scrubbing is recommended. Containers must be disposed of properly by following package label directions or by contacting your local or federal environmental control agency, or by contacting your regional EPA office.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- USEPA, Office of Pesticide Programs, Pesticide Residue Limits, "Ethoxyquin," 40 CFR 180.178. http://www.epa.gov/pesticides/food/viewtols.htm

Ethylene dibromide E:0580

Use Type: Fumigant, Nematicide

CAS Number: 106-93-4

Formula: $C_2H_4Br_2$; $BrCH_2CH_2Br$

Synonyms: Celmide; DBE; 1,2-Dibromaethan (German); 1,2-Dibromoetano (Spanish); Dibromoethane; *α,β*-Dibromoethane; *sym*-Dibromoethane; 1,2-Dibromoethane; Dibromuro de etileno (Spanish); ENT 15,349; Ethane, 1,2-dibromo-; Ethylene bromide; 1,2-Ethylene dibromide; Glycol bromide; Glycol dibromide; NCI-C00522

Trade Names: AADIBROOM®; EDB-85; FUMO-GAS®; ISCOBROME D®; KOPFUME®; NEFIS®; NEPHIS®; SOILFUME®; UNIFUME®

Chemical class: Halogenated organic compound

EPA/OPP PC Code: 042002

California DPR Chemical Code: 271

HSDB Number: 536

UN/NA & ERG Number: UN1605/154

RTECS® Number: KH9275000

EC Number: 203-444-5 [*Annex I Index No.:* 602-010-00-6]

Uses: Not approved for use in EU countries[115]. Not registered for use in the U.S. Persons whose clothing or skin is contaminated with liquid ethylene dibromide (above 10°C) can secondarily contaminate others by direct contact or through off-gassing vapor. Ethylene dibromide was used extensively as a pesticide and an ingredient of soil, vegetable, fruit, and grain fumigant formulations. Still used in India, South Africa and other countries. There are 15 global suppliers[97].

U.S. Maximum Allowable Residue Levels for Ethylene Dibromide [58 FR 65554 (12/15/93)]: This document revokes pesticide tolerances for ethylene dibromide (EDB) resulting from its use as a soil and post-harvest fumigant. EPA is taking this action because uses have been cancelled.

Human toxicity (long-term)[101]: Extra high–0.05 ppb, MCL (Maximum Contaminant Level)

Fish toxicity (threshold)[101]: Very low–4841.72356 ppb, MATC (Maximum Acceptable Toxicant Concentration)

Regulatory Authority and Advisory Information:

Carcinogenicity[83]: GHS (1A, 1B) Known or presumed human carcinogen.; EPA Group B2, Probably human carcinogen; NTP: 12th Report on Carcinogens, 2011: Reasonably anticipated to be a human carcinogen; A3 Confirmed animal carcinogen with unknown relevance to humans

California Proposition 65 Chemical: Cancer (1/1/1987); Developmental/Reproductive toxin (5/15/1998)

Health Advisory: Mutagen, Developmental/Reproductive Toxin, Skin irritant/sensitizer

Acute Oral Category: 1, DANGER–POISON.

Clean Air Act: Hazardous Air Pollutants (Title I, Part A, Section 112); Accidental Release Prevention/Flammable Substances, (Section 112[r], Table 3), TQ = 20,000 lb (9,080 kg)

Clean Water Act: Section 311 Hazardous Substances/RQ 40CFR117.3 (same as CERCLA, see below); Section 313 Water Priority Chemicals (57FR41331, 9/9/92)

U.S. EPA Hazardous Waste Number (RCRA No.): U067

RCRA 40CFR268.48; 61FR15654, Universal Treatment Standards: Wastewater (mg/L), 0.028; Non-wastewater (mg/kg), 15

RCRA 40CFR264, appendix 9; TSD Facilities Ground Water Monitoring List. Suggested test method(s) (PQL μg/L): 8010 (10); 8240 (5)

Safe Drinking Water Act: MCL, 0.00005 mg/L; MCGL, zero

Superfund/EPCRA 302 Extremely Hazardous Substances: TPQ = 10,000 lb (4540 kg)

CERCLA Reportable Quantity (RQ): 1 lb (0.454 kg)

EPCRA Section 313 Form R *de minimis* concentration reporting level: 0.1%

US DOT 49CFR172.101, Inhalation Hazardous Chemical

Rotterdam Convention Annex III [Chemicals Subject to the Prior Informed Consent Procedure (PIC)] [as 1,2-dibromoethane (EDB)]

European/International Regulations: Hazard Symbol: T, Xi, N; risk phrases: R45; R23/24/25; R36/37/38; R51/53; safety phrases: S2; S45; S53; S61 (see Appendix 1)

WGK (German Aquatic Hazard Class): 3-Severe hazard to waters

Description: Ethylene dibromide is a colorless nonflammable liquid or solid (below 10°C). It has a sweet, chloroform-like odor. The minimum concentration detectable by odor is 10 ppm. Molecular weight = 187.86; Specific gravity (H_2O:1) = 2.168; Boiling point = 131.6°C; Freezing/Melting point = 9.84°C; Relative vapor density (air = 1) = 6.5; Vapor pressure = 7.5 mmHg @ 18°C. Hazard Identification (based on NFPA-704 M Rating System): Health 0, Flammability 3, Reactivity 0. Highly soluble in water; solubility = >4000 mg/L @ 30°C.

Incompatibilities: Reacts vigorously with chemically active metals, alkali metals, liquid ammonia, strong bases, strong oxidizers, causing fire and explosion hazard. Light, heat (including hot surfaces), and moisture can cause slow decomposition, forming hydrogen bromide and bromine gases. Attacks fats, rubber, some plastics and coatings.

Permissible Exposure Limits in Air: NIOSH(2) IDLH (immediately dangerous to life or health) = 100 ppm.

Conversion factor: 1 ppm = 7.69 mg/m³ @ 25°C & 1 atm

OSHA PEL: 20 ppm TWA; 30 ppm Ceiling Concentration; 50 ppm [5-minute maximum peak] [skin]. For Construction, Shipyards, and Federal Contractors: 25 ppm/190 mg/m³ Ceiling Concentration [skin]

NIOSH REL: 0.045 ppm TWA; 0.13 ppm [15-minute] Ceiling Concentration; Potential occupational carcinogen. Limit exposure to lowest feasible concentration; See *NIOSH Pocket Guide*, Appendix A

ACGIH TLV®[1]: [skin] confirmed animal carcinogen with unknown relevance to humans.

NIOSH IDLH: Potential occupational carcinogen, 100 ppm

Protective Action Criteria (PAC) Ver. 27[89]

PAC-1: **17** ppm
PAC-2: **24** ppm
PAC-3: **46** ppm

*AEGLs (Acute Emergency Guideline Levels) and ERPGs (Emergency Response Planning Guideline) are in **bold face**.

DFG MAK: [skin] Carcinogen Category 2

Determination in Air: Charcoal tube absorption; workup with Benzene/Methanol; Gas chromatography/Electrochemical detection; NIOSH IV, Method #1008[18].

Permissible Concentration in Water: Federal Drinking Water Standards: 0.2 ppb[93]; EPA 0.05 μg/L; State Drinking Water Standards: Florida 0.02 μg/L; Hawaii 0.04 μg/L; Massachusetts 0.02 μg/L; State Drinking Water Guidelines: Arizona 0.0005 μg/L; Maine 0.004 μg/L; Minnesota 0.2 μg/L.

Determination in Water: Log K_{ow} = <2.0. Unlikely to bioaccumulate in marine organisms.

Routes of Entry: Absorption can occur by the inhalation, oral, and dermal routes. It is toxic by these three routes of exposure. Toxicity is thought to be due to metabolic products of ethylene dibromide

Harmful Effects and Symptoms

Short Term Exposure: Contact can cause severe skin and eye burns, with permanent eye damage. Exposure to the vapor may also damage the eyes. Inhalation may irritate and damage the lungs. Higher exposures can cause pulmonary edema, a medical emergency that can be delayed for several hours. This can cause death. High exposure can cause dizziness, drowsiness, vomiting, unconsciousness, and death. High exposure can damage the liver or kidneys enough to cause death. The systemic effects of ethylene dibromide are in part due to metabolic conversion to the cell toxin 2-bromoacetaldehyde. Persons with pre-existing skin disorders or eye problems, or impaired liver, kidney, or respiratory tract function may be more susceptible to the effects of ethylene dibromide. *Inhalation:* Levels of 75 ppm may cause irritation of the nose, throat and lungs. 100–200 ppm for 1 hour may cause diarrhea, abdominal pain and vomiting. Other symptoms may include headache, loss of appetite, swollen glands, pale skin coloring, insomnia, dizziness and depression. Accidental high exposure has caused symptoms as listed above, internal bleeding and death. *Skin:* Contact with as little as 1 gram (1/28 ounce) may cause itching, swelling, redness, burning and blistering. May be absorbed through the skin and cause symptoms as listed under inhalation. *Eyes:* May cause irritation of eyes and eyelids. *Ingestion:* May cause vomiting, diarrhea, abdominal pain, nausea and damage to the liver and kidneys. High dose, as little as 4.5 ml (about 1 teaspoon), has caused death. LD_{50} (oral, rat) = 108–146 mg/kg; LD_{50} (dermal, rat) = 300 mg/kg.

Long Term Exposure: May cause tumors. No reliable reports exist of adverse health effects in humans exposed chronically to ethylene dibromide. Chronic exposure may be more serious for children because of their potential for a longer latency period. *Carcinogenicity[83]:* The Department of Health and Human Services has determined that ethylene dibromide can reasonably be anticipated to be a human carcinogen, based on ethylene dibromide-induced tumors in multiple sites and by various routes of exposure in animals. Results from epidemiological studies have been inconclusive. *Reproductive and developmental effects:* There is inconclusive but suggestive evidence that ethylene dibromide may reduce fertility in men. Antispermatogenic effects have been demonstrated in various animal species. Ethylene dibromide is included in *Reproductive and Developmental Toxicants,* a 1991 report published by the U.S. General Accounting Office. Special consideration regarding the exposure of pregnant women is warranted, since ethylene dibromide has been shown to be a genotoxin; thus, medical counseling is recommended for pregnant women

Points of Attack: Eyes, skin, respiratory system, liver, kidneys, reproductive system. Cancer site in animals: skin and lung tumors. Possible nerve poison. Possible liver and kidney toxin. May cause testicular damage with abnormal sperm in men and diminished fertility in women.

Medical Surveillance: This chemical is a suspected or known human carcinogen. Exposed persons should contact a physician for advice regarding the possible long term health effects and advice for medical monitoring. In addition to comprehensive initial medical and work histories emphasizing reproductive experience and menstrual history, patient should have physical examination and testing of genito-urinary tract, sperm count, motility and morphology. If required, other tests, such as serum testosterone, serum follicle stimulating hormone (FSH), and serum lutenizing hormone (LH), may be indicated. Preemployment and periodic examinations should evaluate the skin and eyes, respiratory tract, and liver and kidney functions. Medical observation is recommended for 24 to 48 hours following breathing overexposure, as pulmonary edema may be delayed. Serum bromide levels can be used to document that exposure did occur. However, bromide levels do not accurately predict the clinical course. Routine laboratory studies include CBC, glucose, and electrolyte determinations. Additional studies for patients exposed to ethylene dibromide include liver function tests and renal function tests. In cases of inhalation exposure, chest radiography and arterial blood gas measurements may be helpful

First Aid: Persons whose clothing or skin is contaminated with liquid ethylene dibromide (>10°C) can secondarily contaminate others by direct contact or through off gassing vapor. If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least 15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately. If this chemical contacts the skin, remove contaminated clothing and wash immediately with soap and water. Seek medical attention immediately. If this chemical has been inhaled, remove from exposure, begin rescue breathing (using universal precautions) if breathing has stopped, and CPR if heart action has stopped. Transfer promptly to a medical facility. If ingestion of liquid ethylene dibromide occurs, **do not induce vomiting**. If the victim is alert and able to swallow, administer a slurry of activated charcoal at a dose of 1 g/kg (infant, child, and adult dose). A soda can and straw may be of assistance when offering charcoal to a child. As first aid for pulmonary edema, a doctor or authorized paramedic may consider administering a corticosteroid spray.

Note to physician or authorized medical personnel: In cases of respiratory compromise secure airway and respiration via endotracheal intubation. If not possible, perform cricothyrotomy if equipped and trained to do so. Treat patients who have bronchospasm with an aerosolized bronchodilator such as albuterol. Consider racemic epinephrine aerosol for children who develop stridor. Dose 0.25–0.75 mL of 2.25% racemic epinephrine solution, repeat every 20 minutes as needed, cautioning for myocardial variability. Patients who are comatose, hypotensive, or are having seizures or cardiac arrhythmias should be treated according to advanced life support protocols. If evidence of shock or hypotension is observed, begin fluid administration. For adults with systolic pressure <80 mmHg, bolus perfusion of 1000 mL/hour intravenous saline or lactated Ringer's solution may be appropriate. Higher adult systolic pressures may necessitate lower perfusion rates. For children with compromised perfusion administer a 20 mL/kg bolus of normal saline over 10 to 20 minutes, then infuse at 2 to 3 mL/kg/hour.

Personal Protective Methods: Wear protective gloves, clothing, including eye protection to prevent any reasonable probability of skin or eye contact. Safety equipment suppliers/manufacturers can provide recommendations on the most protective glove/clothing material for your operation. **8 hr:** polyvinyl alcohol gloves; Teflon™ gloves, suits, boots; Viton™ gloves, suits; 4H™ and Silver Shield™ gloves; Barricade® coated suits; Trychem 1000™ suits. Do NOT use chlorinated polyethylene. All protective clothing (suits, gloves, footwear, headgear) should be clean, available each day, and put on before work. Contact lenses should not be worn when working with this chemical. Wear splash-proof chemical goggles and face shield unless full facepiece respiratory protection is worn. Employees should wash immediately with soap when skin is wet or contaminated. Provide emergency showers and eyewash.

Respirator Selection: SCBA >17 ppm. NIOSH: *At any detectable concentration:* SCBAF: Pd,Pp (APF = 10,000) (any NIOSH/MSHA- or European Standard EN 149-approved self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode); or SaF: Pd,Pp: ASCBA (APF = 10,000) (any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary, self-contained breathing apparatus operated in a pressure-demand or other positive-pressure mode). *Escape:* GmFOv (APF = 50) [any air-purifying, full facepiece respirator (gas mask) with a chin-style, front- or back-mounted organic vapor canister]; or SCBAE (any appropriate escape-type, self-contained breathing apparatus).

Storage: Color Code-Blue: Health Hazard/Poison/Corrosive: Store in a secure poison location. Store in a cool, dry place that is well-ventilated. Keep in tightly sealed containers and away from light, heat, active metals and liquid ammonia. A regulated, marked area should be established where this chemical is handled, used, or stored in compliance with OSHA Standard 1910.1045. Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: This compound requires a shipping label of "poisonous materials." Hazard Class is 6.1.

Spill Handling: Evacuate and restrict persons not wearing protective equipment from area of spill or leak until clean up is complete. Ventilate area of spill or leak. Absorb liquids in vermiculite, dry sand, earth, peat, carbon, or a similar material and deposit in sealed containers. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be

properly trained and equipped. OSHA 1910.120(q) may be applicable.

Initial isolation and protective action distances

Distances shown are likely to be affected during the first 30 minutes after materials are spilled and could increase with time. If more than one tank car, cargo tank, portable tank, or large cylinder involved in the incident is leaking, the protective action distance may need to be increased. You may need to seek emergency information from CHEMTREC at (800) 424-9300 or seek professional environmental engineering assistance from the U.S. EPA Environmental Response Team at (908) 548-8730 (24-hour response line).

Small spills (From a small package or a small leak from a large package)

First: isolate in all directions (feet/meters) 100/30
Then: Protect persons downwind (miles/kilometers)
Day 0.1/0.2
Night 0.1/0.2

Large spills (From a large package or from many small packages)

First: isolate in all directions (feet/meters) 100/30
Then: Protect persons downwind (miles/kilometers)
Day 0.2/0.3
Night 0.3/0.5

Fire Extinguishing: EDB is a noncombustible liquid. Hazardous decomposition includes oxides of carbon, bromine, vinyl bromide, and hydrogen bromide gas. *Fire involving storage or vehicular tanks:* isolate for 800 meters/0.5 mile in all directions; also, consider initial evacuation for 800 meters/0.5 mile in all directions. *Small fire:* dry chemical, carbon dioxide or water spray. *Large fire:* dry chemical, carbon dioxide, alcohol-resistant foam or water spray. Move containers from fire area if you can do it without risk. Dike fire-control water for later disposal; do not scatter the material. *Fire involving tanks or car/trailer loads:* fight fire from maximum distance or use unmanned hose holders or monitor nozzles. Do not get water inside containers. Cool containers with flooding quantities of water until well after fire is out. Withdraw immediately in the case of rising sound from venting safety devices or discoloration of tank. Always stay away from tanks engulfed in fire. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode.

Disposal Method Suggested: Generators of waste containing this contaminant (≥100 kg/mo) must conform with EPA regulations governing storage, transportation, treatment, and waste disposal. Controlled incineration with adequate scrubbing and ash disposal facilities. A potential candidate for rotary kiln incineration at a temperature range of 820 to 1,600 °C and residence times of seconds for liquids and gases, and hours for solids. A potential candidate for fluidized bed incineration at a temperature range of 450 to 980 °C and residence times of seconds for liquids and gases, and longer for solids[83].

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- Environmental Protection Agency, Sampling and Analysis of Selected Toxic Substances, Task II-Ethylene Dibromide, Final Report. Office of Toxic Substances, EPA, Washington DC (September 1975)
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- Agency for Toxic Substances and Disease Registry, U.S. Department of Health and Human Services, Public Health Service, "Managing Hazardous Materials Incidents," Atlanta, GA (June 2003)
- Sax, N. I., Ed., "Dangerous Properties of Industrial Materials Report," 1, No. 5, 58-60 (1981)
- New York State Department of Health, "Chemical Fact Sheet: Ethylene Dibromide," Albany, NY, Bureau of Toxic Substance Assessment (March 1986, Version 2)
- New Jersey Department of Health and Senior Services, "Hazardous Substance Fact Sheet, Ethylene Dibromide," Trenton, NJ (October 1995, rev. August 2001). http://www.state.nj.us/health/eoh/rtkweb/0877.pdf
- U.S. Environmental Protection Agency, Engineering Handbook for Hazardous Waste Incineration, EPA 68-03-3025, p.3-12, Washington DC, (1981)

Ethylene dichloride E:0590

Use Type: Fumigant, Insecticide

CAS Number: 107-06-2

Formula: $C_2H_4Cl_2$; $ClCH_2CH_2Cl$

Synonyms: 1,2-Bichloroethane; Dichloremulsion; Dichlor-mulsion; *α,β*-Dichloroethane; *sym*-Dichloroethane; 1,2-Dichloroethane; Dichloroethylene; 1,2-Dicloroetano (Spanish); EDC; ENT 1,656; Ethane, 1,2-dichloro-; Ethane dichloride; Ethylene chloride; 1,2-Ethylene dichloride; Freon 150; Glycol dichloride; NCI-C00511

Trade Names: BORER SOL®; BROCIDE®; DESTRUXOL BORER-SOL®; DOWFUME®[C]; DUTCH LIQUID®; DUTCH OIL®

Chemical class: Chlorinated hydrocarbon

EPA/OPP PC Code: 042003

California DPR Chemical Code: 274

HSDB Number: 65
UN/NA & ERG Number: UN1184/131
RTECS® Number: KI0525000
EC Number: 203-458-1 [*Annex I Index No.:* 602-012-00-7]
Uses: Not approved for use in EU countries[115]. Not registered for use in the U.S. When mixed with carbon tetrachloride, ethylene dichloride is used as a grain fumigant for bulk storage in bags, sealed containers, bins or on floors. In recent years, 1,2-dichloroethane has found wide use in the manufacture of ethylene glycol, diaminoethylene, polyvinyl chloride, nylon, viscose rayon, styrenebutadiene rubber, and various plastics. It is a solvent for resins, asphalt, bitumen, rubber, cellulose acetate, cellulose ester, and paint; a degreaser in the engineering, textile and petroleum industries; and an extracting agent for soybean oil and caffeine. It is also used as an antiknock agent in gasoline, a pickling agent and a dry-cleaning agent. It has found use in photography, xerography, water softening, and also in the production of adhesives, cosmetics, pharmaceuticals, and varnishes.
U.S. Maximum Allowable Residue Levels for Fumigants, including ethylene dichloride [40 CFR 193.225, 180.521, 180.522]: grain, cereal, milled fractions 125 ppm; corn, field, grits 125 ppm; rice, cracked 125 ppm.
Regulatory Authority and Advisory Information:
Carcinogenicity[83]: IARC: Animal Sufficient Evidence; Human Inadequate Evidence*, possibly carcinogenic to humans*, Group 2b, 1999; EPA: Sufficient evidence from animal studies; inadequate evidence or no useful data from epidemiologic studies; NTP: 12th Report on Carcinogens, 2011: Reasonably anticipated to be a human carcinogen; NIOSH: Potential occupational carcinogen
California Proposition 65 Chemical: Cancer (1/1/1987)
Health Advisory: Mutagen, Developmental/Reproductive Toxin, Skin irritant/sensitizer
Clean Air Act: Hazardous Air Pollutants (Title I, Part A, Section 112)
Clean Water Act: Section 311 Hazardous Substances/RQ 40CFR117.3 (same as CERCLA, see below); 40CFR423, appendix A, Priority Pollutants; Section 313 Water Priority Chemicals (57FR41331, 9/9/92); Toxic Pollutant (Section 401.15)
U.S. EPA Hazardous Waste Number (RCRA No.): U077, D028
RCRA Toxicity Characteristic (Section 261.24), Maximum Concentration of Contaminants, regulatory level, 0.5 mg/L
RCRA 40CFR268.48; 61FR15654, Universal Treatment Standards: Wastewater (mg/L), 0.21; Non-wastewater (mg/kg), 6.0
RCRA 40CFR264, appendix 9; TSD Facilities Ground Water Monitoring List. Suggested test method(s) (PQL μg/L): 8010 (0.5); 8240 (5)
Safe Drinking Water Act: MCL, 0.005 mg/L; MCLG, zero; Regulated chemical (47 FR 9352)
CERCLA Reportable Quantity (RQ): 100 lb (45.4 kg)
US DOT Regulated Marine Pollutant (49CFR172.101, appendix B)
US DOT 49CFR172.101, Inhalation Hazardous Chemical
Rotterdam Convention Annex III [Chemicals Subject to the Prior Informed Consent Procedure (PIC)]
European/International Regulations: Hazard Symbol: F, T; risk phrases: R45; F11; R22-36/37/38; safety phrases: S2; S53; S45 (see Appendix 1)
WGK (German Aquatic Hazard Class): 3-Severe hazard to waters
Description: 1,2-Dichloroethane is a clear, colorless, flammable liquid. A pleasant, chloroform-like odor, and a sweet taste. Decomposes slowly: turns dark and acidic on contact with air, moisture, and light. The Odor Threshold is 100 ppm. Molecular weight = 98.96; Specific gravity (H_2O:1) = 1.245; Boiling point = 83.5°C; Freezing/Melting point = –35.7°C; Vapor pressure = 75 mmHg @ 23.70°C; Flash point = 13.33°C (cc)[17]; Autoignition temperature = 413°C. Explosive limits: LEL = 6.2%; UEL = 16.0%. Hazard Identification (based on NFPA-704 M Rating System): Health 2, Flammability 3, Reactivity 0. Soluble in water; solubility = 0.869 g/100 mL @ 20°C.
Incompatibilities: Forms explosive mixture with air. Reacts violently with strong oxidizers and caustics; chemically active metals such as magnesium or aluminum powder, sodium and potassium, alkali metals, alkali amides; liquid ammonia. Decomposes to vinyl chloride and HCl above 600°C. Attacks plastics, rubber, coatings. Attacks many metals in presence of water.
Permissible Exposure Limits in Air: Conversion factor: 1 ppm = 4.05 mg/m^3 @ 25°C & 1 atm
NIOSH IDLH: 50 ppm; a potential human carcinogen.
OSHA PEL: 50 ppm TWA; 100 ppm Ceiling Concentration; 200 ppm [5 minute maximum peak in any 3 hours]. For Construction and Shipyards: 50 ppm/200 mg/m^3 TWA
NIOSH REL: 1 ppm/4 mg/m^3 TWA; 2 ppm/8 mg/m^3 STEL, a potential occupational carcinogen. Limit exposure to lowest feasible concentration. See *NIOSH Pocket Guide*, Appendix A
ACGIH TLV®[1]: 10 ppm, not classifiable as a human carcinogen as chloroethanes
Protective Action Criteria (PAC) Ver. 27[89]
PAC-1: $\mathbf{50}_{\mathbf{E}}$ ppm
PAC-2: $\mathbf{200}_{\mathbf{E}}$ ppm
PAC-3: $\mathbf{300}_{\mathbf{E}}$ ppm
PAC values marked with a subscript "**E**" correspond to ERPGs (Emergency Response Planning Guideline) values and are in **bold face**.
DFG MAK: [skin] Carcinogen Category 2
Determination in Air: Charcoal adsorption, workup with CS_2, analysis by gas chromatography/flame ionization. See NIOSH IV, Method #1003 for halogenated hydrocarbons[18]
Permissible Concentration in Water: Federal Drinking Water Guidelines: 4 ppb[93]
Determination in Water: Inert gas purge followed by chromatography with halide-specific detection (EPA Method 601) or gas chromatography plus mass spectrometry (EPA Method 624). Log K_{ow} = <1.5. Unlikely to bioaccumulate in marine organisms.
Routes of Entry: Inhalation of vapor, skin absorption of liquid, ingestion, skin and/or eye contact

Harmful Effects and Symptoms

Short Term Exposure: Irritates the eyes, skin, and respiratory tract. Inhalation of the vapors can cause pulmonary edema, a medical emergency that can be delayed for several hours. This can cause death. Exposure can cause nausea, vomiting, headaches, drowsisness and loss of consciousness. Overexposure to ethylene dichloride may damage the central nervous system, kidneys, liver. *Inhalation:* Levels of 10 to 30 ppm may cause dizziness, nausea, and vomiting. Levels up to 50 pm may cause weakness, trembling, headaches, abdominal cramps, liver and kidney damage, and fluid build up in lungs. May cause coma and death at high levels. *Skin:* Contact may cause irritation and skin rash, and irritates the eyes. *Eyes:* May cause redness, pain, and blurred vision. Vapor can damage the cornea. *Ingestion:* Ingestion of 2 ounces has resulted in nausea, vomiting, faintness, drowsiness, difficulty breathing, pale skin, internal bleeding, kidney damage, and death due to respiratory failure. Other possible symptoms may include abdominal spasms, severe headache, lethargy, lowered blood pressure, diarrhea, shock, physical collapse, and coma. LD_{50} (oral, rat) = 670–900 mg/kg.

Long Term Exposure: May cause tumors. Repeated or prolonged contact can chronically irritate the skin causing dryness, redness and a rash. Prolonged or repeated exposure may cause eye, nose and throat irritation, nerve damage, liver and kidney damage. This substance has been determined to cause cancer of the lung, stomach, breast and other sites in laboratory animals, and may be a human carcinogen. Can irritate the lungs and bronchitis may develop. Repeated or prolonged exposure can cause loss of appetite, nausea and vomiting, trembling and low blood sugar.

Points of Attack: Eyes, skin, kidneys, liver, respiratory system, central nervous system, cardiovascular system. Cancer site in animals: forestomach, mammary gland and circulatory system cancer.

Medical Surveillance: This chemical is a suspected or known human carcinogen. Exposed persons should contact a physician for advice regarding the possible long term health effects and advice for medical monitoring. Before beginning employment and at regular times after that, the following are recommended: Lung function tests. Liver and kidney function tests. If symptoms develop or overexposure is suspected, the following may be useful: Consider chest x-ray after acute overexposure.

First Aid: If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least 15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately. If this chemical contacts the skin, remove contaminated clothing and wash immediately with soap and water. Seek medical attention immediately. If this chemical has been inhaled, remove from exposure, begin rescue breathing (using universal precautions) if breathing has stopped, and CPR if heart action has stopped. Transfer promptly to a medical facility. When this chemical has been swallowed, get medical attention. Give large quantities of water and induce vomiting. Do not make an unconscious person vomit. Medical observation is recommended for 24 to 48 hours following breathing overexposure, as pulmonary edema may be delayed. As first aid for pulmonary edema, a doctor or authorized paramedic may consider administering a corticosteroid spray.

Personal Protective Methods: Wear protective gloves and clothing to prevent any reasonable probability of dermal and/or eye contact. Safety equipment suppliers/manufacturers can provide recommendations on the most protective glove/clothing material for your operation. **8 hr:** Teflon™ gloves, suits, boots; Viton™ gloves, suits; 4H™ and Silver Shield™ gloves; Barricade® coated suits; CPF3™ suits; Responder™ suits; Trychem 1000™ suits; **4 hr:** polyvinyl alcohol gloves. All protective clothing (suits, gloves, footwear, headgear) should be clean, available each day, and put on before work. Contact lenses should not be worn when working with this chemical. Wear splash-proof chemical goggles and face shield unless full facepiece respiratory protection is worn. Employees should wash immediately with soap when skin is wet or contaminated. Provide emergency showers and eyewash.

Respirator Selection: SCBA >50 ppm. NIOSH: *At any detectable concentration:* SCBAF: Pd,Pp (APF = 10,000) (any NIOSH/MSHA- or European Standard EN 149-approved self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode); or SaF: Pd,Pp: ASCBA (APF = 10,000) (any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary, self-contained breathing apparatus operated in a pressure-demand or other positive-pressure mode). *Escape:* GmFOv (APF = 50) [any air-purifying, full facepiece respirator (gas mask) with a chin-style, front- or back-mounted organic vapor canister]; or SCBAE (any appropriate escape-type, self-contained breathing apparatus).

Storage: Color Code-Red: Flammability Hazard: Store in a flammable liquid storage area or approved cabinet away from ignition sources and corrosive and reactive materials. Prior to working with this chemical you should be trained on its proper handling and storage. Before entering confined space where this chemical may be present, check to make sure that an explosive concentration does not exist. Store in tightly closed containers in a cool, well-ventilated area away from oxidizers (such as perchlorates, peroxides, permanganates, chlorates and nitrates), strong acids (such as hydrochloric, sulfuric and nitric), chemically active metals (such as potassium, sodium, magnesium and zinc), strong caustics (such as sodium hydroxide) and dimethylaminopropylamine, since violent reactions occur. A regulated, marked area should be established where this chemical is handled, used, or stored in compliance with OSHA Standard 1910.1045. Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: This compound requires a shipping label of "FLAMMABLE LIQUID, POISONOUS/TOXIC

MATERIALS." It usually falls in Hazard Class 3 and Packing Group II.

Spill Handling: Evacuate and restrict persons not wearing protective equipment from area of spill or leak until clean up is complete. Establish forced ventilation to keep levels below explosive limit. Absorb liquids in vermiculite, dry sand, earth, peat, carbon, or a similar material and deposit in sealed containers. Keep ethylene dichloride out of a confined space, such as a sewer, because of the possibility of an explosion, unless the sewer is designed to prevent the build-up of explosive concentrations. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable.

Fire Extinguishing: This chemical is a flammable liquid. Hazardous decomposition includes phosgene, acetylene, vinyl chloride, and hydrogen chloride[9]. CAUTION: This product may have a very low flash point: Use of water spray when fighting fire may be inefficient. *Small fire*: dry chemical, CO_2, water spray or alcohol-resistant foam. *Large fire*: water spray, fog or alcohol-resistant foam. Move containers from fire area if you can do it without risk. Dike fire-control water for later disposal; do not scatter the material. Use water spray or fog; do not use straight streams. *Fire involving tanks or vehicular loads:* fight fire from maximum distance or use unmanned hose holders or monitor nozzles. Cool containers with flooding quantities of water until well after fire is out. Withdraw immediately in the case of rising sound from venting safety devices or discoloration of tank. ALWAYS stay away from tanks engulfed in fire. For massive fire, use unmanned hose holders or monitor nozzles; if this is impossible, withdraw from area and let fire burn. Vapors are heavier than air and will collect in low areas. Vapors may travel long distances to ignition sources and flashback. Vapors in confined areas may explode when exposed to fire. Storage containers and parts of containers may rocket great distances, in many directions. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies. From a secure, explosion-proof location, use water spray to cool exposed containers. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode.

Disposal Method Suggested: Do not discharge into drains or sewers. Dispose of waste material as hazardous waste using a licensed disposal contractor to an approved landfill. Consult with environmental regulatory agencies for guidance on acceptable disposal practices. Generators of waste containing this contaminant (≥100 kg/mo) must conform with EPA regulations governing storage, transportation, treatment, and waste disposal. If allowed, incineration with effluent gas scrubbing is recommended. Containers must be disposed of properly by following package label directions or by contacting your local or federal environmental control agency, or by contacting your regional EPA office. Contaminated porous surfaces (sand, vemiculite, etc.) should be disposed of at a waste management facility. Recovered liquids may be reprocessed, incinerated, or treated at a waste management facility. Consider liquid injection incineration, with a temp range of 650 to 1600°C and a residence time of 0.1 to 2 seconds. Also a potential candidate for rotary kiln incineration, with a temp range of 820 to 1600°C and a residence time of seconds. Also a potential candidate for fluidized bed incineration, with a temp range of 450–980°C and a residence time of seconds.

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Ethylene oxide E:0660

Use Type: Fungicide and fumigant
CAS Number: 75-21-8
Formula: C_2H_4O
Synonyms: Dihydrooxirene; Dimethylene oxide; ENT 26,263; E. O; 1,2-Epoxyaethan (German); Epoxyethane; 1,2-Epoxyethane; Ethene oxide; ETO; NCI-C50088; Oxacyclopropane; Oxane; *α,β*-Oxidoethane; Oxirane; Oxirene, Dihydro-; UN 1040
Trade Names: AMPROLENE®; ANPROLENE®; ANPROLINE®; BIODAC®; MERPOL®; OXYFUME®; OXYFUME 12®; T-GAS®; STERILIZING GAS ETHYLENE OXIDE 100%®
Chemical class: Alcohol/ether
EPA/OPP PC Code: 042301
California DPR Chemical Code: 277
HSDB Number: 170
UN/NA & ERG Number: UN1040/119; IMO 2.3
RTECS® Number: KX2450000
EC Number: 200-849-9 [*Annex I Index No.:* 603-023-00-X]
Uses: Ethylene oxide is used as a fumigant for spices, seasonings, and foodstuffs and as an agricultural fungicide. When used directly in the gaseous form or in nonexplosive gaseous mixtures with nitrogen or carbon dioxide, ethylene oxide can act as a disinfectant, fumigant, sterilizing agent, and insecticide. It is a man-made chemical used as an intermediate in organic synthesis for ethylene glycol, polyglycols, glycol ethers, esters, ethanolamines, acrylonitrile, plastics, and surface-active agents. It is also used as a fumigant for textiles and for sterilization, especially for surgical instruments. It is used in drug synthesis and as a pesticide intermediate. Not approved for use in EU countries[115]. Actively registered in the U.S.
U.S. Maximum Allowable Residue Levels for Ethylene Oxide [(40 CFR 180.151, 185.2850 (a)]: walnut, black 50 ppm; coconut, copra 50 ppm; spices, whole 50 ppm; seasonings, processed natural, including spices, except salt mixture 50 ppm; spices, processed 50 ppm. [*40 CFR 180.151(a)(2)*]: can be safely used as a fumigant for the control of microorganisms and insect infestation in ground spices and other processed natural seasoning materials, except mixtures to which salt has been added, in accordance with the following prescribed conditions: (i) Ethylene oxide, either alone or admixed with carbon dioxide or dichlorodifluoromethane, shall be used in amounts not to exceed that required to accomplish the intended technical effects. If used with dichlorodifluoromethane, the dichlorodifluoromethane shall conform with the requirements prescribed by 21 CFR 173.355 of this chapter. (ii) To assure safe use of the fumigant, its label and labeling shall conform to that registered with the U.S. Environmental Protection Agency and it shall be used in accordance with such label or labeling. (iii) Residues of ethylene oxide in ground spices from both post-harvest application to whole spices and application to the ground spices shall not exceed the established tolerance of 50 ppm for residues in whole spices in paragraph (a)(1) of this section.

Regulatory Authority and Advisory Information:
Carcinogenicity[83]: GHS (1A, 1B) Known or presumed human carcinogen; NTP: 12th Report on Carcinogens, 2011: Known to be a human carcinogen; ACGIH A2 Suspected Human Carcinogen.
California Proposition 65 Chemical: Cancer (7/1/1987); female (2/27/87); Developmental/Reproductive toxin (male) (8/7/2009).
Health Advisory: Mutagen, Developmental/Reproductive Toxin, Skin irritant/sensitizer
Highly Reactive Substance and Explosive (World Bank)[15]
OSHA, 29CFR1910 Specifically Regulated Chemicals (See CFR 1910.1047)
U.S. DOT 49CFR172.101, Inhalation Hazard Chemical
OSHA 29CFR1910.119, Appendix A. Process Safety List of Highly Hazardous Chemicals, TQ = 5,000 lb (2,270 kg)
Clean Air Act: Hazardous Air Pollutants (Title I, Part A, Section 112); Accidental Release Prevention/Flammable substances, (Section 112[r], Table 3), TQ = 10,000 lb (4540 kg)
EPA Hazardous Waste Number (RCRA No.): U115
RCRA 40CFR268.48; 61FR15654, Universal Treatment Standards: Wastewater (mg/L), 0.12; Non-wastewater (mg/kg), N/A
Superfund/EPCRA 302 Extremely Hazardous Substances: TPQ = 1000 lb (454 kg)
Superfund/EPCRA 40CFR302.4 RQ: CERCLA, 10 lb (4.54 kg)
EPCRA Section 313 Form R *de minimus* concentration reporting level: 0.1%
US DOT 49CFR172.101, Inhalation Hazardous Chemical
Rotterdam Convention Annex III [Chemicals Subject to the Prior Informed Consent Procedure (PIC)]
European/International Regulations: Hazard Symbol: F+, T; Risk Phrases: R45; R46; R6; R12; R23; R36/37/38; safety phrases: S2; S53; S45 (see Appendix 1)
WGK (German Aquatic Hazard Class): 2-Hazard to waters
Description: Ethylene oxide is a colorless, compressed, liquefied gas or liquid (<11°C). Sweet odor. *Danger*: the Odor Threshold = 50 ppm. Molecular weight = 44.05; Specific gravity (H_2O:1) = 0.8821 (liquid) @ 10°C; Boiling point = 10.6°C; Freezing/Melting point = –112.2°C; Vapor pressure = 1.46 atm; 750 mmHg @ 10.2°C; Relative vapor density (air = 1) = 1.49; Relative vapor density (air = 1) = 1.49; Flash point = flammable gas (–20°C, liquid); Autoignition temperature = 429°C. Explosive limits: LEL = 3.0%; UEL = 100%. Hazard Identification (based on NFPA-704 M Rating System): Health 3, Flammability 4, Reactivity 3. Easily dissolved in water.
Incompatibilities: Forms explosive mixture with air. Dangerously reactive; may rearrange chemically and/or polymerize violently with evolution of heat, when in contact with highly active catalytic surfaces such as anhydrous chlorides of iron, tin and aluminum, pure oxides of iron and aluminum, and alkali metal hydroxides. Even small amounts of strong acids, alkalis, oxidizers can cause a dangerous reaction. Avoid

contact with copper. Protect container from physical damage, sun and heat. Attacks some plastics, rubber or coatings.

Permissible Exposure Limits in Air: Conversion factor: 1 ppm = 1.80 mg/m^3 @ 25°C & 1 atm

OSHA PEL: 1 ppm/5 ppm [15 min excursion] TWA, cancer hazard, see 29CFR1910.1047(c).

NIOSH REL: <0.1 ppm/<0.18 mg/m^3 TWA; 5 ppm/9 mg/m^3 [10 min/day] Ceiling Concentration; Potential carcinogen. Limit exposure to lowest feasible level. See *NIOSH Pocket Guide*, Appendix A

ACGIH TLV®[1]: 1 ppm/1.8 mg/m^3 TWA, Suspected Human Carcinogen

NIOSH IDLH: 800 ppm

Protective Action Criteria (PAC) Ver. 27[89]

PAC-1: 5 ppm
PAC-2: **45** ppm (60 min.)
PAC-3: **200** ppm (60 min.)

*AEGLs (Acute Emergency Guideline Levels) & ERPGs (Emergency Response Planning Guideline) are in **bold face**.

DFG MAK: [skin]; Carcinogen Category 2; Germ Cell Mutagen Category 2; TRK: 1 ppm/1.83 mg/m^3; Sampling time: not fixed; 90 μg[hydroxyethylvaline]/L blood.

Determination in Air: Collection by charcoal tube (petroleum-based); DMF. Any dust and mist respirator with a full facepiece; analysis by gas chromatography/electrochemical detection; NIOSH IV, Method #1614[18].

Permissible Concentration in Water: State Drinking Water Guidelines: Florida 10 μg/L.

Determination in Water: Log K_{ow} = Negative (<–0.5). Unlikely to bioaccumulate in marine organisms.

Routes of Entry: Ethylene oxide is rapidly absorbed after inhalation, and solutions of ethylene oxide can penetrate human skin.

Harmful Effects and Symptoms

Short Term Exposure: Ethylene oxide gas may produce immediate local irritation of the skin, eyes, and upper respiratory tract. At high concentrations, it may cause an immediate or delayed accumulation of fluid in the lungs. Inhalation of ethylene oxide can produce central nervous system depression, and, in extreme cases, respiratory distress and coma. The onset of symptoms may be delayed for up to 72 hours. In some persons, ethylene oxide exposure may result in allergic sensitization, and future exposure may cause hives or a life-threatening allergic reaction. Signs and symptoms of acute exposure to ethylene oxide may be severe, and include dyspnea (shortness of breath), cough, pulmonary edema, pneumonia, and respiratory failure. Lethargy, headache, dizziness, twitching, convulsions, paralysis, and coma may be observed. Cardiac arrhythmias and cardiovascular collapse may also occur. Gastrointestinal effects of acute exposure may include nausea, vomiting, and abdominal pain. Ethylene oxide irritates the eyes, skin, and respiratory tract. Very high exposures can cause pulmonary edema, a medical emergency that can be delayed for several hours. *Inhalation:* Exposure to 500–700 ppm for 2 to 3 minutes, resulted in nausea, vomiting, headache, disorientation, fluid in the lungs, followed by seizures. Human volunteers breathing a concentration of about 2500 ppm experienced slight irritation of the respiratory tract; breathing in 12,500 ppm showed definite respiratory tract irritation within 10 seconds. Symptoms may not occur for hours after exposure. Other symptoms reported at unknown concentrations include headache, nausea, coughing, vomiting, difficult breathing, respiratory tract irritation, weakness, incoordination, seizures and fluid in the lungs. *Skin:* The pure liquid may cause frostbite. A 1% water solution can cause irritation and redness. A 40–80% water solution may cause extensive blister formation. Ethylene oxide may severely irritate or burn mucous membranes and moist skin. *Eyes:* May cause irritation and severe burns. May affect the eyes, causing delayed development of cataract. Eye contact may result in conjunctivitis (red, inflamed eyes) and erosion of the cornea. *Ingestion:* May cause gastric irritation and liver injury. LD_{50} (oral, rat) = 72–330 mg/kg.

Long Term Exposure: May cause tumors. Chronic ethylene oxide exposure may cause delayed peripheral nerve damage (neuropathy), especially in the lower extremities. Although the results are inconclusive, some data suggest that chronic ethylene oxide exposure impairs cognitive function. Ethylene oxide may also damage the liver and kidneys. Skin allergy can occur, and some persons may become sensitized to the chemical. Cataracts and corneal burns have been reported from occupational exposure. Chronic exposure may be more serious for children because of their potential longer latency period. *Carcinogenicity:* The DHHS has determined that ethylene oxide may reasonably be anticipated to be a human carcinogen (NTP 2000). In animals, chronic exposure causes leukemia and intra-abdominal cancer, and there is some evidence that it increases the risk of leukemia in human workers. The International Agency for Research on Cancer has determined that ethylene oxide is carcinogenic to humans. *Reproductive and developmental effects:* Shepard's Catalog of Teratogenic Agents describes one study in which the spontaneous abortion frequency in hospital workers exposed to ethylene oxide during pregnancy was average for the general population (6.7%); however, the frequency for appropriate hospital controls was below average for the general population (5.6%). Ethylene oxide is included in *Reproductive and Developmental Toxicants*, a 1991 report published by the U.S. General Accounting Office. Special consideration regarding the exposure of pregnant women is warranted, since ethylene oxide has been shown to be a teratogen and genotoxin; thus, medical counseling is recommended for the acutely exposed pregnant woman. ETO has caused cancer in several species of laboratory animals. It has also caused changes in genetic material and reproductive problems in laboratory animals. may damage the developing fetus. It may cause inheritable genetic damage in humans. There is an increased incidence of gynecological disorders and spontaneous abortions among workers in ethylene oxide production. Its role in this increase is unclear at this time. (NJ) Increased incidence of leukemia and stomach cancer have been reported; however, the evidence is not considered conclusive. Leukemia, brain tumors, lung tumors, and other cancers have been observed in laboratory animals.

Points of Attack: Eyes, skin, respiratory system, liver, central nervous system, blood, kidneys, reproductive system. Cancer site: peritoneal cancer, leukemia.

Medical Surveillance: This chemical is a suspected or known human carcinogen. Exposed persons should contact a physician for advice regarding the possible long term health effects and advice for medical monitoring. Comprehensive physical examination with emphasis on the genito-urinary tract including testicle size and consistency in males. Semen analysis to include sperm count, motility and morphology. Other tests, such as serum testosterone, serum follicle stimulating hormone (FSH), and serum lutenizing hormone (LH), may be carried out if, in the opinion of a physician, they are indicated. For those with frequent or potentially high exposure (half the TLV or greater), the following are recommended before beginning work and at regular times after that: Lung function tests. If symptoms develop or overexposure is suspected, the following may be useful: Consider chest x-ray after acute overexposure. Evaluation by a qualified allergist, including exposure history and testing, may help diagnose allergy. Liver and kidney function tests. Medical observation is recommended for 24 to 48 hours following breathing overexposure, as pulmonary edema may be delayed.

First Aid: *Note:* Persons whose clothing or skin is contaminated with ethylene oxide liquid or solution can secondarily contaminate personnel by direct contact or through off-gassing vapor. If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least 15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately. If this chemical contacts the skin, remove contaminated clothing and wash immediately with soap and water. Seek medical attention immediately. If this chemical has been inhaled, remove from exposure, begin rescue breathing (using universal precautions) if breathing has stopped, and CPR if heart action has stopped. Transfer promptly to a medical facility. When this chemical has been swallowed, get medical attention. Give large quantities of water and induce vomiting. Do not make an unconscious person vomit. If frostbite has occurred, seek medical attention immediately; do *NOT* rub the affected areas or flush them with water. In order to prevent further tissue damage, do *NOT* attempt to remove frozen clothing from frostbitten areas. If frostbite has *NOT* occurred, immediately and thoroughly wash contaminated skin with soap and water. As first aid for pulmonary edema, a doctor or authorized paramedic may consider administering a corticosteroid spray.

Note to physician or authorized medical personnel: In cases of respiratory compromise secure airway and respiration via endotracheal intubation. If not possible, perform cricothyroidotomy if equipped and trained to do so. Treat patients who have bronchospasm with aerosolized bronchodilators. The use of bronchial sensitizing agents in situations of multiple chemical exposures may pose additional risks. Consider the health of the myocardium before choosing which type of bronchodilator should be administered. Cardiac sensitizing agents may be appropriate; however, the use of cardiac sensitizing agents after exposure to certain chemicals may pose enhanced risk of cardiac arrhythmias (especially in the elderly). Ethylene oxide poisoning is not known to pose additional risk during the use of bronchial or cardiac sensitizing agents. Consider racemic epinephrine aerosol for children who develop stridor. Dose 0.25–0.75 mL of 2.25% racemic epinephrine solution in 2.5 cc water, repeat every 20 minutes as needed, cautioning for myocardial variability. Patients who are comatose, hypotensive, or are having seizures or cardiac arrhythmias should be treated according to advanced life support protocols.

Personal Protective Methods: Wear protective gloves and clothing to prevent any reasonable probability of dermal and/or eye contact. Safety equipment suppliers/manufacturers can provide recommendations on the most protective glove/clothing material for your operation. **8 hr:** Barricade® coated suits; Responder, Trellchem HPS™ suits; Trychem 1000™ suits; **4 hr:** Teflon™ gloves, suits, boots; 4H™ and Silver Shield™ gloves. All protective clothing (suits, gloves, footwear, headgear) should be clean, available each day, and put on before work. Contact lenses should not be worn when working with this chemical. Wear gas and splash-proof chemical goggles and face shield unless full facepiece respiratory protection is worn. Employees should wash immediately with soap when skin is wet or contaminated. Provide emergency showers and eyewash.

Respirator Selection: SCBA >5 ppm. OSHA: Employees engaged in handling operations involving this carcinogen must be provided with, and required to wear and use, a half-mask filter-type respirator for dusts, mists, and fumes. A respirator affording higher levels of protection than this respirator may be substituted. NIOSH: *5 ppm:* GmFS+ [any air-purifying, full facepiece respirator (gas mask) with a chin-style, front- or back-mounted canister providing protection against the compound of concern]; or SCBAF (APF = 50) (any self-contained breathing apparatus with a full facepiece); or SaF (APF = 50) (any supplied-air respirator with a full facepiece). *Emergency or planned entry into unknown concentrations or IDLH conditions:* SCBAF: Pd,Pp (APF = 10,000) (any self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode); or SaF: Pd,Pp: ASCBA (any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary self-contained breathing apparatus operated in a pressure-demand or other positive-pressure mode). *Escape:* GmFS+ [any air-purifying, full facepiece respirator (gas mask) with a chin-style, front- or back-mounted canister providing protection against the compound of concern]; or SCBAE (any appropriate escape-type, self-contained breathing apparatus).

+End-of- service life indicator (ESLI) required.

Storage: Color Code-Red Stripe: Flammability Hazard: Store separately from all other flammable materials. Prior to working with this chemical you should be trained on its proper handling and storage. Before entering confined space where this chemical may be present, check to make sure that an explosive concentration does not exist. It must be stored to avoid contact with even small amounts of acids (such as nitric or sulfuric acids); alkalis (such as sodium hydroxide or potassium hydroxide); catalytic anhydrous chlorides of iron, aluminum or tin; iron or aluminum oxide; or metallic potassium, since it may react by itself, liberating much heat and causing a possible explosion. Ethylene oxide should not contact oxidizers (such as perchlorates, peroxides, permanganates, chlorates, and nitrates) since an explosion could occur. Store in tightly closed containers in a cool, well-ventilated area away from heat, sparks, or sunlight. If this material contains a flammable carrier, sources of ignition, such as smoking and open flames, are prohibited where ethylene oxide is handled, used, or stored. Metal containers involving the transfer of 5 gallons or more of ethylene oxide should be grounded and bonded. Drums must be equipped with self-closing valves, pressure vacuum bungs, and flame arresters. Use only non-sparking tools and equipment, especially when opening and closing containers of ethylene oxide. Wherever ethylene oxide is used, handled, manufactured, or stored, use explosion-proof electrical equipment and fittings. Procedures for the handling, use and storage of cylinders should be in compliance with OSHA 1910.101 and 1910.169, as with the recommendations of the Compressed Gas Association. A regulated, marked area should be established where this chemical is handled, used, or stored in compliance with OSHA Standard 1910.1045. Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: Ethylene oxide requires a shipping label of “POISON, GAS, FLAMMABLE GAS.” It usually falls in Hazard Class 2.3 and there is no Packing Group. It is a violation of transportation regulations to refill compressed gas cylinders without the express written permission of the owner.

Spill Handling: *Gas:* Evacuate and restrict persons not wearing protective equipment from area of spill or leak until clean up is complete. Establish forced ventilation to keep levels below explosive limit. Stop the flow of gas if it can be done safely. If source of leak is a cylinder and the leak cannot be stopped in place, remove leaking cylinder to a safe place in the open air, and repair leak or allow cylinder to empty. Keep this chemical out of confined space, such as a sewer, because of the possibility of explosion, unless the sewer is designed to prevent the buildup of explosive concentrations. *Liquid:* For *small spills* flush area with flooding amounts of water. For *large spills* dike spill for later disposal. Absorb liquids in vermiculite, dry sand, earth, peat, carbon, or a similar material and deposit in sealed containers. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable.

Initial isolation and protective action distances

Distances shown are likely to be affected during the first 30 minutes after materials are spilled and could increase with time. If more than one tank car, cargo tank, portable tank, or large cylinder involved in the incident is leaking, the protective action distance may need to be increased. You may need to seek emergency information from CHEMTREC at (800) 424-9300 or seek professional environmental engineering assistance from the U.S. EPA Environmental Response Team at (908) 548-8730 (24-hour response line).

Small spills (from a small package or a small leak from a large package)

Ethylene oxide and Ethylene oxide with Nitrogen: First: isolate in all directions (feet/meters) 100/30
Then: Protect persons downwind (miles/kilometers)
Day 0.1/0.2
Night 0.1/0.2

Large spills (from a large package or from many small packages)

First: isolate in all directions (feet/meters) 500/150
Then: Protect persons downwind (miles/kilometers)
Day 0.5/0.8
Night 1.6/2.5

Fire Extinguishing: Decomposition products are explosive. Highly flammable. *Gas:* Hazardous decomposition includes carbon monoxide. Do not extinguish the fire unless the flow of gas can be stopped and any remaining gas is out of the line. Specially trained personnel may use fog lines to cool exposures and let the fire burn itself out. Vapors are heavier than air and will collect in low areas. Vapors may travel long distances to ignition sources and flashback. Vapors in confined areas may explode when exposed to fire. Containers may explode in fire. Storage containers and parts of containers may rocket great distances, in many directions. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies. From a secure, explosion-proof location, use water spray to cool exposed containers. If cooling streams are ineffective (venting sound increases in volume and pitch, tank discolors, or shows any signs of deforming), withdraw immediately to a secure position. If cylinders are exposed to excessive heat from fire or flame contact, withdraw immediately to a secure location. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode.

Liquid: Highly flammable. Hazardous decomposition includes oxides of carbon. Use dry chemical, carbon dioxide; or foam extinguishers. Although soluble in water, solutions will continue to burn until diluted to approximately 22 volumes of water to one volume of ethylene oxide. Vapors are heavier than air and will collect in low areas. Vapors may travel long distances to ignition sources and flashback. Vapors in confined areas may explode when exposed to fire. Containers may explode in fire. Storage containers and parts of containers may rocket great distances, in many directions. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies. From a secure, explosion-proof location, use water spray to cool exposed containers. If cooling streams are ineffective (venting sound increases in volume and pitch, tank discolors, or shows any signs of deforming), withdraw immediately to a secure position. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode.

Disposal Method Suggested: Generators of waste containing this contaminant (≥100 kg/mo) must conform with EPA regulations governing storage, transportation, treatment, and waste disposal. Concentrated waste containing no peroxides – discharge liquid at a controlled rate near a pilot flame. Concentrated waste containing peroxides – perforation of a container of the waste from a safe distance followed by open burning.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- USEPA, Office of Pesticide Programs, Topical & Chemical Fact Sheets, “Ethylene Oxide.” http://www.epa.gov/pesticides/factsheets/chemicals/etofactsheet.htm#bkmrk1
- USEPA, Office of Pesticide Programs, Pesticide Residue Limits, “Ethylene Oxide”, 40 CFR 180.151, 185.2850. http://www.epa.gov/pesticides/food/viewtols.htm
- New Jersey Department of Health and Senior Services, "Hazardous Substance Fact Sheet: Ethylene Oxide,” Trenton, NJ (December 1994, rev. May 2001). http://www.state.nj.us/health/eoh/rtkweb/0882.pdf
- U.S. Department of Health and Human Services; Agency for Toxic Substances and Disease Registry, “ToxFAQs, Ethylene Oxide,” Atlanta, GA (July 1999). http://www.atsdr.cdc.gov/tfacts137.html
- Bogyo, D. A., Lande, S. S., Meylan, W. M., Howard, P. H. and Santodonate, J., (Syracuse Research Corp. Center for Chemical Hazard Assessment), Investigation of Selected Potential Environmental Contaminants: Epoxides, Report 560/11-80-005, Washington DC, U.S. Environmental Protection Agency (March 1980)
- Agency for Toxic Substances and Disease Registry, U.S. Department of Health and Human Services, Public Health Service, “Managing Hazardous Materials Incidents,” Atlanta, GA (June 2003)
- National Institute for Occupational Safety and Health, Ethylene Oxide, Current Intelligence Bulletin N.35, DHHS (NIOSH) Publication No. 81-130, Cincinnati, OH (May 22, 1981)
- Sax, N. I., Ed., “Dangerous Properties of Industrial Materials Report,” 4, No. 2, 70-73 (1984)
- USEPA, “Chemical Profile: Ethylene Oxide,” Washington DC, Chemical Emergency Preparedness Program (November 30, 1987)

Ethyl formate E:0690

Use Type: Fumigant, Insecticide
CAS Number: 109-94-4
Formula: $C_3H_6O_2$; $HCOOC_2H_5$
Synonyms: Areginal; Ethyl formic ester; Ethyl methanoate; Formic acid, ethyl ester; Formic ether
Chemical class: Unclassified
EPA/OPP PC Code: 043102
California DPR Chemical Code: 278
HSDB Number: 943
UN/NA & ERG Number: UN1190/129; IMO 3.1
RTECS® Number: LQ8400000
EC Number: 203-721-0 [*Annex I Index No.:* 607-015-00-7]

Uses: Used as a fumigant, especially on dried fruit, Also used as a solvent for cellulose nitrate and acetate and in the production of synthetic flavors. Not currently registered for agricultural use in EU countries and the U.S. Used in Australia and there are 63 global suppliers[97].

U.S. Maximum Allowable Residue Levels for the food additive Ethyl formate [40 CFR 185.2900(a)]: may be safely used in or on specified dried fruits in accordance with the following conditions: it is used or intended for use in or on raisins and dried Zante currants as a bulk and package fumigant. [*40 CFR 185.2900(b)*]: may be safely used in or on specified dried fruits in accordance with the following conditions: it is used in accordance with directions registered with the U.S. EPA, and so used that the total formic acid present free and combined, in the finished product shall not exceed 250 ppm. [*40 CFR 185.2900(c)*]: may be safely used in or on specified dried fruits in accordance with the following conditions: to assure safe use of the additive, its label and labeling shall conform to that.

Regulatory Authority and Advisory Information:

Health Advisory: Skin irritant/sensitizer, Very toxic by Inhalation (EU)

+Acute Oral Category: 3, CAUTION

European/International Regulations: Hazard Symbol: F; risk phrases: R11; R20/22; R36/37; safety phrases: S2; S9; S16; S24; S26; S33 (see Appendix 1)

WGK (German Aquatic Hazard Class): 1-Low hazard to waters

Description: Ethyl formate is a colorless liquid. Fruit-like odor. Molecular weight = 74.09; Specific gravity (H_2O:1) = 0.92; Boiling point = 54.3°C; Freezing/Melting point = –79°C; Vapor pressure = 200 mmHg @ 21°C; 100 mmHg @ 5.4°C Flash point = –20°C (cc); Autoignition temperature = 440°C. Explosive limits: LEL = 2.8% (36000 ppm); UEL = 16.0%. Hazard Identification (based on NFPA-704 M Rating System): Health 2, Flammability 3, Reactivity 0. Solubility in water = 9% @ 18°C.

Incompatibilities: Forms explosive mixture with air. Reacts violently with nitrates, strong oxidizers, strong alkalis, and strong acids. Decomposes slowly in water to form ethyl alcohol and formic acid. May accumulate static electrical charges, and may cause ignition of its vapors.

Permissible Exposure Limits in Air: NIOSH IDLH: 1500 ppm

OSHA PEL: 100 ppm/300 mg/m^3 TWA

NIOSH REL: 100 ppm/300 mg/m^3 TWA

ACGIH TLV®[1]: 100 ppm/303 mg/m^3 TWA

Protective Action Criteria (PAC) Ver. 27[89]

PAC-1: 100 ppm

PAC-2: 100 ppm

PAC-3: 8000 ppm

DFG MAK: 100 ppm/310 mg/m^3 TWA; Peak Limitation Category I(1); [skin]; Pregnancy Risk Group C

Determination in Air: Charcoal (tube) adsorption, workup with CS_2; analysis by gas chromatography/flame ionization detection; NIOSH IV, Method #1452

Determination in Water: Log K_{ow} = <1.0. Unlikely to bioaccumulate in marine organisms.

Routes of Entry: Inhalation, ingestion, eye and/or dermal contact.

Harmful Effects and Symptoms

Short Term Exposure: Either contact or the vapor can cause skin and eye irritation. Inhalation irritates the respiratory tract. Higher exposures can cause pulmonary edema, a medical emergency that can be delayed for several hours. This can cause death. Ethyl formate may affect the central nervous system. Exposure can cause headache, nausea, and vomiting. LD_{50} (oral, rat) = >4000 mg/kg.

Long Term Exposure: May cause tumors. Prolonged or repeated contact can cause skin dryness and cracking. May affect the nervous system; chronic respiratory disease, skin disease, liver and kidney disease.

Points of Attack: Eyes, respiratory system, central nervous system, skin, liver, and kidneys.

Medical Surveillance: Consider the points of attack in preplacement and periodic physical examinations. Consider chest x-ray following acute overexposure. Nervous system tests.

First Aid: If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least 15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately. If this chemical contacts the skin, remove contaminated clothing and wash immediately with soap and water. Seek medical attention immediately. If this chemical has been inhaled, remove from exposure, begin rescue breathing (using universal precautions) if breathing has stopped, and CPR if heart action has stopped. Transfer promptly to a medical facility. When this chemical has been swallowed, get medical attention. Give large quantities of water and induce vomiting. Do not make an unconscious person vomit. Do not induce vomiting when formulations containing petroleum solvents are ingested

Personal Protective Methods: Wear protective gloves and clothing to prevent any reasonable probability of dermal and/or eye contact. Safety equipment suppliers/manufacturers can provide recommendations on the most protective glove/clothing material for your operation. Neoprene™, Nitrile and styrene-butadiene rubber are among the recommended protective materials. All protective clothing (suits, gloves, footwear, headgear) should be clean, available each day, and put on before work. Contact lenses should not be worn when working with this chemical. Wear splash-proof chemical goggles and face shield unless full facepiece respiratory protection is worn. Employees should wash immediately with soap when skin is wet or contaminated. Provide emergency showers and eyewash.

Respirator Selection: SCBA >100 ppm. NIOSH: *up to 1500 ppm:* Sa:Cf (APF = 25) (any supplied-air respirator operated in a continuous-flow mode); or PaprOv (APF = 25) [any powered, air-purifying respirator with organic vapor cartridge(s)]; or CcrOv (APF = 10) [any chemical cartridge respirator with a full facepiece and organic vapor cartridge(s)]; or GmFOv (APF = 50) [any air-purifying, full facepiece respirator (gas mask) with a chin-style, front- or back-mounted organic vapor canister]; or SCBAF (APF = 50) (any self-contained breathing apparatus with a full facepiece); SaF (APF = 50) (any supplied-air respirator with a full facepiece). *Emergency or planned entry into unknown concentrations or IDLH conditions:* SCBAF: Pd,Pp (APF = 10,000) (any NIOSH/MSHA- or European Standard EN 149-approved self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode); or SaF: Pd,Pp: ASCBA (APF = 10,000) (any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary, self-contained breathing apparatus operated in a pressure-demand or other positive-pressure mode). *Escape:* GmFOv (APF = 50) [any air-purifying, full facepiece respirator (gas mask) with a chin-style, front- or back-mounted organic vapor canister]; or SCBAE (any appropriate escape-type, self-contained breathing apparatus).

Storage: Color Code-Red: Flammability Hazard: Store in a flammable liquid storage area or approved cabinet away from ignition sources and corrosive and reactive materials. Prior to working with this chemical you should be trained on its proper handling and storage. Before entering confined space where this chemical may be present, check to make sure that an explosive concentration does not exist. Store in tightly closed containers in a cool, well-ventilated area away from oxidizers, strong bases, moisture and heat. Metal containers involving the transfer of this chemical should be grounded and bonded. Drums must be equipped with self-closing valves, pressure vacuum bungs, and flame arresters. Use only non-sparking tools and equipment, especially when opening and closing containers of this chemical. If this material contains a flammable carrier, sources of ignition, such as smoking and open flames, are prohibited where this chemical is used, handled, or stored in a manner that could create a potential fire or explosion hazard. Wherever this chemical is used, handled, manufactured, or stored, use explosion-proof electrical equipment and fittings. Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: This compound requires a shipping label of "FLAMMABLE LIQUID." It usually falls in Hazard Class 3 and Packing Group II.

Spill Handling: Evacuate and restrict persons not wearing protective equipment from area of spill or leak until clean up is complete. Establish forced ventilation to keep levels below explosive limit. Absorb liquids in vermiculite, dry sand, earth, peat, carbon, or a similar material and deposit in sealed containers. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable.

Fire Extinguishing: This chemical is a flammable liquid. Hazardous decomposition includes carbon monoxide. Use dry chemical, carbon dioxide; or alcohol foam extinguishers. Vapors are heavier than air and will collect in low areas. Vapors may travel long distances to ignition sources and flashback. Vapors in confined areas may explode when exposed to fire. Containers may explode in fire. Storage containers and parts of containers may rocket great distances, in many directions. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies. From a secure, explosion-proof location, use water spray to cool exposed containers. If cooling streams are ineffective (venting sound increases in volume and pitch, tank discolors, or shows any signs of deforming), withdraw immediately to a secure position. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode.

Disposal Method Suggested: Spray into a furnace in admixture with a flammable solvent[24].

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- New Jersey Department of Health and Senior Services, "Hazardous Substance Fact Sheet, Ethyl Formate," Trenton, NJ (March 1999). http://www.state.nj.us/health/eoh/rtkweb/0885.pdf

Etofenprox E:0835

Use Type: Insecticide
CAS Number: 80844-07-1
Formula: $C_{25}H_{28}O_3$
Synonyms: Benzene, 1-[(2-(4-ethoxyphenyl)-2-methylpropoxy)methyl]-3-phenoxy-; 2-(4-Ethoxyphenyl)-2-methylpropyl 3-phenoxybenzyl ether; 3-Phenoxybenzyl-2-(4-ethoxyphenyl)-2-methylpropyl ether
Trade Names: MTI 500®; PUNKASO®; TREBON®; ZOECON® RF-316
Chemical class: Pyrethroid
EPA/OPP PC Code: Not assigned; Reg No. 2724-791
California DPR Chemical Code: 2292
UN/NA & ERG Number: UN3352 (liquid)/151; UN3349 (solid)/151
RTECS® Number: DA0670000
EC Number: 407-980-2
Uses: Approved for use in the U.S. and more than a dozen EU countries.

Regulatory Authority and Advisory Information:
Carcinogenicity[83]: EPA Group C, Possible human carcinogen
Health Advisory: Developmental/Reproductive Toxin, Endocrine disruptor (S!)
Acute Oral Category: 4, Caution, not acutely toxic
European/International Regulations: Hazard Symbol: N; risk phrases: R50/53; safety phrases: S2; S23; S27/28; S36/37/39 (see Appendix 1)

Description: A white crystalline solid. Some commercial products are liquids in combustible or flammable solvents. Citrus-like odor. Molecular weight = 376.49; Specific gravity (H_2O:1) = 1.073; Boiling point = (decomposes) 482 °C; Freezing/Melting point = 194°C; Flash point = 161°C; Hazard Identification (based on NFPA-704 M Rating System) for liquid in hydrocarbon solvent: Health 1, Flammability 2, Reactivity 0. Low solubility in water. Physical and toxicological properties may be affected by carrier solvents in commercial formulations.

Permissible Exposure Limits in Air: NIOSH(2)
IDLH = 5,000 ppm
OSHA PEL: 5 mg/m^3 TWA
NIOSH REL: 5 mg/m^3 TWA
ACGIH TLV®[1]: 5 mg/m^3 TWA
STEL set by HSE(33) = 10 mg/m^3.

Determination in Air: Collection by impinger or fritted bubbler, analysis by gas-liquid chromatography/ultraviolet. See NIOSH IV, Method #5008[18], as pyrethroid.

Permissible Concentration in Water: Acceptable Daily Intake (ADI) = 0.02 mg/kg as pyrethroid.

Determination in Water: Log K_{ow} = >6.5. Values above 3.0 are likely to bioaccumulate in aquatic organisms.

Incompatibilities: Strong oxidizing agents; hypochlorites.

Harmful Effects and Symptoms

Short Term Exposure: Contact with eyes or skin may cause irritation or injury. Inhalation should be avoided; use NIOSH- or CEN (UK)-approved air-purifying respirators for pesticides. May be very harmful if swallowed. LD_{50} (oral, rat) = >4 g/kg; LD_{50} (dermal, rat) = >2000 mg/kg.

Long Term Exposure: The NOAEL for chronic toxicity is 3.7 mg/kg/day for male rats. The target organ in mice is the kidney. The NOAEL is 3.1 mg/kg/day for mice.

Points of Attack: Liver, thyroid. May cause reproductive and fetal effects.

Medical Surveillance: This chemical is a suspected or known human carcinogen. Exposed persons should contact a physician for advice regarding the possible long term health effects and advice for medical monitoring. Before beginning employment and at regular times after that, the following are recommended: Employees should be screened for history of certain medical conditions which might place the employee at increased risk from pyrethroid exposure. Chronic respiratory disease: In persons with chronic respiratory disease, especially asthma, the inhalation of pyrethroids might cause exacerbation of symptoms due to their sensitizing properties. Lung function tests. These may be normal if the person is not having an attack at the time of the test. Consider chest x-ray if lung symptoms are present. Skin disease: Pyrethroids can cause dermatitis which may be allergic in nature. Persons with pre-existing skin disorders may be more susceptible to the effects of this agent. Evaluation by a qualified allergist, including exposure history and testing, may help diagnose allergy. Any employee developing the above-listed conditions should be referred for further medical examination[9]. In addition to comprehensive initial medical and work histories emphasizing reproductive experience and menstrual history, patient should have physical examination and testing of genito-urinary tract, sperm count, motility and morphology. If required, other tests, such as serum testosterone, serum follicle stimulating hormone (FSH), and serum lutenizing hormone (LH), may be indicated.

First Aid: If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least 15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately. If this chemical contacts the skin, remove contaminated clothing and wash immediately with soap and water. Seek medical attention immediately. If this chemical has been inhaled, remove from exposure, begin rescue breathing (using universal precautions) if breathing has stopped, and CPR if heart action has stopped. Transfer promptly to a medical facility. When this chemical has been swallowed, get medical attention. Give large quantities of water and induce vomiting. Do not make an unconscious person vomit. Do not induce vomiting when formulations containing petroleum solvents are ingested.

Respirator Selection: NIOSH/OSHA *for pyrethrum*: *50 mg/m³:* CcrOv95 (APF = 10) [any air-purifying half-mask respirator equipped with an organic vapor cartridge(s) in combination with an N95, R95, or P95 filter. The following filters may also be used: N99, R99, P99, N100, R100, P100]; or Sa (APF = 10) (any supplied-air respirator). *125 mg/m³:* Sa:Cf (APF = 25) (any supplied-air respirator operated in a continuous-flow mode); or PaprOvHie (APF = 25) (any air-purifying full facepiece respirator equipped with an organic vapor cartridge in combination with a high-efficiency particulate filter). *250 mg/m³:* CcrFOv100 (APF = 50) [any air-purifying full facepiece respirator equipped with organic vapor cartridge(s) in combination with an N100, R100, or P100 filter]; or PaprTOvHie (APF = 50) [any powered, air-purifying respirator with a tight-fitting face-piece and organic vapor cartridge(s) in combination with a high-efficiency particulate filter]; or SCBAF (APF = 50) (any self-contained breathing apparatus with full facepiece); or SaF (APF = 50) (any supplied-air respirator with a full facepiece). *5000 mg/m³:* SaF:Pd,Pp (APF = 2000) (any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode). *Emergency or planned entry into unknown concentrations or IDLH conditions:* SCBAF:Pd,Pp (APF = 10,000) (any self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode); or SaF:Pd,Pp:ASCBA (APF = 10,000) (any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary self-contained breathing apparatus operated in a pressure-demand or other positive-pressure mode). *Escape:* GmFOv100 (APF = 50) [any air-purifying, full facepiece respirator (gas mask) with a chin-style, front- or back-mounted organic vapor canister having an N100, R100, or P100 filter]; or SCBAE (any appropriate escape-type, self-contained breathing apparatus).

Note: Substance reported to cause eye irritation or damage; may require eye protection.

Storage: Color Code-Blue: Health Hazard/Poison. Store in a secure poison location at temperature <35°C and away from alkaline materials. Prior to working with this chemical you should be trained on its proper handling and storage. Store in tightly closed containers in a cool, well-ventilated area. Color Code-Green: General storage may be used. Store in tightly closed containers in a cool, well-ventilated area. Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: This material is a toxic pesticide and should be labeled "poisonous materials." It falls into Hazard Class 6.1. PG III.

Spill Handling: First remove all sources of ignition. Evacuate persons not wearing protective equipment from area of spill or leak until clean up is complete. Ventilate area of spill or leak. Use water spray to reduce vapor. Absorb liquids in vermiculite, dry sand, earth, or a similar material and deposit in sealed containers. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be

properly trained and equipped. OSHA 1910.120(q) may be applicable.

Fire Extinguishing: Hazardous decomposition includes oxides of carbon. *On a small fire:* use dry chemical, CO_2 or water spray. *On a large fire:* use water spray, fog or regular foam. Move containers from fire area if you can do it without risk. Dike fire-control water for later disposal; do not scatter the material. Use water spray or fog; do not use straight streams. *Fire involving storage or vehicular tanks:* isolate for 800 meters/0.5 mile in all directions; also, consider initial evacuation for 800 meters/0.5 mile in all directions. Fight fire from maximum distance or use unmanned hose holders or monitor nozzles. Do not get water inside containers. Cool containers with flooding quantities of water until well after fire is out. Withdraw immediately in the case of rising sound from venting safety devices or discoloration of tank. ALWAYS stay away from tanks engulfed in fire. For massive fire, use unmanned hose holders or monitor nozzles; if this is impossible, withdraw from area and let fire burn. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies.

Disposal Method Suggested: Incineration would be an effective disposal procedure where permitted. If an efficient incinerator is not available, the product should be mixed with large amounts of combustible material and contact with the smoke should be avoided. In accordance with 40CFR165, follow recommendations for the disposal of pesticides and pesticide containers.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- United States National Library of Medicine, ChemIDplus Advanced, Bethesda, MD. http://chem.sis.nlm.nih.gov/chemidplus/rn/80844-07-1

Etridiazole E:0848

Use Type: Fungicide

CAS Number: 2593-15-9; 153233-91-1

Formula: $C_5H_5Cl_3N_2OS$

Synonyms: Ethazole; 5-Ethoxy-3-(trichloromethyl)-1,2,4-thiadiazole; ETMT; Terrazole; 3-(Trichloromethyl)-5-ethoxy-1,2,4-thiadiazole; 1,2,4-Thiadiazole, 5-ethoxy-3-(trichloromethyl)-

Trade Names: AATERRA®; BANROT® (With Thiophanate-methyl); DWELL®[C]; ETHAZOLE®; 4-WAY®; KOBAN®; MF-344®; OLIN MATHIESON® 2,424; OM® 2424; PANSOIL®; TERRACHLOR-SUPER X® (with Pentachloronitrobenzene); TERRACLOR SUPER X® (with Pentachloronitrobenzene); TERRACOAT®; TERRAFLO®; TERRAMASTER®; TRUBAN®

Chemical class: Aromatic hydrocarbon; Thiazole

EPA/OPP PC Code: 084701

California DPR Chemical Code: 580

HSDB Number: 1709

UN/NA & ERG Number: UN2810/153

RTECS® Number: XI3875000

EC Number: 219-991-8 [*Annex I Index No.:* 613-133-00-X]

Uses: Etridiazole is a fungicide used in some countries as a seed treatment on barley, beans, corn, cotton, peanuts, peas, sorghum, soybeans, safflower, and wheat. It is also used on cotton for in-furrow application at planting, on ornamental plants and shrubs by horticultural nurseries, on non-bearing citrus and non-bearing coffee, and for golf course fairways, tees and greens. Some states hold Special Local Need registrations for use on tobacco transplants.

U.S. Maximum Allowable Residue Levels for Etridiazole: is not registered for use on any (U.S.) food crops; however, residues could be present on foods as a result of seed treatment use. It is also used on tomatoes imported into the U.S.

Human toxicity (long-term)[101]: Intermediate–10.51051 ppb, CHCL (Chronic Human Carcinogen Level)

Fish toxicity (threshold)[101]: Low–369.29192 ppb, MATC (Maximum Acceptable Toxicant Concentration)

Regulatory Authority and Advisory Information:

Carcinogenicity[83]: EPA Group B2, Probable human carcinogen; EU GHS Category 2: Suspected human carcinogen

California Proposition 65 Chemical: Carcinogen (10/1/1994)

Acute Oral Category: 3, CAUTION

Health Advisory: Mutagen, Endocrine disruptor

Potential Ground Water Pollutant [California FAC Section 13145(d)/12811, active] as terrazole

European/International Regulations: Hazard Symbol: T, Xn, N; risk phrases: R21; R22; R23; R40; R50/53; safety phrases: S1/2; S36/37; S38; S45; S60; S61 (see Appendix 1)

Description: Pale-yellow liquid when pure or reddish-brown liquid or semi-solid as a technical product. Mild odor. Molecular weight = 247.53; Specific gravity (H_2O:1) = 1.503; Freezing/Melting point = 20.1°C; Boiling point = 95°C @1 mmHg; Vapor pressure = 1.3×10^{-4} mmHg @ 20°C; 9.75×10^{-5} mmHg @ 25°C; Flash point = 155°C. Moderately soluble in water; solubility = 50–110 mg/L @ 25°C.

Incompatibilities: Alkali materials can cause material to become hydrolyzed. Toxic fumes of nitrogen and sulfur oxides and chlorine gas are formed when heated to decomposition.

Permissible Exposure Limits in Air: OEL (Russia): 1 mg/m^3 STEL (1/1993)[9]

Permissible Concentration in Water: State Drinking Water Guidelines: Florida 175 μg/L.

Determination in Water: Log K_{ow} = >3.0. Values above 3.0 are likely to bioaccumulate in aquatic organisms.

Harmful Effects and Symptoms

Short Term Exposure: Contact with eyes or skin may cause irritation or injury. May be harmful if swallowed. Skin sensitizer. LD_{50} (oral, rat) = >1000 mg/kg; LD_{50} (dermal, rabbit) = >1700 mg/kg.

Long Term Exposure: Skin sensitizer. Possible liver toxin. A neurotoxin. Endocrine system disruptor. Reproductive effects.

Points of Attack: Skin, liver, brain, endocrine system.

Medical Surveillance: This chemical is a suspected or known human carcinogen. Exposed persons should contact a physician for advice regarding the possible long term health effects and advice for medical monitoring. If symptoms develop or overexposure is suspected, the following may be useful: liver function tests; routine blood analysis. Evaluation by a qualified allergist, including exposure history and testing, may help diagnose allergy.

First Aid: If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least 15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately. If this chemical contacts the skin, remove contaminated clothing and wash immediately with soap and water. Seek medical attention immediately. If this chemical has been inhaled, remove from exposure, begin rescue breathing (using universal precautions) if breathing has stopped, and CPR if heart action has stopped. Transfer promptly to a medical facility. When this chemical has been swallowed, get medical attention. Give large quantities of water and induce vomiting. Do not make an unconscious person vomit. Do not induce vomiting when formulations containing petroleum solvents are ingested

Personal Protective Methods: Because of its low vapor pressure and low order of toxicity, it does not usually present a major problem in industry. Protective creams, gloves, and masks with organic vapor canisters for use in areas of elevated vapor concentrations should suffice. Elevated temperature may increase the requirement for protective methods or ventilation. Wear appropriate clothing to prevent repeated or prolonged dermal and/or eye contact. Wear eye protection to prevent any possibility of eye contact with molten biphenyl. Employees should wash promptly when skin is contaminated. Work clothing should be changed daily as it may be contaminated. Remove nonimpervious clothing immediately if wet or contaminated.

Respirator Selection: *Up to 10 mg/m^3:* CcrOv95 (APF = 10) [any air-purifying half-mask respirator with organic vapor cartridge(s) in combination with an N95, R95, or P95 filter. The following filters may also be used: N99, R99, P99, N100, R100, P100]; or Sa (APF = 10) (any supplied-air respirator). *Up to 25 mg/m^3:* Sa:Cf* (APF = 25) (any supplied-air respirator operated in a continuous-flow mode); or PaprOvHie* (APF = 25) (any powered air-purifying respirator with an organic vapor cartridge in combination with a high-efficiency particulate filter). *Up to 50 mg/m^3:* CcrFOv100 (APF = 50) [any air-purifying full facepiece respirator equipped with organic vapor cartridge(s) in combination with an N100, R100, or P100 filter]; or GmFOv100 (APF = 50) [any air-purifying, full facepiece respirator (gas mask) with a chin-style, front- or back-mounted organic vapor canister having an N100, R100, or P100 filter]; or PaprTOvHie* (APF = 50) [any powered, air-purifying respirator with a tight-fitting face-piece and organic vapor cartridge(s) in combination with a high-efficiency particulate filter]; or SCBAF (APF = 50) (any self-contained breathing apparatus with a full facepiece); or SaF (APF = 50) (any supplied-air respirator with a full facepiece). *Up to 100 mg/m^3:* SaF: Pd,Pp (APF = 2000) (any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode). *Emergency or planned entry into unknown concentrations or IDLH conditions:* SCBAF: PD,PP (any self-contained breathing apparatus that has a full faceplate and is operated in a pressure-demand or other positive-pressure mode); or SaF: Pd,Pp: ASCBA (any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary, self-contained breathing apparatus operated in a pressure-demand or other positive-pressure mode). *Escape:* GmFOv100 [any air-purifying, full facepiece respirator (gas mask) with a chin-style, front- or back-mounted organic vapor canister having an N100, R100, or P100 filter]; or SCBAE (any appropriate escape-type, self-contained breathing apparatus).

Storage: Color Code-Blue: Health Hazard: Store in a secure poison location. Before entering confined space where biphenyl may be present, check to make sure that an explosive concentration does not exist. Store in tightly closed containers in a cool, well-ventilated area. Metal containers involving the transfer of this chemical should be grounded and bonded. Drums must be equipped with self-closing valves, pressure vacuum bungs, and flame arresters. Use only non-sparking tools and equipment, especially when opening and closing containers of this chemical. If this material contains a flammable carrier, sources of ignition, such as smoking and open flames, are prohibited where this chemical is used, handled, or stored in a manner that could create a potential fire or explosion hazard. Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: Toxic solids, organic, n.o.s. requires a shipping label of "poisonous materials." It usually falls in Hazard Class 6.1 and Packing Group II.

Spill Handling: Evacuate and restrict persons not wearing protective equipment from area of spill or leak until clean up is complete. Establish ventilation to keep levels below explosive limit. Don't wash it away. Instead, sprinkle the spill with sawdust, vermiculite, or kitty litter. Sweep it into a plastic garbage bag, and dispose of it as directed on the pesticide product label. Wash all contaminated surfaces with a soap and water solution. Do not re-enter the contaminated area until an expert verifies that the area has been properly cleaned. Ventilate area of spill or leak following clean-up. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable.

Fire Extinguishing: Hazardous decomposition includes oxides of nitrogen and sulfur, chlorides, hydrogen chloride gas, carbon monoxide, and acrid smoke. Use dry chemical, carbon dioxide; water spray; or alcohol foam extinguishers. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies. From a secure, explosion-proof location, use water spray to cool exposed containers. If cooling streams are ineffective (venting sound increases in volume and pitch, tank discolors, or shows any signs of deforming), withdraw immediately to a secure position. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode.

Disposal Method Suggested: Incineration would be an effective disposal procedure where permitted. If an efficient incinerator is not available, the product should be mixed with large amounts of combustible material and contact with the smoke should be avoided. In accordance with 40CFR165, follow recommendations for the disposal of pesticides and pesticide containers.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- USEPA, "Reregistration Eligibility Decision (RED), Etridiazole" Office of Prevention, Pesticides and Toxic Substances, Washington DC (September 2000). http://www.epa.gov/REDs/0009red.pdf
- USEPA, Office of Pesticide Programs, Pesticide Residue Limits, "Etridiazole," 40 CFR 180.370. http://www.epa.gov/pesticides/food/viewtols.htm

F

Famoxadone F:0025

Use Type: Fungicide
CAS Number: 131807-57-3
Formula: $C_{22}H_{18}N_2O_4$
Synonyms:(*RS*)-3-Anilino-5-methyl-5-(4-phenoxyphenyl)-1, 3-oxazolidine-2,4-dione; 5-Methyl-5-(4-phenoxyphenyl)-3-(phenylamino)-2,4-oxazolidinedione; 2,4-Oxazolidinedione, 5-methyl-5-(4-phenoxyphenyl) -3-(phenylamino)-
Trade names: DPX-JE874®; FAMOXATE®; MEDLEY®; TANOS-50DF®
Chemical Class: Oxazole
EPA/OPP PC Code: 113202
California DPR Chemical Code:
HSDB Number: 7266
UN/NA & ERG Number: UN3077 (solid)/177; UN1992 (flammable liquid, toxic, n.o.s.)/131
RTECS® Number: None assigned
EC Number: [*Annex I Index No.* 612-206-00-3]
Uses: Tanos 50-DF is recommended for use as a preventative fungicide for control of late blight and early blight on potatoes and field tomatoes.
U.S. Maximum Allowable Residue Levels for the fungicide famoxadone [40 CFR 180.587(a)]: in or on the following commodities: cattle, fat 0.02 ppm; cattle, liver 0.05 ppm; goat, fat 0.02 ppm; goat, liver 0.05 ppm; horse, fat 0.02 ppm; horse, liver 0.05 ppm; lettuce, head 10.0 ppm; milk, fat (reflecting negligible residues in whole milk) 0.06 ppm; potato 0.02 ppm; sheep, fat 0.02 ppm; sheep, liver 0.05 ppm; tomato 1.0 ppm; vegetable, cucurbits, group 9, 0.30 ppm; and vegetable, fruiting, group 8 except tomato 4.0 ppm.
Regulatory Authority and Advisory Information:
Carcinogenicity[83]: EPA, Not likely to be carcinogenic to humans
Acute Oral Category: 4, Caution, not acutely toxic
European/International Regulations: Hazard Symbol: Xn, F, N; risk phrases: R48/22; R50; R53; safety phrases: S2; S46; S60; S61 (see Appendix 1)
Description: Light off-white powder. Commercial formulations may be a flammable liquid. Molecular weight = 374.39; Specific gravity (H_2O:1) = 1.29 @ 20 °C; Boiling point = (decomposes); Freezing/Melting point = 140.8 °C; Flash point (liquid formulation) = 5–10 °C; Henry's Law constant = 4.6×10^{-8} atm-m^3/mol @ 25 °C (est)[83]. Hazard Identification (based on NFPA-704 M Rating System) (liquid formulation): Health 2, Flammability 3, Reactivity 0. Very low solubility in water; solubility = 50 μg/L. Physical and toxicological properties may be affected by carrier solvents in commercial formulations.
Incompatibilities: Combustible; dust may form explosive mixture with air. May react with strong oxidizers such as chlorates, peroxides, nitrates, etc. Imides react with azo- and diazo-compounds, generating toxic gases. Contact with organic imides and reducing agents releases flammable gases. Imides are extremely weak bases (weaker than water). They react as acids with strong bases, forming salts.
Permissible Concentration in Water: Runoff from spills or fire control may cause water pollution.
Determination in Water: Log K_{ow} = >4.5. Values above 3.0 are likely to bioaccumulate in aquatic organisms.
Routes of Entry: Inhalation, dermal and/or eye contact.
Harmful Effects and Symptoms
Short Term Exposure: Harmful if the liquid is absorbed through the skin. May cause irritation to the eyes, skin, and respiratory tract. Eye irritation may be serious. Harmful if swallowed. LD_{50} (oral, rat) = 5 g/kg; LD_{50} (dermal, rat) = 2 g/kg.
Long Term Exposure: Possible nerve poison and liver toxin.
Points of Attack: Nervous system, brain, liver, kidney, lungs, blood.
Medical Surveillance: Complete blood count. Neurofunctional test battery. Liver function tests.
First Aid: If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least 15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately. If this chemical contacts the skin, remove contaminated clothing and wash immediately with soap and water. Seek medical attention immediately. If this chemical has been inhaled, remove from exposure, begin rescue breathing (using universal precautions) if breathing has stopped, and CPR if heart action has stopped. Transfer promptly to a medical facility. When this chemical has been swallowed, get medical attention. Give large quantities of water and induce vomiting. Do not make an unconscious person vomit. Do not induce vomiting when formulations containing petroleum solvents are ingested.
Personal Protective Methods: Wear positive-pressure self-contained breathing apparatus (SCBA). Wear chemical protective clothing that is specifically recommended by the manufacturer. DuPont™ Tychem® Suit Fabrics is recommended by one government source[88]. It may provide little or no thermal protection. Structural firefighters' protective clothing provides limited protection in fire situations ONLY; it is not effective in spill situations where direct contact with the substance is possible.
Respirator Selection: *At any detectable concentration:* SCBAF: Pd,Pp (APF = 10,000) (any NIOSH/MSHA- or European Standard EN 149-approved self-contained

breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode); or SaF: Pd,Pp: ASCBA (APF = 10,000) (any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary, self-contained breathing apparatus operated in a pressure-demand or other positive-pressure mode). *Escape:* 100F (APF = 50) (any air-purifying, full facepiece respirator with and N100, R100, or P100 filter k-mounted organic vapor canister having a high-efficiency particulate filter); or SCBAE (any appropriate escape-type, self-contained breathing apparatus).

Storage: Color Code-(powder) Blue: Health Hazard/Poison: Store in a tightly closed container in a dry, well-ventilated and secure poison location and refrigerate 2 to 8 °C. Prior to working with this chemical you should be trained on its proper handling and storage. Where possible, automatically transfer material from other storage containers to process containers. Color Code-(flammable solution) Red Stripe: Flammability Hazard: Store separately from all other flammable materials. Prior to working with this chemical you should be trained on its proper handling and storage. Before entering confined space where this chemical may be present, check to make sure that an explosive concentration does not exist. Store in tightly closed containers in a cool, well-ventilated area away from chlorine compounds, oxidizing agents; and combustible materials. If this material contains a flammable carrier, sources of ignition, such as smoking and open flames, are prohibited where this chemical is handled, used, or stored, Use only non-sparking tools and equipment, especially when opening and closing containers. Wherever this chemical is used, handled, manufactured, or stored, use explosion-proof electrical equipment and fittings. Piping should be electrically bonded and grounded. Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: Environmentally hazardous substances, solid or liquid, usually fall in Hazard Class 9. Flammable liquids, n.o.s. require a label of "Flammable liquids" They fall in Hazard Class 3, 6.1. Technical name required.

Spill Handling: *Small spills* and leakage: should a spill occur while you are handling this chemical, first remove all sources of ignition, then you should dampen the solid spill material with 60–70% ethanol and transfer the dampened material to a suitable container. Use absorbent paper dampened with 60–70% ethanol to pick up any remaining material. Seal the absorbent paper, and any of your clothes, which may be contaminated, in a vapor-tight plastic bag for eventual disposal. Solvent wash all contaminated surfaces with 60–70% ethanol followed by washing with a soap and water solution. Do not reenter the contaminated area until the safety officer (or other responsible person) has verified that the area has been properly cleaned.

Fire Extinguishing: Hazardous decomposition includes oxides of nitrogen and carbon. CAUTION: This product may have a very low flash point: Use of water spray when fighting fire may be inefficient. *Small fire*: dry chemical, CO_2, water spray or alcohol-resistant foam. *Large fire*: water spray, fog or alcohol-resistant foam. Move containers from fire area if you can do it without risk. Dike fire-control water for later disposal; do not scatter the material. Use water spray or fog; do not use straight streams. *Fire involving tanks or vehicular loads*: fight fire from maximum distance or use unmanned hose holders or monitor nozzles. Cool containers with flooding quantities of water until well after fire is out. Withdraw immediately in the case of rising sound from venting safety devices or discoloration of tank. ALWAYS stay away from tanks engulfed in fire. For massive fire, use unmanned hose holders or monitor nozzles; if this is impossible, withdraw from area and let fire burn. Vapors are heavier than air and will collect in low areas. Vapors may travel long distances to ignition sources and flashback. Vapors in confined areas may explode when exposed to fire. Storage containers and parts of containers may rocket great distances, in many directions. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies. From a secure, explosion-proof location, use water spray to cool exposed containers. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode.

Disposal Method Suggested: Do not discharge into drains or sewers. Dispose of waste material as hazardous waste using a licensed disposal contractor to an approved landfill. Consult with environmental regulatory agencies for guidance on acceptable disposal practices. If allowed, incineration with effluent gas scrubbing is recommended. Containers must be disposed of properly by following package label directions or by contacting your local or federal environmental control agency, or by contacting your regional EPA office.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- Health Canada, Pest Management Regulatory Agency; Regulatory Note- Famoxadone/Tanos 50DF REG2003-10 (Septemder 24, 2003)

Fenamiphos F:0050

Use Type: Nematicide, Insecticide

CAS Number: 22224-92-6

Formula: $C_{13}H_{22}NO_3PS$

Synonyms: ENT 27,572; Ethyl 3-methyl-4-(methylthio) phenyl(1-methylethyl)phosphoramidate; Ethyl 4-(methylthio)-*m*-tolylisopropylphosphoramidate; Isopropylamino-*O*-ethyl-(4-methylmer capto-3-methylphenyl)phosphate;

(1-Methylethyl)phosphoramidicacidethyl3-methyl-4-(methylthio)phenyl ester; Isopropylphosphoramidic acidethyl 4-(methylthio)-*m*-toyl ester; 1-(Methylethyl)-ethyl 3-methyl-4-(methylthio)phenylphosphoramidate; NSC-195106; Phenamiphos; Phosphoramidic acid, (1-methylethyl)-, ethyl(3-methyl-4-(methylthio)phenyl)ester; Phosphoramidic acid, (1-methylethyl)-, ethyl 3-methyl-4-(methylthio)phenyl ester; Phosphoramidic acid,isopropyl-, ethyl 4-(methylthio)-*m*-tolyl ethyl ester

Trade Names: BAY 68138®; Bayer 68138®; NEMACUR®; NEMACURP®

Chemical Class: Organophosphate

EPA/OPP PC Code: 100601

California DPR Chemical Code: 1857

HSDB Number: 295

UN/NA & ERG Number: UN2783 (solid)/152

RTECS® Number: TB3675000

EC Number: 244-848-1 [*Annex I Index No.:* 015-123-00-5]

Uses: A U.S. EPA restricted Use Pesticide (RUP). Fenamiphos is an organophosphate nematicide used to control a wide variety of nematode (roundworm) pests. Nematodes can live as parasites on the outside or the inside of a plant. They may be free living or associated with cyst and root-knot formations in plants. Fenamiphos is used on a variety of plants including tobacco, turf, bananas, pineapples, citrus and other fruit vines, some vegetables, and grains. The compound is absorbed by roots and is then distributed throughout the plant. Fenamiphos, as is typical of other organophosphates, blocks the enzyme acetylcholinesterase in the target pest. The pesticide also has secondary activity against other invertebrates such as sucking insects and spider mites.

U.S. Maximum Allowable Residue Levels for Fenamiphos and its cholinesterase inhibiting metabolites ethyl 3-methyl-4-(methylsulfinyl)phenyl(1-methylethyl)phosphoramidate and ethyl 3-methyl-4-(methylsulfonyl)phenyl (1-methylethyl) phosphoramidate [40 CFR 180.349(a)(1)]: in or on the following food commodities: apple 0.25 ppm; banana 0.10 ppm; Brussels sprouts 0.10 ppm; cabbage 0.10 ppm; cherry 0.25 ppm; citrus, oil 25.0 ppm; citrus, dried pulp 2.5 ppm; cottonseed 0.05 ppm; eggplant 0.1 ppm; garlic 0.50 ppm; grapefruit 0.60 ppm; grape 0.10 ppm; lemon 0.60 ppm; lime 0.60 ppm; okra 0.30 ppm; oranges 0.60 ppm; peach 0.25 ppm; peanut 0.02 ppm; pineapple 0.30 ppm; pineapple, bran 10.0 ppm; raisins 0.3 ppm; raspberry 0.1 ppm; strawberry 0.6 ppm; and tangerine 0.60 ppm. ***[40 CFR 180.349(a)(2)]:*** in or on the following raw agricultural meat commodities: cattle, fat 0.05 ppm; cattle, meat 0.05 ppm; cattle, meat byproducts 0.05 ppm; goat, fat 0.05 ppm; goat, meat 0.05 ppm; goat, meat byproducts 0.05 ppm; hog, fat 0.05 ppm; hog, meat 0.05 ppm; hog, meat byproducts 0.05 ppm; horse, fat 0.05 ppm; horse, meat 0.05 ppm; horse, meat byproducts 0.05 ppm; milk 0.01 ppm; sheep, fat 0.05 ppm; sheep, meat 0.05 ppm; and sheep, meat byproducts 0.05 ppm. ***Regional registration, as defined in section 180.1(n) [40 CFR 180.349 (c)]:*** in or on the following raw agricultural commodities: asparagus 0.02 ppm; beet, garden, roots 1.5 ppm; beet, garden, tops 1.0 ppm; bok choy 0.5 ppm; kiwifruit 0.1 ppm; and pepper, nonbell 0.6 ppm.

U.S. Maximum Allowable Residue Levels for Fenamiphos: 100% of U.S. production for seed treatment.

Human toxicity (long-term)[101]: High–2.00 ppb, Health Advisory

Fish toxicity (threshold)[101]: Extra high–0.33001 ppb, MATC (Maximum Acceptable Toxicant Concentration)

Regulatory Authority and Advisory Information:

Carcinogenicity[83]: EPA Group E, evidence of non-carcinogenicity for humans

Acute Oral Category: 1, DANGER–POISON

Health Advisory: Nerve Toxin

Potential Ground Water Pollutant [California FAC Section 13145(d)/12811, inactive)

Acceptable Daily Intake (ADI): EPA Oral reference dose (RfD) = 0.00025 mg/kg/day (UF: 1000, MF: 1)

Superfund/EPCRA 302 Extremely Hazardous Substances: TPQ = 10/10,000 lb (4.54/4,540 kg)

Superfund/EPCRA 40CFR302.4 RQ: EHS, 1 lb (0.454 kg)

MARINE POLLUTANT (49CFR, Subchapter 172.101, Appendix B

U.S. DOT 49CFR172.101, Inhalation Hazard Chemical as organophosphates

UN Packaging Group I, Greatest Danger

European/International Regulations: Hazard Symbol: T+, Xn, N; risk phrases: R21; R25; R28; R52/53; safety phrases: S1/2; S23-S28; S36/37; SS45; S55; S60; S61 (see Appendix 1)

WGK (German Aquatic Hazard Class): 3-Severe hazard to waters.

Description: Fenamiphos is a yellowish-brown powder or off-white to tan, waxy solid. Found commercially as a granular ingredient (5 to 15%) or in an emulsifiable concentrate (400 g/l). Molecular weight = 251.24; 303.39; Specific gravity (H_2O:1) =1.15 @ 20 °C; Boiling point = (decomposes) 200 °C; Freezing/Melting point = 40 °C (technical grade); 49.2 °C (pure compound); Vapor pressure = 1×10^{-6} mmHg @ 20 °C. Hazard Identification (based on NFPA-704 M Rating System): Health 3, Flammability 1, Reactivity 0. Practically insoluble in water; solubility = 0.03%.

Incompatibilities: Fenamiphos is unstable in alkaline media and is rapidly decomposed in the presence of light. Dilute aqueous solutions are completely decolorized in 30 minutes or less when exposed to ordinary light, concentrated solutions decompose more slowly. Decomposes above 200 °C, releasing toxic gases, including nitrogen oxides, sulfur oxides and phosphorus oxides. In the presence of strong reducing agents such as hydrides, organophosphates form highly toxic and flammable phosphine gas. Contact with oxidizers can cause the release of toxic oxides of phosphorus.

Permissible Exposure Limits in Air: OSHA PEL: None

NIOSH REL: 0.1 mg/m^3 TWA [skin]

ACGIH TLV®[1]: 0.05 mg/m^3 TWA inhalable fraction and vapor [skin]; not classifiable as a human carcinogen; BEI$_A$ issued for Acetylcholinesterase inhibiting pesticides.

Protective Action Criteria (PAC) Ver. 27[89]
PAC-1: 0.082 mg/m^3
PAC-2: 0.9 mg/m^3
PAC-3: 4 mg/m^3

Determination in Air: OSHA versatile sampler-2; Toluene/Acetone; Gas chromatography/Flame ionization detection; NIOSH IV, Method #5600, Organophosphorus pesticides[18].

Permissible Concentration in Water: Federal Drinking Water Guidelines: EPA 0.7 μg/L; State Drinking Water Guidelines: Arizona 1.8 μg/L; Maine 1.8 μg/L; Florida 1.75 μg/L.

Determination in Water: Log K_{ow} = >3.2. Values at or above 3.0 are likely to bioaccumulate in marine organisms.

Routes of Entry: Inhalation, dermal contact, ingestion, eye contact.

Harmful Effects and Symptoms: Exposure may be fatal due to respiratory failure.

Short Term Exposure: This is a highly toxic chemical. It can be absorbed through the unbroken skin and is a cholinesterase inhibitor with effects typical of such compounds. Acute exposure to fenamiphos may produce the following signs and symptoms: pinpoint pupils, blurred vision, headaches, dizziness, muscle spasm, and profound weakness. Vomiting, diarrhea, abdominal pain, seizures, and coma may also occur. The heart rate may increase following oral exposure or decrease following dermal exposure. Hypotension (low blood pressure) may occur although hypertension (high blood pressure) is not uncommon. Chest pain may be noted. Respiratory symptoms include dyspnea (shortness of breath), respiratory depression, and respiratory paralysis. Psychosis may occur. This material is highly toxic orally, by inhalation, and by absorption through the skin. Death may occur from respiratory failure. Delayed pulmonary edema may occur after inhalation. Exposure may be fatal, caused by respiratory failure. LD_{50} (oral, rat) = 8 mg/kg; LD_{50} (dermal, rat) = 80 mg/kg.

Long Term Exposure: Cholinesterase inhibitor; cumulative effect is possible. Organophosphates may damage the nervous system with repeated exposure, resulting in convulsions, respiratory failure. May cause liver damage. A neurotoxin.

Points of Attack: Respiratory system, central nervous system, cardiovascular system, blood cholinesterase.

Medical Surveillance: Medical observation is recommended for 24 to 48 hours following breathing overexposure, as pulmonary edema may be delayed. Routine biological monitoring of pesticide applicators and field workers includes testing of plasma and red blood cell acetylcholinesterase levels (for enzyme poisoned by this chemical). These tests are normally accurate only if done within about two hours of exposure. If exposure stops, plasma levels return to normal in 1–2 weeks while red blood cell levels may be reduced for 1–3 months. When acetylcholinesterase enzyme levels are reduced by 25% or more below preemployment levels, risk of poisoning is increased, even if results are in lower ranges of "normal." Reassignment to work not involving organophosphate pesticides is recommended until enzyme levels recover. Do not drink any alcoholic beverages before or during use as it promotes absorption of organophosphates.

First Aid: **Treatment for organophosphate poisoning consists of thorough decontamination, cardiorespiratory support, and administration of the antidotes atropine and pralidoxime. In cases of severe poisoning, diazepam, an anticonvulsant, should also be administered. Antidotes should be administered as prevention even if the diagnosis is in doubt**. Speed in removing material from eyes and skin is of extreme importance. *Eyes:* Eye contact can cause dangerous amounts of these chemicals to be quickly absorbed through the mucous membrane into the bloodstream. Immediately and gently flush eyes with plenty of warm or cold water (NO hot water) for at least 15 minutes, occasionally lifting the upper and lower eyelids. Get medical aid immediately. *Skin:* Get medical aid. Dermal contact can cause dangerous amounts of these chemicals to be absorbed into the bloodstream. Wearing the appropriate PPE equipment and respirator for organophosphate/carbamate pesticides, immediately flush skin with plenty of soap and water for at least 15 minutes while removing contaminated clothing and shoes. Shampoo hair promptly if contaminated. The removed, contaminated clothing and shoes should be double-bagged and left in Hot Zone for later disposal by hazardous materials experts. Skin may also be decontaminated with diluted hypochlorite solution. *Inhalation:* Get medical aid. Do not contaminate yourself. Wearing the appropriate PPE equipment and respirator for organophosphate pesticides, immediately remove the victim from the contaminated area to fresh air. If the victim is not breathing, administer artificial respiration. Do not use mouth-to-mouth method if victim ingested or inhaled the substance; give artificial respiration with the aid of a pocket mask equipped with a one-way valve or other proper respiratory medical device. If breathing is difficult, administer oxygen through bag/mask apparatus until medical help arrives. Do not leave victim unattended. *Ingestion:* Call poison control. Loosen all clothing. Never give anything by mouth to an unconscious person. If victim is *unconscious or having convulsions,* do nothing except keep victim warm. Get medical aid. Transfer promptly to a medical facility. In cases of ingestion, **do not induce vomiting**. If the victim is alert and asymptomatic, administer a slurry of activated charcoal at a dose of 1 g/kg (infant, child, and adult dose). A soda can and straw may be of assistance when offering charcoal to a child. *In some cases you may be specifically instructed by poison control to induce vomiting by way of 2 tablespoons of syrup of ipecac (adult) washed down with a cup of water*. Do NOT give activated charcoal before or with ipecac syrup. *Note to physician or authorized medical personnel:* Treat cases of respiratory compromise, coma, or excessive pulmonary secretions with respiratory support using protocols and techniques available and within the scope of training. Some cases may necessitate procedures such as endotracheal intubation or cricothyrotomy by properly trained and equipped personnel. When possible, atropine (see *Antidotes*, below) should be given under medical supervision. Patients who are comatose, hypotensive, or having seizures or cardiac arrhythmias should be treated according to advanced life support protocols. *Antidotes:* Two antidotes are administered to treat organophosphate poisoning. Atropine is a competitive antagonist of acetylcholine at muscarinic receptors and is used to control the excessive bronchial secretions which are often responsible for death. Pralidoxime relieves both the nicotinic and muscarine effects of organophosphate poisoning by regenerating acetylcholinesterase and can reduce both the bronchial secretions and the muscle weakness associated with poisoning. The initial intravenous dose of atropine in adults should be determined by the severity of symptoms: An initial adult dose of 1.0 to 2.0 mg or pediatric dose of 0.01 mg/kg (minimum 0.01 mg) should be administered intravenously. If intravenous access cannot be established, atropine may also be given intramuscularly, subcutaneously or via endotracheal tube. Doses should be repeated every 15 minutes until excessive secretions and sweating have been controlled. Once bronchial secretion has been controlled, atropine administration should be repeated whenever the secretions begin to recur. In seriously poisoned patients, very large doses may be required. Alterations of pulse rate and pupillary size should not be used as indicators of treatment adequacy. Pralidoxime should be administered as early in poisoning as possible as its efficacy may diminish when given more than 24 to 36 hours after exposure. Doses are as follows: adult 1.0 g; pediatric 25 to 50 mg/kg. The drug should be administered intravenously over 30 to 60 minutes, but in a life-threatening situation one-half of the total dose can be given per minute for a total administration time of 2 minutes. Treatment should begin to take effect within 40 minutes with a reduction in symptoms and the amount of atropine necessary to control bronchial secretion. The initial dose can be repeated in 1 hour and then every 8 to 12 hours until the patient is clinically well and no longer requires atropine. If intravenous access cannot be established, pralidoxime may also be given intramuscularly. Early administration of diazepam in addition to the combined atropine and pralidoxime treatment may help prevent the onset of seizures and potential brain and cardiac morphologic damage following high-level organophosphate poisoning.

Respirator Selection: SCBA >0.082 mg/m^3. Wherever and whenever workplace conditions warrant respirator use, a respiratory protection program must be followed that meets one or more of the following government standards: OSHA's 29 CFR 1910.134, ANSI Z88.2, or European Standard EN 149.

Storage: Color Code-Blue: Health Hazard/Poison. Store in a secure poison location. Prior to working with this chemical, you should be trained on its proper handling and storage. Store in tightly closed containers in a cool, well- ventilated area away from strong bases. Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: Organophosphorus pesticides, solid or liquid (nonflammable), require a label of "poisonous materials." This chemical falls in Hazard Class 6.1.

Spill Handling: First remove all sources of ignition. Evacuate persons not wearing protective equipment from area of spill or leak until clean up is complete. Stay upwind; keep out of low areas. Ventilate area of spill or leak. Remove and isolate contaminated clothing at the site. Do not touch spilled material; stop leak if you can do so without risk. Use water spray to reduce vapors. *Small spills:* absorb with sand or other noncombustible absorbent material and place into containers for later disposal. *Large spills:* dike far ahead of spill for later disposal. Collect powdered material in the most convenient and safe manner and deposit in sealed containers. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable. Seek professional environmental engineering assistance from the U.S. EPA Environmental Response Team at (908) 548-8730 (24-hour response line).

Fire Extinguishing: Hazardous decomposition includes nitrogen oxides, sulfur oxides and phosphorus oxides. May be fatal if inhaled, ingested or absorbed through skin. Inhalation or contact with some of these materials will irritate or burn skin and eyes. Vapors may cause dizziness or suffocation. *Small fires:* dry chemical, carbon dioxide; water spray; or foam. *Large fires:* water spray, fog, or foam. Stay upwind; keep out of low areas. Ventilate closed spaces before entering them. Firefighting gear (including SCBA) may not provide adequate protection. If exposure occurs, remove and isolate gear immediately and thoroughly decontaminate personnel. Wear positive-pressure breathing apparatus and special protective clothing. Remove and isolate contaminated clothing at the site. Move container from fire area if you can do so without risk. Fight fire from maximum distance. Dike fire control water for later disposal; do not scatter the material. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies. From a secure, explosion-proof location, use water spray to cool exposed containers. If cooling streams are ineffective (venting sound increases in volume and pitch, tank discolors, or shows any signs of deforming), withdraw immediately to a secure position. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode.

Disposal Method Suggested: Destruction by alkali hydrolysis or incineration. Containers must be disposed of properly by following package label directions or by contacting your local or federal environmental control agency, or by contacting your regional EPA office.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- EXTOXNET, Extension Toxicology Network, "Pesticide Information Profile, Fenamiphos," Oregon State University, Corvallis, OR (June 1996). http://extoxnet.orst.edu/pips/fenamiph.htm
- USEPA, Office of Pesticide Programs, Pesticide Residue Limits, "Fenamiphos", 40 CFR 180.349. http://www.epa.gov/pesticides/food/viewtols.htm
- New Jersey Department of Health and Senior Services, "Hazardous Substance Fact Sheet: Fenamiphos," Trenton, NJ (February 1999). http://www.state.nj.us/health/eoh/rtkweb/0914.pdf
- Sax, N. I., Ed., "Dangerous Properties of Industrial Materials Report," 3, No. 1, 52-56, New York, Van Nostrand Reinhold Co. (1983)
- Agency for Toxic Substances and Disease Registry, U.S. Department of Health and Human Services, Public Health Service, "Managing Hazardous Materials Incidents," Atlanta, GA (June 2003)
- USEPA, "Chemical Profile: Fenamiphos," Washington DC, Chemical Emergency Preparedness Program (November 30, 1987)
- USEPA, "Health Advisory: Fenamiphos," Washington DC, Office of Drinking Water (August 1987)

Fenbutatin oxide F:0085

Use Type: Insecticide, Miticide

CAS Number: 13356-08-6

Formula: $C_{60}H_{78}OSn_2$

Synonyms: AI3-27738; Bis(trineophyltin)oxide; Bis[tris(β,β-dimethylphenethyl)tin]oxide; Bis[tris(2-methyl-2-phenylpropyl) tin]oxide; Caswell No. 481DD; Distannoxane, hexakis (β,β-dimethylphenethyl)-; Distannoxane, hexakis(2-methyl-2-phenylpropyl)-; Di[tri(2,2-dimethyl-2-phenylethyl)tin]oxide; ENT27738; Fenbutatin-oxyde; Hexakis(β,β-dimethylphenethyl) distannoxane; Hexakis; Hexakis(2-methyl-2-phenylpropyl) distannoxane; 2-(Methyl-2-phenylpropyl)distannoxane

Trade Names: BENDEX®; NEOSTANOX®; OSDARAN®; SD-14114®; SHELL SD-14114®; TORQUE®; VENDEX®

Chemical Class: Organotin; Phenyltin

EPA/OPP PC Code: 104601; 596300 (obsolete)

California DPR Chemical Code: 1876

HSDB Number: 6632; 7001 for tin compounds

UN/NA & ERG Number: UN2786/154; UN2811/154

RTECS® Number: JN8770000

EC Number: 236-407-7 [*Annex I Index No.:* 050-017-00-2]

Uses: A U.S. EPA restricted Use Pesticide (RUP). A selective miticide for deciduous pome and stone fruits, citrus fruits, grapes, vegetables, berry fruit, nut crops (selected), ornamentals and greenhouse crops.

U.S. Maximum Allowable Residue Levels for Fenbutatin Oxide and its organotin metabolites calculated as hexakis (2-methyl-2-phenylpropyl) distannoxane [40 CFR 180.362 (a)]: Almond 0.5 ppm; almond, hulls 80 ppm; apple 15 ppm; cattle, fat 0.5 ppm; cattle, meat 0.5 ppm; cattle, meat byproducts 0.5 ppm; cherry, sweet 6 ppm; cherry, tart 6 ppm; citrus, dried pulp 100 ppm; citrus, oil 140 ppm; cucumber 4 ppm; egg 0.1 ppm; eggplant 6 ppm; fruit, stone, group 12 20 ppm; goat, fat 0.5 ppm; goat, meat 0.5 ppm; goat, meat byproducts 0.5 ppm; grape 5 ppm; grape, raisin 20 ppm; hog, fat 0.5 ppm; hog, meat 0.5 ppm; hog, meat byproducts 0.5 ppm; horse, fat 0.5 ppm; horse, meat 0.5 ppm; horse, meat byproducts 0.5 ppm; milk, fat 0.1 ppm; papaya 2 ppm; peach 10 ppm; pear 15 ppm; pecan 0.5 ppm; plum 4 ppm; plum, prune 4 ppm; plum, prune, dried 20 ppm; poultry, fat 0.1 ppm; poultry, meat 0.1 ppm; poultry, meat byproducts 0.1 ppm; raspberry 10 ppm; sheep, fat 0.5 ppm; sheep, meat 0.5 ppm; sheep, meat byproducts 0.5 ppm; strawberry 10 ppm; walnut 0.5 ppm. *Regional registration, as defined in section 180.1(n)* ***[40 CFR 180.362 (a)]*** Raspberries: 10.0 ppm.

Regulatory Authority and Advisory Information:

Carcinogenicity[83]: EPA Group E, evidence of non-carcinogenicity for humans

Acute Oral Category: 3, CAUTION

Health Advisory: Developmental toxin (TRI)

EPCRA Section 313 Form R *de minimus* concentration reporting level: 1.0%

U.S. DOT Regulated Marine Pollutant (49CFR, Subchapter 172.101, Appendix B), severe pollutant, as organotin pesticide compounds

European/International Regulations: Hazard symbol: T+, Xn, N; risk phrases: R26; R36/38; R50/R53; safety phrases: S1/2; S28; S36/37; S45; S60; S61 (see Appendix 1)

WGK (German Aquatic Hazard Class): 3-Severe hazard to waters

Description: White crystalline solid or powder. Mild odor. Molecular weight = 1052.66; Specific gravity (H_2O:1) = 1.312; Boiling point = (decomposes) 238 °C @ 0.05 mm; Freezing/Melting point = 138 °C; 148 °C; Vapor pressure = 1.8×10^{-11} mmHg @ 20 °C. Practically insoluble in water; solubility = 0.005 mg/L @ 23 °C.

Incompatibilities: Forms explosive mixture with air. Decomposes above 230 °C. Contact with water causes slow decomposition. Organotin oxides can be strongly basic and will react, possibly dangerously, with acidic compounds and mixtures.

Permissible Exposure Limits in Air: NIOSH IDLH: 25 mg[Sn]/m^3

OSHA PEL: 0.1 mg[Sn]/m^3 TWA [*Note*: The PEL applies to all organic tin compounds.]

NIOSH REL: 0.1 mg[Sn]/m^3 TWA [skin] [*Note:* The REL applies to all organic tin compounds, except cyhexatin.]

ACGIH TLV®[1]: 0.1 mg[Sn]/m^3 TWA; 0.2 mg[Sn]/m^3 STEL [skin], A4, not classified as a human carcinogen

DFG MAK: 0.1 mg[Sn]/m^3; inhalable fraction TWA; Peak Limitation Category II(2); [skin]; Pregnancy Risk Group D *phenyltin compounds*

DFG MAK: 0.002 mg[Sn]/m^3; inhalable fraction TWA; Peak Limitation Category II(2); Pregnancy Risk Group C

Determination in Air: Filter/XAD-2® (tube); CH_3COOH/CH_3CN; high-pressure liquid chromatography/Graphite furnace atomic absorption spectrometry; NIOSH IV Method #5504, as organotin compounds.[18].

Permissible Concentration in Water: Runoff from spills or fire control may cause water pollution.

Determination in Water: Log K_{ow} = >4.0. Values above 3.0 are likely to bioaccumulate in aquatic organisms.

Routes of Entry: Inhalation, skin and/or eye contact. Absorbed through the skin.

Harmful Effects and Symptoms

Short Term Exposure: Highly toxic. Irritates the eyes, skin, and respiratory tract. Contact may cause skin burns. Inhalation can cause coughing, wheezing and/or shortness of breath. Toxic hazard rating is high for oral, intravenous, intraperitoneal administration. This material causes swelling of the brain and spinal cord. Exposure may result in muscular weakness and paralysis, leading to respiratory failure; convulsive movements; closure of eyelids and sensitivity to light; headaches, and EEG changes, headache, dizziness, psychological and neurological disturbances, vertigo (an illusion of movement), sore throat, cough, abdominal pain, nausea, vomiting, diarrhea; urine retention; paresis, focal anesthesia; pruritus. Higher levels can cause unconsciousness, collapse and death. LD_{50} (oral, rat) = >2.5 g/kg; LD_{50} (dermal, rat) = 1000 mg/kg.

Long Term Exposure: Repeated or prolonged contact can cause dermatitis; dry and cracked skin. May cause brain damage, hepatic necrosis; kidney damage. Some organotin compounds, such as dibutyltins and tributyltins, have been shown to affect the immune system in animals, but this has not been examined in people. Studies in animals and people also have shown that some organotins, such as dibutyltins, tributyltins, and triphenyltins, can affect the reproductive system. Reproductive effects.

Points of Attack: Skin, brain, kidneys.

Medical Surveillance: Kidney function tests. Psychological testing. Examination of the nervous system. EEG.

First Aid: If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least 15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately. If this chemical contacts the skin, remove contaminated clothing and wash immediately with soap and water. Seek medical attention immediately. If this chemical has been inhaled, remove from exposure, begin rescue breathing (using universal precautions) if breathing has stopped, and CPR if heart action has stopped. Transfer promptly to a medical facility. When this chemical has been swallowed, get medical attention. *Do not induce vomiting when formulations containing petroleum solvents are ingested*. Otherwise, give large quantities of water and induce vomiting. Do not make an unconscious person vomit.

Personal Protective Methods: Wear protective gloves and clothing to prevent any reasonable probability of dermal and/or eye contact. Safety equipment suppliers/manufacturers can provide recommendations on the most protective glove/clothing material for your operation. All protective clothing (suits, gloves, footwear, headgear) should be clean, available each day, and put on before work. Contact lenses should not be worn when working with this chemical. Wear dust-proof chemical goggles and face shield unless full facepiece respiratory protection is worn. Employees should wash immediately with soap when skin is wet or contaminated. Provide emergency showers and eyewash.

Respirator Selection: NIOSH/OSHA *[Tin, organic compounds as (Sn)]*: *Up to 1 mg/m^3:* CcrOv95 (APF = 10) [any air-purifying half-mask respirator with organic vapor cartridge(s) in combination with an N95, R95, or P95 filter. The following filters may also be used: N99, R99, P99, N100, R100, P100]; or Sa (APF = 10) (any supplied-air respirator). *Up to 2.5 mg/m^3:* Sa:Cf (APF = 25) (any supplied-air respirator operated in a continuous-flow mode); or PaprOvHie (APF = 25) (any air-purifying full facepiece respirator equipped with an organic vapor cartridge in combination with a high-efficiency particulate filter). *Up to 5 mg/m^3:* CcrFOv100 (APF = 50) [any air-purifying full facepiece respirator equipped with organic vapor cartridge(s) in combination with an N100, R100, or P100 filter]; or GmFOv100 (APF = 50) [any air-purifying, full facepiece respirator (gas mask) with a chin-style, front- or back-mounted organic vapor canister having an N100, R100, or P100 filter]; or PaprTOvHie (APF = 50) [any powered, air-purifying respirator with a tight-fitting facepiece and organic vapor cartridge(s) in combination with a high-efficiency particulate filter]; or SaT: Cf (APF = 50) (any supplied-air respirator that has a tight-fitting face-piece and is operated in a continuous-flow mode); or SCBAF (APF = 50) (any self-contained breathing apparatus with a full facepiece); or SaF (APF = 50) (any supplied-air respirator with a full facepiece). *Up to 25 mg/m^3:* SaF: Pd,Pp (APF = 2000) (any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode). *Emergency or planned entry into unknown concentrations or IDLH conditions*: SCBAF: Pd,Pp (APF = 10,000) (any self-contained breathing apparatus that has a full faceplate and is operated in a pressure-demand or other positive-pressure mode); or SaF: Pd,Pp: ASCBA (any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary, self-contained breathing apparatus operated in a pressure-demand or other positive-pressure mode). *Escape:* GmFOv100 (APF = 50) [Any air-purifying, full facepiece respirator (gas mask) with a chin-style, front- or back-mounted organic vapor canister having an N100, R100, or P100 filter]; or SCBAE (any appropriate escape-type, self-contained breathing apparatus).

Storage: Color Code-Blue: Health Hazard/Poison. Store in a secure poison location. Prior to working with this chemical you should be trained on its proper handling and storage. Store in tightly closed containers in a cool, dark, well-ventilated area away from oxidizers. Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: Organotin pesticides, solid, toxic, require a label of "poisonous materials." It falls in Hazard Class 6.1.

Spill Handling: First remove all sources of ignition. Evacuate persons not wearing protective equipment from area of spill or leak until clean up is complete. Collect powdered material in the most convenient and safe manner and deposit in sealed containers. Ventilate area after clean up is complete. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable.

Fire Extinguishing: Hazardous decomposition includes inorganic tin, tin oxides, and phenyltin compounds. This material is a severe marine pollutant. *Fire involving storage or vehicular tanks:* isolate for 800 meters/0.5 mile in all directions; also, consider initial evacuation for 800 meters/0.5 mile in all directions. *Small fire:* dry chemical, carbon dioxide or water spray. *Large fire:* dry chemical, carbon dioxide, alcohol-resistant foam or water spray. Move containers from fire area if you can do it without risk. Dike fire-control water for later disposal; do not scatter the material. *Fire involving tanks or car/trailer loads:* fight fire from maximum distance or use unmanned hose holders or monitor nozzles. Do not get water inside containers. Cool containers with flooding quantities of water until well after fire is out. Withdraw immediately in the case of rising sound from venting safety devices or discoloration of tank. Always stay away from tanks engulfed in fire. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode.

Disposal Method Suggested: Organic tin compounds may be disposed of in sealed containers in secured sanitary landfill. *Chemical Treatability of tin; Concentration Process*: Chemical precipitation; Chemical Classification: Metals; Scale of Study: Pilot scale Type of Wastewater Used: Synthetic wastewater; Results of Study: At 600 ppm, 95.3% reduction with alum. At 500 ppm, 98% reduction with ferric chloride, 92% reduction with lime. (Three coagulants used: 200 mg of alum at pH = 6.4, 40 ppm of ferric chloride @ pH = 6.2, 41 ppm of lime @ pH = 11.5. Chemical coagulation was followed by dual media filtration)[83]. Consult with environmental regulatory agencies for guidance on acceptable disposal practices. Incineration with effluent gas scrubbing is recommended. Containers must be disposed of properly by following package label directions or by contacting your local or federal environmental control agency, or by contacting your regional EPA office.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- USEPA, Office of Pesticide Programs, Pesticide Residue Limits, "Fenbutatin Oxide," 40 CFR 180.362. http://www.epa.gov/pesticides/food/viewtols.htm
- International Programme on Chemical Safety (IPCS), "Health and Safety Guide, Fenbutatin Oxide," Geneva, Switzerland (1977). http://toxnet.nlm.nih.gov
- Mackison, F. W., R. S. Stricoff, and L. J. Partridge, Jr. (eds.). NIOSH/OSHA, *Occupational Health Guidelines for Chemical Hazards*. DHHS(NIOSH) Publication No. 81-123,Washington DC (January 1981)

Fenhexamid F:0075

Use Type: Fungicide

CAS Number: 126833-17-8

Formula: $C_{14}H_{17}Cl_2NO_2$

Synonyms: 2',3'-Dichloro-4'-hydroxy-1-methylcyclohexanecarboxanilide; (*N*-2,3-Dichloro-4-hydroxyphenyl)-1-methyl cyclohexanecarboxamide;*N*-(2,3-dichloro-4-hydroxyphenyl)-1-methylcyclohexanecarboxamide; 1-Methyl-cyclohexanecarboxylic acid (2,3-dichloro-4-hydroxy-phenyl)-amide

Trade names: KBR-2738

Chemical Class: Hydroxyanilide

EPA/OPP PC Code: 090209

California DPR Chemical Code: 4032

HSDB Number: 7273

UN/NA & ERG Number: UN3077(solid)/171

EC Number: 422-530-5 [*Annex I Index No.*616-111-00-8]

Uses: Fungicide; for control of Botrytis cinerea and related diseases on Rubus, Ribes, bushberries, caneberries, grapes, pistachios, strawberries, ornamentals and other crops. Control of Monilinia diseases of almonds and stone fruit. On grapes and grapevines for suppression of powdery mildew and to control bunch rot[83].

U.S. Maximum Allowable Residue Levels for the fungicide fenhexamid [40 CFR 180.553(a)]: in or on the following commodities: almond, hull 2.0 ppm; almond 0.02 ppm; bushberry, subgroup 13B, 5.0 ppm; caneberry, subgroup 13A, 20.0 ppm; cucumber 2.0 ppm; fruit, stone, group 12, except plum, prune, fresh, postharvest 10.0 ppm; grape 4.0 ppm; grape, raisin 6.0 ppm; juneberry 5.0 ppm; kiwifruit, postharvest 15.0 ppm; leafy greens, subgroup 4A, except spinach 30.0 ppm; lingonberry 5.0 ppm; pistachio 0.02 ppm; plum, prune, dried 2.5 ppm; plum, prune, fresh 1.5 ppm; salal 5.0 ppm; strawberry 3.0 ppm; and vegetable, fruiting, group 8, except nonbell pepper 2.0 ppm.

Regulatory Authority and Advisory Information:
Carcinogenicity[83]: EPA, Not likely to be carcinogenic to humans
Toxic to aquatic life
Acute Oral Category: 3, CAUTION
European/International Regulations: Hazard Symbol: N; risk phrases: R51/53; safety phrases: S2; S61 (see Appendix 1)
WGK (German Aquatic Hazard Class): No value assigned

Description: White to beige powder. Commercial products are available in various form, including wettable powders, suspension concentrates, and water dispersible granules. Molecular weight = 302.21; Specific gravity (H_2O:1) = 1.338 @ 20 °C; Boiling point = 319.8 °C; Freezing/Melting point = 141 °C; 154 °C; Vapor pressure = 5×10^{-9} mmHg @ 25 °C. Low solubility in water; solubility 15 mg/L.

Incompatibilities: Dust may form explosive mixture with air. Decomposes >300 °C. May react with strong oxidizers such as chlorates, peroxides, nitrates, etc.

Permissible Concentration in Water: Runoff from spills or fire control may cause water pollution.

Determination in Water: Log K_{ow} = >3.5. Values above 3.0 are likely to bioaccumulate in aquatic organisms.

Routes of Entry: Inhalation, dermal and/or eye contact.

Harmful Effects and Symptoms

Short Term Exposure: May be harmful if swallowed. May cause eye irritation. Higher levels may cause irritation of the respiratory tract. LD_{50} (oral, rat) = >5 g/kg; LD_{50} (dermal, rat) = >2 g/kg[83].

Long Term Exposure: Possible liver, kidney and erythrocyte toxicity.

Points of Attack: Liver, kidneys, blood cells.

Medical Surveillance: Complete blood count, liver and kidney function tests.

First Aid: If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least 15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately. If this chemical contacts the skin, remove contaminated clothing and wash immediately with soap and water. Seek medical attention immediately. If this chemical has been inhaled, remove from exposure, begin rescue breathing (using universal precautions) if breathing has stopped, and CPR if heart action has stopped. Transfer promptly to a medical facility. When this chemical has been swallowed, get medical attention. Give large quantities of water and induce vomiting. Do not make an unconscious person vomit. Do not induce vomiting when formulations containing petroleum solvents are ingested.

Personal Protective Methods: Smoking, eating, and drinking before washing should be absolutely prohibited when any pesticide is being handled or used. Applicators and other handlers must wear: Coveralls worn over long-sleeved shirt and long pants; Chemical-resistant gloves such as DuPont™ Tychem® suit fabrics, barrier laminate, or Viton®; Chemical-resistant footwear plus socks; Protective eye wear; Chemical-resistant headgear for overhead exposure; Chemical-resistant apron when cleaning equipment, mixing, or loading[83]. Agricultural Use/Engineering Controls: When handlers use closed systems, enclosed cabs, or aircraft in a manner that meets the requirements listed in the Worker Protection Standard (WPS) for agricultural pesticides, ***[40 CFR 170.240(d)(4-6)]***, the handler PPE requirements may be reduced or modified as specified in the Worker Protection Standard.

Respirator Selection: Wherever and whenever workplace conditions warrant respirator use, a respiratory protection program must be followed that meets one or more of the following government standards: OSHA's 29 CFR 1910.134, ANSI Z88.2, or European Standard EN 149.

Storage: Color Code-Green: General storage may be used. Prior to working with this chemical you should be trained on its proper handling and storage. Store in tightly closed containers in a cool, well-ventilated area away from oxidizers, acids, water, or combustible materials. Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: Environmentally hazardous substances, solid or liquid, usually fall in Hazard Class 9.

Spill Handling: If you spill this chemical, first remove all sources of ignition. Dampen the spilled material with water. Clean up with dampened absorbent paper and transfer material to a suitable trash container. Seal the absorbent paper and your clothing in a vapor-tight plastic bag for eventual disposal. Wash all contaminated surfaces with a soap and water solution. Do not reenter the contaminated area until an expert verifies that the area has been properly cleaned.

Fire Extinguishing: Hazardous decomposition includes toxic oxides of nitrogen and carbon and hydrogen chloride gas. As an immediate precautionary measure, isolate spill or leak area in all directions for at least 50 meters/150 feet for liquids and at least 25 meters/75 feet for solids. *Fire involving storage or vehicular tanks:* isolate for 800 meters/0.5 mile in all directions; also, consider initial evacuation for 800 meters/0.5 mile in all directions. *On a small fire:* use dry chemical, CO_2, water spray or regular foam. *On a large fire:* use water spray, fog or regular foam. Do not scatter spilled material with high-pressure streams of water. Move containers from fire area if you can do it without risk. Dike fire-control water for later disposal. *Fire involving tanks:* from a secure, explosion-proof location, use water spray to cool exposed containers. If cooling streams are ineffective (venting sound increases in volume and pitch, tank discolors, or shows any signs of deforming), withdraw immediately to a secure position. Always stay away from tanks engulfed in fire. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode.

Disposal Method Suggested: It is the responsibility of chemical waste generators to determine if a discarded chemical is classified as a hazardous waste. See ***40 CFR*** Parts 261.3 for U.S. EPA guidelines for the classification determination. Additionally, in order to ensure complete and accurate classification, waste generators must consult state and local hazardous waste regulations.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- United States National Library of Medicine, ChemIDplus Advanced, Bethesda, MD, http://chem.sis.nlm.nih.gov/chemidplus/rn/126833-17-8

Fenitrothion F:0100

Use Type: Insecticide, Acaracide

CAS Number: 122-14-5

Formula: $C_9H_{12}NO_5PS$; $(CH_3O)_2PSO\text{-}C_6H_3(NO_2)(CH_3)$

Synonyms: *O,O*-Dimethyl-*O*-(3-methyl-4-nitrophenyl)-phosphorothioate; *O,O*-Dimethyl-*O*-(3-methyl-4-nitrophenyl)-thiophosphate; *O,O*-Dimethyl-*O*-(3-methyl)phosphorothioate; *O,O*-Dimethyl-*O*-(4-nitro-3-methylphenyl)thiophosphate; *O,O*-Dimethyl-*O*-4-nitro-*m*-toylphosphorothioate; ENT 25,715; Methylnitrophos (used in Eastern Europe); Phosphorothioic acid, *O,O*-dimethyl *O*-(3-methyl-4-nitrophenyl)ester; Phosphorothioic acid, *O,O*-dimethyl *O*-(4-nitro-*m*-tolyl)ester; Phenitrothion

Trade Names: ACCOTHION®; ACEOTHION®; AGRIA 1050®; AGRIYA 1050®; AGROTHION®; AMERICAN CYANAMID CL-47,300®; ARBOGAL®; BAY 41831®; BAYER 41831®; BAYER S 5660®; CEKUTROTHION®; CL 47300®; CP47114®; CYFEN®; CYTEL®; CYTEN®; DICATHION®; DICOFEN®; DYBAR®; EI 47300®; FALITHION®; FENITEX®; FENITOX®; FENSTAN®; FOLETHION®; FOLITHION®; H-35-F 87 (BVM)®; 8057HC®; KALEIT®; KEEN SUPERKILL ANT AND ROACH EXTERMINATOR®; KILLGERM TETRACIDE INSECTICIDAL SPRAY®; KOTION®; MEP (PESTICIDE)®; METATHION®; METATHIONE®; METATION®; MICROMITE®; MONSANTO CP 47114®; NITROPHOS®; NOVATHION®; NUVAND®; NUVANOL®; OLEOSUMIFENE®; OMS 43®; OVADOFOS®; PENNWALT C-4852; PESTROY®; S 112A®; S 5660®; SMT®; SUMITHION®[C]; TURBAIR GRAIN STORAGE INSECTICIDE®; VERTHION®

Chemical Class: Organophosphate

EPA/OPP PC Code: 105901

California DPR Chemical Code: 2520

HSDB Number: 1590

UN/NA & ERG Number: UN2783 (solid)/152; UN3018 (liquid)/152, depending on which commercial products are being shipped.

RTECS® Number: TG0350000

EC Number: 204-254- 2 [*Annex I Index No.:* 015-054-00-0]

Uses: Not approved for use in EU countries[115]. Registered for use in the U.S. This is a selective acaricide and a contact and stomach insecticide. Fenitrothion is a contact insecticide and selective acaricide of low ovicidal properties. It is considered an acetylcholinesterase inhibitor. Fenitrothion is effective against a wide range of pests, i.e. penetrating, chewing and sucking insect pests (coffee leafminers, locusts, rice stem borers, wheat bugs, flour beetles, grain beetles, grain weevils) on cereals, cotton, orchard fruits, rice, vegetables, and forests. It may also be used as a fly, mosquito, and cockroach residual contact spray for farms and public health programs. Fenitrothion is also effective against household insects and all of the nuisance insects listed by the World Health Organization. Its effectiveness as a vector control agent for malaria is confirmed by the World Health Organization. Fenitrothion is non-systemic, and non-persistent. Fenitrothion was introduced in 1959 by both Sumitomo Chemical Company and Bayer Leverkusen and later by American Cyanamid Company. Fenitrothion is far less toxic than parathion with a range of insecticidal activity that is very similar and is similar enough in structure to be produced in the same factories. The difference in precursor chemicals might make it somewhat more expensive, but it is heavily used in other countries, including Japan, where parathion has been banned. Fenitrothion comes in dust, emulsifiable concentrate, flowable, fogging concentrate, granules, ULV, oil-based liquid spray, and wettable powder formultaions. It is compatible with other neutral insecticides.

U.S. Maximum Allowable Residue Levels for Fenitrothion [40 CFR 185.2200]: in wheat gluten resulting from post-harvest application of the insecticide to stored wheat in Australia, 30 ppm, of which not >15 ppm for combined residues of the insecticide *O,O*-dimethyl *O*-(4-nitro-*m*-totyl) phosphorothioate and its metabolites *O,O*-dimethyl *O*-(4-nitro-*m*-totyl) phosphate and 3-methyl-4-nitrophenol.

Human toxicity (long-term)[101]: High–9.10 ppb, Health Advisory

Fish toxicity (threshold)[101]: Intermediate–63.62386 ppb, MATC (Maximum Acceptable Toxicant Concentration)

Regulatory Authority and Advisory Information:

Carcinogenicity[83]: EPA Group E, evidence of non-carcinogenicity for humans

Acute Oral Category: 2, WARNING

Health Advisory: Nerve Toxin, Mutagen, Developmental/Reproductive Toxin, Endocrine disruptor (S!)

U.S. DOT 49CFR172.101, Inhalation Hazard Chemical as organophosphates

Superfund/EPCRA 302 Extremely Hazardous Substances:

TPQ = 500 lb (227 kg)

Superfund/EPCRA 40CFR302.4 RQ: EHS, 1 lb (0.454 kg)

U.S. DOT Regulated Marine Pollutant (49CFR, Subchapter 172.101, Appendix B), severe pollutant

European/International Regulations: Hazard Symbol: Xn, N; risk phrases: R22; R50/53; safety phrases: S2; S60; S61 (see Appendix 1)

WGK (German Aquatic Hazard Class): 3-Severe hazard to waters

Description: Fenitrothion is a volatile brownish-yellow oil. Phenol-like odor. Commercial products in various forms, including dust and dry granules. Molecular weight = 277.25; Specific gravity (H_2O:1) = 1.323 @ 25 °C; Boiling point = (decomposes) 140 °C; Freezing/Melting point = 0.28 °C; Vapor pressure = 5.3×10^{-5} mbar @ 20 °C; Flash point = 157 °C. Hazard Identification (based on NFPA-704 M Rating System): Health 3, Flammability 1, Reactivity 0. Practically insoluble in water; solubility = 30 ppm. Physical and toxicological properties may be affected by carrier solvents in commercial formulations.

Incompatibilities: Keep away from strong oxidizers, reducing agents, strong bases; unstable in alkaline media. In the presence of strong reducing agents such as hydrides, organophosphates form highly toxic and flammable phosphine gas. Contact with oxidizers can cause the release of toxic oxides of phosphorus. Decomposes at about 100–140 °C releasing poisonous gases and various organophosphorus polymers.

Determination in Air: OSHA versatile sampler-2; Toluene/Acetone; Gas chromatography/Flame photometric detection for sulfur, nitrogen, or phosphorus; NIOSH Method IV Method #5600, Organophosphorus pesticides[18].

Determination in Water: Log K_{ow} = >3.0. Values at or above 3.0 are likely to bioaccumulate in marine organisms.

Determination in Water: NIOSH Method 1657. The determination of organophosphorus pesticides in municipal and industrial wastewater by gas chromatography. Detection limit = 6.0 ng/L.

Routes of Entry: Inhalation, through the skin, ingestion.

Harmful Effects and Symptoms: Organophosphates are highly toxic. Symptoms may develop rapidly, or there may be a delay of several hours following exposure before they become noticeable. The delay tends to be longer in the case of some compounds that dissolve fats, lipids, oils and non-polar solvents such as toluene. Symptoms may increase in severity for more than a single day and last for several days. In severe cases of organophosphate intoxication, respiratory failure may occur.

Short Term Exposure: Irritates the eyes and skin. Nausea is often the first symptom, followed by vomiting; abdominal cramps; diarrhea; excessive salivation; headache; giddiness; dizziness; weakness; tightness in the chest; loss of muscle coordination; slurring of speech, muscle twitching (particularly the tongue and eyelid); respiratory difficulty; blurring or dimness of vision; pinpoint pupils; profound weakness; mental confusion; disorientation and drowsiness. This compound is an organophosphate insecticide. It is a highly toxic cholinesterase inhibitor that acts on the nervous system. Does not cause delayed neurotoxicity and contact produces little irritation. The effects may be delayed. Delayed pulmonary edema may occur after inhalation. Keep exposed victim under medical observation. LD_{50} (oral, rat) = 200–300 mg/kg; LD_{50} (dermal, rat) = >1000 mg/kg.

Long Term Exposure: Cholinesterase inhibitor; cumulative effect is possible. This chemical may damage the nervous system with repeated exposure, resulting in convulsions, respiratory failure. May cause liver damage.

Points of Attack: Respiratory system, kidneys, lungs, central nervous system, cardiovascular system, skin, eyes, plasma and red blood cell cholinesterase; personality change, depression, anxiety or irritability. May be a skin sensitizer.

Medical Surveillance: Medical observation is recommended for 24 to 48 hours following breathing overexposure, as pulmonary edema may be delayed. Routine biological monitoring of pesticide applicators and field workers includes testing of plasma and red blood cell acetylcholinesterase levels (for enzyme poisoned by this chemical). These tests are normally accurate only if done within about two hours of exposure. If exposure stops, plasma levels return to normal in 1–2 weeks while red blood cell levels may be reduced for 1–3 months. When acetylcholinesterase enzyme levels are reduced by 25% or more below preemployment levels, risk of poisoning is increased, even if results are in lower ranges of "normal." Reassignment to work not involving organophosphate pesticides is recommended until enzyme levels recover. Do not drink any alcoholic beverages before or during use as it promotes absorption of organophosphates. Also consider complete blood count and chest x-ray following acute overexposure. Evaluation by a qualified allergist, including exposure history and testing, may help diagnose allergy.

First Aid: **Treatment for organophosphate poisoning consists of thorough decontamination, cardiorespiratory support, and administration of the antidotes atropine and pralidoxime. In cases of severe poisoning, diazepam, an anticonvulsant, should also be administered. Antidotes should be administered as prevention even if the diagnosis is in doubt**. Speed in removing material from eyes and skin is of extreme importance. *Eyes:* Eye contact can cause dangerous amounts of these chemicals to be quickly absorbed through the mucous membrane into the bloodstream. Immediately and gently flush eyes with plenty of warm or cold water (NO hot water) for at least 15 minutes, occasionally lifting the upper and lower eyelids. Get medical aid immediately. *Skin:* Get medical aid. Dermal contact can cause dangerous amounts of these chemicals to be absorbed into the bloodstream. Wearing the appropriate PPE equipment and respirator for organophosphate/carbamate pesticides, immediately flush skin with plenty of soap and water for at least 15 minutes while removing contaminated clothing and shoes. Shampoo hair promptly if contaminated. The removed, contaminated clothing and shoes should be double-bagged and left in Hot Zone for later disposal by hazardous materials experts. Skin may also be decontaminated with diluted hypochlorite solution. *Inhalation:* Get medical aid. Do not contaminate yourself.

Wearing the appropriate PPE equipment and respirator for organophosphate pesticides, immediately remove the victim from the contaminated area to fresh air. If the victim is not breathing, administer artificial respiration. Do not use mouth-to-mouth method if victim ingested or inhaled the substance; give artificial respiration with the aid of a pocket mask equipped with a one-way valve or other proper respiratory medical device. If breathing is difficult, administer oxygen through bag/mask apparatus until medical help arrives. Do not leave victim unattended. *Ingestion:* Call poison control. Loosen all clothing. Never give anything by mouth to an unconscious person. If victim is *unconscious or having convulsions,* do nothing except keep victim warm. Get medical aid. Transfer promptly to a medical facility. In cases of ingestion, **do not induce vomiting**. If the victim is alert and asymptomatic, administer a slurry of activated charcoal at a dose of 1 g/kg (infant, child, and adult dose). A soda can and straw may be of assistance when offering charcoal to a child. *In some cases you may be specifically instructed by poison control to induce vomiting by way of 2 tablespoons of syrup of ipecac (adult) washed down with a cup of water*. Do NOT give activated charcoal before or with ipecac syrup. *Note to physician or authorized medical personnel:* Treat cases of respiratory compromise, coma, or excessive pulmonary secretions with respiratory support using protocols and techniques available and within the scope of training. Some cases may necessitate procedures such as endotracheal intubation or cricothyrotomy by properly trained and equipped personnel. When possible, atropine (see *Antidotes*, below) should be given under medical supervision. Patients who are comatose, hypotensive, or having seizures or cardiac arrhythmias should be treated according to advanced life support protocols. *Antidotes:* Two antidotes are administered to treat organophosphate poisoning. Atropine is a competitive antagonist of acetylcholine at muscarinic receptors and is used to control the excessive bronchial secretions which are often responsible for death. Pralidoxime relieves both the nicotinic and muscarine effects of organophosphate poisoning by regenerating acetylcholinesterase and can reduce both the bronchial secretions and the muscle weakness associated with poisoning. The initial intravenous dose of atropine in adults should be determined by the severity of symptoms: An initial adult dose of 1.0 to 2.0 mg or pediatric dose of 0.01 mg/kg (minimum 0.01 mg) should be administered intravenously. If intravenous access cannot be established, atropine may also be given intramuscularly, subcutaneously or via endotracheal tube. Doses should be repeated every 15 minutes until excessive secretions and sweating have been controlled. Once bronchial secretion has been controlled, atropine administration should be repeated whenever the secretions begin to recur. In seriously poisoned patients, very large doses may be required. Alterations of pulse rate and pupillary size should not be used as indicators of treatment adequacy. Pralidoxime should be administered as early in poisoning as possible as its efficacy may diminish when given more than 24 to 36 hours after exposure. Doses are as follows: adult 1.0 g; pediatric 25 to 50 mg/kg. The drug should be administered intravenously over 30 to 60 minutes, but in a life-threatening situation one-half of the total dose can be given per minute for a total administration time of 2 minutes. Treatment should begin to take effect within 40 minutes with a reduction in symptoms and the amount of atropine necessary to control bronchial secretion. The initial dose can be repeated in 1 hour and then every 8 to 12 hours until the patient is clinically well and no longer requires atropine. If intravenous access cannot be established, pralidoxime may also be given intramuscularly. Early administration of diazepam in addition to the combined atropine and pralidoxime treatment may help prevent the onset of seizures and potential brain and cardiac morphologic damage following high-level organophosphate poisoning.

Personal Protective Methods: Wear protective gloves and clothing to prevent any reasonable probability of dermal and/or eye contact. Safety equipment suppliers/manufacturers can provide recommendations on the most protective glove/clothing material for your operation. One recommendation is the use of DuPont™ Tychem® suit fabrics[88]. All protective clothing (suits, gloves, footwear, headgear) should be clean, available each day, and put on before work. Contact lenses should not be worn when working with this chemical. Wear splash-proof chemical goggles and face shield unless full facepiece respiratory protection is worn. Employees should wash immediately with soap when skin is wet or contaminated. Provide emergency showers and eyewash.

Respirator Selection: Engineering controls should be used wherever feasible to maintain airborne concentrations of this chemical below the prescribed exposure limit. Respirators and protective equipment are less effective than engineering controls, and should be used only in non-routine or emergency situations which may result in exposure concentrations in excess of the TWA environmental limit. *At any concentrations above the NIOSH REL, or where there is no REL, at any detectable concentration:* SCBAF: Pd,Pp (APF = 10,000) (any NIOSH/MSHA- or European Standard EN 149-approved self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode); or SaF: Pd,Pp: ASCBA (APF = 10,000) (any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary, self-contained breathing apparatus operated in a pressure-demand or other positive-pressure mode).

Storage: Color Code-Blue: Health Hazard/Poison. Store in a secure poison location. Stable for 2 years if stored at 20–25 °C. Do not store above 40 °C. Prior to working with this chemical you should be trained on its proper handling and storage. Where possible, automatically transfer material from other storage containers to process containers. Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: Organophosphorus pesticides, solid or liquid (nonflammable), require a "poisonous materials" label. This chemical falls in Hazard Class 6.1.

Spill Handling: First remove all sources of ignition. Evacuate persons not wearing protective equipment from area of spill or leak until clean up is complete. Stay upwind; keep out of low areas. Ventilate area of spill or leak. Remove and isolate contaminated clothing at the site. Do not touch spilled material; stop leak if you can do so without risk. Use water spray to reduce vapors. *Small spills:* absorb with sand or other noncombustible absorbent material and place into containers for later disposal. *Large spills:* dike far ahead of spill for later disposal. Collect powdered material in the most convenient and safe manner and deposit in sealed containers. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable. Seek professional environmental engineering assistance from the U.S. EPA Environmental Response Team at (908) 548-8730 (24-hour response line).

Fire Extinguishing: Poisonous gases produced in fire, including oxides of nitrogen, sulfur and phosphorus. May be fatal if inhaled, ingested or absorbed through skin. Inhalation or contact with some of these materials will irritate or burn skin and eyes. Vapors may cause dizziness or suffocation. *Small fires:* dry chemical, carbon dioxide; water spray; or foam. *Large fires:* water spray, fog, or foam. Stay upwind; keep out of low areas. Ventilate closed spaces before entering them. Firefighting gear (including SCBA) may not provide adequate protection. If exposure occurs, remove and isolate gear immediately and thoroughly decontaminate personnel. Wear positive-pressure breathing apparatus and special protective clothing. Remove and isolate contaminated clothing at the site. Move container from fire area if you can do so without risk. Fight fire from maximum distance. Dike fire control water for later disposal; do not scatter the material. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies. From a secure, explosion-proof location, use water spray to cool exposed containers. If cooling streams are ineffective (venting sound increases in volume and pitch, tank discolors, or shows any signs of deforming), withdraw immediately to a secure position. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode.

Disposal Method Suggested: Destruction by alkali hydrolysis or incineration. Containers must be disposed of properly by following package label directions or by contacting your local or federal environmental control agency, or by contacting your regional EPA office.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- EXTOXNET, Extension Toxicology Network, "Pesticide Information Profile, Fenitrothion," Oregon State University, Corvallis, OR (September 1995). http://extoxnet.orst.edu/pips/fenitrot.htm
- USEPA, Office of Pesticide Programs, Pesticide Residue Limits, "Fenitrothion", 40 CFR 180.540. http://www.epa.gov/pesticides/food/viewtols.htm
- New Jersey Department of Health and Senior Services, "Hazardous substance Fact Sheet, Fenitrothion," Trenton, NJ (August 2000). http://www.state.nj.us/health/eoh/rtkweb/2410.pdf
- Sax, N. I., Ed., "Dangerous Properties of Industrial Materials Report," 2, No. 4, 88-92 (1982)
- Lee, C. C., "Environmental Law Index to Chemicals," Government Institutes, Inc., Rockville, MD (1996)
- Agency for Toxic Substances and Disease Registry, U.S. Department of Health and Human Services, Public Health Service, "Managing Hazardous Materials Incidents," Atlanta, GA (June 2003)
- USEPA, "Chemical Profile: Fenitrothion," Washington DC, Chemical Emergency Preparedness Program (November 30, 1987)

Fenoxaprop-ethyl F:0105

Use Type: Herbicide

CAS Number: 66441-23-4; 71283-80-2 (P-ethyl)

Formula: $C_{18}H_{16}ClNO_5$

Synonyms: Caswell No. 431C; 2-[4-((6-Chloro-2-benzoxazolyl)oxy)phenoxy]propionic acid, ethyl ester, (±)-; (±)-Ethyl 2-[4-((6-chloro-2-benzoxazolyl)oxy)phenoxy] propanoate; Ethyl-2-[(4-(6-chloro-2-benzoxazolyloxy))-phenoxy]propionate; Ethyl-2-[4-((6-chlorobenzoxazol-2-yl)oxy)phenoxy]propionate; Ethyl (D+)-2-[4-(6-chlor-2-benzoxazolyloxy)phenoxy]propanoate; (±)Ethyl-2-[-((6-chloro-2-benzoxazolyl)oxy)phenoxy]ropionate; Propionic acid, 2-[4-((6-chloro-2-benzoxazolyl)oxy)phenoxy] ethylester, (±)-

Trade Names: ACCLAIM®[C]; DEPON®; EXCEL®; FENOXYPROP®; FURORE®; HOE 033171®; HOE-A 25-01®; OPTION® Fenoxaprop-ethyl; PUMA®; WHIP®

Chemical Class: Chlorophenoxy; Aryloxyphenoxypropionate

EPA/OPP PC Code: 128701

California DPR Chemical Code: 2311

HSDB Number: 6848 (CAS: 66441-23-4)

UN/NA & ERG Number: UN3077(solid)/171

RTECS® Number: UA2454000

EC Number: 266-362-9 [*Annex I Index No.:* 604-039-00-X]

Uses: Used to control annual and perennial grassy weeds in potatoes, soy beans, beans, beets, vegetables, flax, ground nuts, rape and cotton. Not approved for use in EU countries[115]. Not registered for use in the U.S. There are 17 global suppliers[97].

U.S. Maximum Allowable Residue Levels for Fenoxaprop-Ethyl and its metabolites [2-[4-[(6-chloro-2-benzoxazoyl) oxy]phenoxy]propanoic acid and 6-chloro-2,3- dihydrobenzoxazol-2-one], expressed as fenoxaprop-ethyl [40 CFR 180.430(a)]: in or on the following raw agricultural commodities: cottonseed 0.05 ppm; peanuts 0.05 ppm; peanut hulls 0.05 ppm; rice grain 0.05 ppm; soybeans 0.05 ppm.

Human toxicity (long-term)[101]: Intermediate–17.50 ppb, Health Advisory

Fish toxicity (threshold)[101]: Intermediate–34.71346 ppb, MATC (Maximum Acceptable Toxicant Concentration)

Regulatory Authority and Advisory Information:

California Proposition 65 Chemical: Developmental/Reproductive toxin (3/26/1999)

Acute Oral Category: 3, CAUTION

Health Advisory: Endocrine disruptor (S!), Developmental/Reproductive Toxin (confirmed), Ground water contaminant (PAN)

AB 2588-Air Toxics “Hot Spots” Chemicals (CAL) as chlorophenoxy pesticides

EPCRA Section 313 Form R *de minimis* concentration reporting level: 1.0%

Marine Pollutant: IMDG

European/International Regulations: Hazard Symbol: Xi, N; risk phrases: R43; R50/53; safety phrases: S2; S24; S37, S60; S61 (see Appendix 1)

WGK (German Aquatic Hazard Class): 2-Hazard to waters

Description: Colorless or white solid. Liquid form is dark brown and has an aromatic hydrocarbon odor. Molecular weight = 361.78; Specific gravity (H_2O:1) = 1.33; Boiling point = 199.6 °C; Freezing/Melting point = 84–86 °C; Vapor pressure = 3.2×10^{-8} mmHg @ 20 °C. Practically insoluble in water.

Incompatibilities: Decomposed by acids and alkalis. May react with strong oxidizers such as chlorates, peroxides, nitrates, etc.

Determination in Water: Log K_{ow} = >4.0. Values above 3.0 are likely to bioaccumulate in aquatic organisms.

Routes of Entry: Inhalation, ingestion, absorbed through the skin.

Harmful Effects and Symptoms

Short Term Exposure: Irritates the skin, eyes, and respiratory tract. Eye contact may cause irritation, burning sensation, and damage. Harmful if ingested, inhaled or absorbed through the skin. May be harmful if swallowed. LD_{50} (oral, rat) = >2 g/kg; LD_{50} (dermal, rat) = >2 g/kg.

Long Term Exposure: May cause skin sensitization. May cause reproductive and fetal effects.

Points of Attack: Skin. Reproductive system.

Medical Surveillance: Preliminary medical exam to detect chronic diseases of central nervous system, liver, heart, kidneys, lung and skin, as well as endocrinological or immunological disturbances, should protect susceptible individuals. Periodical medical exams of internal organs, skin and eyes are important to avoid chronic occupational intoxications. They should include lab and patch tests when necessary[83]. Comprehensive physical examination with emphasis on the genito-urinary tract analysis to include sperm count, motility and morphology. Other tests, such as serum testosterone, serum follicle stimulating hormone (FSH), and serum luteinizing hormone (LH), may be carried out if, in the opinion of a physician, they are indicated. Consult a physician if poisoning is suspected or if redness, itching, or burning of the eyes or skin develop. Evaluation by a qualified allergist, including exposure history and testing, may help diagnose allergy.

First Aid: If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least 15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately. If this chemical contacts the skin, remove contaminated clothing and wash immediately with soap and water. Seek medical attention immediately. If this chemical has been inhaled, remove from exposure, begin rescue breathing (using universal precautions) if breathing has stopped, and CPR if heart action has stopped. Transfer promptly to a medical facility. When this chemical has been swallowed, get medical attention. Give large quantities of water and induce vomiting. Do not make an unconscious person vomit. Do not induce vomiting when formulations containing petroleum solvents are ingested.

Personal Protective Methods: Wear protective gloves and clothing to prevent any reasonable probability of dermal and/or eye contact. Safety equipment suppliers/manufacturers can provide recommendations on the most protective glove/clothing material for your operation. All protective clothing (suits, gloves, footwear, headgear) should be clean, available each day, and put on before work. Contact lenses should not be worn when working with this chemical. Wear dust-proof chemical goggles and face shield unless full facepiece respiratory protection is worn. Employees should wash immediately with soap when skin is wet or contaminated. Provide emergency showers and eyewash.

Respirator Selection: Follow regulations in OSHA 29CFR1910.134 or European Standard EN149. Use a NIOSH/MSHA- or European Standard EN149-approved respirator; or use an approved supplied-air respirator with a full facepiece operated in the positive-pressure mode, or with a full facepiece, hood, or helmet in the continuous-flow mode; or use a NIOSH/MSHA- or European Standard EN149-approved self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive-pressure mode.

Storage: Color Code-Blue: Health Hazard/Poison. Store in a secure poison location. Prior to working with this chemical you should be trained on its proper handling and storage. Store in tightly closed containers in a cool, well-ventilated area away from strong oxidizers and bases. Metal containers involving the transfer of this chemical should be grounded and bonded. Where possible, automatically transfer material from drums or other storage containers to process containers. Drums must be equipped with self-closing valves, pressure vacuum bungs, and flame arresters. Use only non-sparking tools and equipment, especially when opening and closing containers of this chemical. If this material contains a flammable carrier, sources of ignition, such as smoking and open flames, are prohibited where this chemical is used, handled, or stored in a manner that could create a potential fire or explosion hazard. Wherever this chemical is used, handled, manufactured, or stored, use explosion-proof electrical equipment and fittings. Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: This material may be classified as Environmentally hazardous substances, solid, n. o. s. It usually falls in Hazard Class 9.

Spill Handling: *Solid material:* First remove all sources of ignition. Evacuate persons not wearing protective equipment from area of spill or leak until clean up is complete. Collect powdered material in the most convenient and safe manner and deposit in sealed containers. Ventilate area after clean up is complete. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable. *Liquid formulations containing organic solvents*: Evacuate and restrict persons not wearing protective equipment from area of spill or leak until clean up is complete. Ventilate area of spill or leak. Absorb liquids in vermiculite, dry sand, earth, peat, carbon, or a similar material and deposit in sealed containers. Keep this chemical out of a confined space, such as a sewer, because of the possibility of an explosion, unless the sewer is designed to prevent the build-up of explosive concentrations. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable.

Fire Extinguishing: Hazardous decomposition includes oxides of nitrogen and oxygen and hydrogen chloride gas. As an immediate precautionary measure, isolate spill or leak area in all directions for at least 50 meters/150 feet for liquids and at least 25 meters/75 feet for solids. *Fire involving storage or vehicular tanks:* isolate for 800 meters/0.5 mile in all directions; also, consider initial evacuation for 800 meters/0.5 mile in all directions. *On a small fire:* use dry chemical, CO_2, water spray or regular foam. *On a large fire:* use water spray, fog or regular foam. Do not scatter spilled material with high-pressure streams of water. Move containers from fire area if you can do it without risk. Dike fire-control water for later disposal. *Fire involving tanks:* from a secure, explosion-proof location, use water spray to cool exposed containers. If cooling streams are ineffective (venting sound increases in volume and pitch, tank discolors, or shows any signs of deforming), withdraw immediately to a secure position. Always stay away from tanks engulfed in fire. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode. *Solid material: A* combustible solid. Use dry chemical, carbon dioxide; water spray; or alcohol foam extinguishers. Hazardous decomposition includes chlorates, hydrogen chloride and carbon monoxide. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies. From a secure, explosion-proof location, use water spray to cool exposed containers. If cooling streams are ineffective (venting sound increases in volume and pitch, tank discolors, or shows any signs of deforming), withdraw immediately to a secure position. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode. *Liquid formulations containing organic solvents:* A combustible liquid. Hazardous decomposition includes chlorates, hydrogen chloride and carbon monoxide. Use dry chemical, carbon dioxide; or alcohol foam extinguishers. Vapors are heavier than air and will collect in low areas. Vapors may travel long distances to ignition sources and flashback. Vapors in confined areas may explode when exposed to fire. Containers may explode in fire. Storage containers and parts of containers may rocket great distances, in many directions. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies. From a secure, explosion-proof location, use water spray to cool exposed containers. If cooling streams are ineffective (venting sound increases in volume and pitch, tank discolors, or shows any signs of deforming), withdraw immediately to a secure position. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode.

Disposal Method Suggested: In accordance with ***40CFR165***, follow recommendations for the disposal of pesticides and pesticide containers. Containers must be disposed of properly by following package label directions or by contacting your local or federal environmental control agency, or by contacting your regional EPA office.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- USEPA, Office of Pesticide Programs, Pesticide Residue Limits, "Fenoxaprop-Ethyl," 40 CFR 180.430. http://pmep.cce.cornell.edu/profiles/herb-growthreg/fatty-alcohol-monuron/fenoxaprop-ethyl/Fenoxaprop-ethyl_tol_498.html

Fenoxycarb F:0107

Use Type: Insecticide, Miticide

CAS Number: 72490-01-8; 79127-80-3

Formula: $C_{17}H_{19}NO_4$

Synonyms: AI3-29460; Carbamic acid, [2-(4-phenoxyphenoxy)ethyl]-, ethyl ester; Carbamic acid, [2-4(-phenoxyphenoxy)ethyl]-, ethyl ester; Caswell No. 652C; Ethyl [2-(4-phenoxyphenoxy)ethyl]carbamate; Ethyl 2-(*p*-phenoxyphenoxy)ethyl carbamate; Ethyl[2-(*p*-phenoxyphenoxy) ethyl]carbamate; 2-(4-Phenoxyphenoxy)ethylcarbamic acidethyl ester; [2-(4-Phenoxyphenoxy)ethyl]carbamic acidethyl ester; *N*-[2-(*p*-Phenoxyphenoxy)ethyl]carbamic acid; [2-(4-Phenoxy-phenoxy)-ethyl]carbamic acidethyl ester

Trade Names: AWARD; ABG 6215; ACR®-2984 F; ACR® 2913; BASUS®[C]; COMPLY®; ECTOGARD®[C]; ELIMINATOR®[C]; INSEGAR®; LogIC®; LUFOX®; PICTYL®; PRECISION®; TORUS®[C]; RO 13-5223®; VARIKILL®

Chemical Class: Carbamate

EPA/OPP PC Code: 125301; (128801 old Code No.)

California DPR Chemical Code: 2283

HSDB Number: 6635

UN/NA & ERG Number: UN3077(solid)/171

RTECS® Number: FD0423000

EC Number: 276-696-7 [*Annex I Index No.:* 006-086-00-6]

Uses: Fenoxycarb is an insect growth regulator, sex attractant, or feeding stimulant. It is intended to be used to inhibit metamorphosis of juvenile insects to the adult stage. It is used as bait to control a broad spectrum of insects on olives, vines, fruit, cotton, and stored products. It is used to control fire ants, cockroaches, mosquitos, beetles, moths, scale and sucking insects.

Regulatory Authority and Advisory Information:

Carcinogenicy: EPA, Likely to be a human carcinogen

Health Advisory: Nerve Toxin (S!), Developmental toxin (TRI)

Potential Ground Water Pollutant [California FAC Section 13145(d)/12811, active]

EPCRA Section 313 Form R *de minimis* concentration reporting level: 1.0%

European/International Regulations: Hazard Symbol: N; risk phrases: R40; R50/53; safety phrases: S2; S24; S37, S60; S61 (see Appendix 1)

Description: Light tan to white flaky solid or powder. Molecular weight = 301.35. Specific gravity (H_2O:1) = 1.23 @ 20 °C; Boiling point = 100 °C; Freezing/Melting point = 49–54 °C. Low solubility in water; solubility = 6 ppm @ 25 °C.

Incompatibilities: Carbamates are incompatible with reducing agents, strong acids, oxidizing acids, peroxides, and bases. Contact with active metals or nitrides causes the release of flammable, and potentially explosive, hydrogen gas. Keep away from sulfuric acid, caustics, ammonia, aliphatic amines, alkanolamines, isocyanates, alkylene oxides, epichlorohydrin.

Determination in Water: Log K_{ow} = >4.0. Values above 3.0 are likely to bioaccumulate in aquatic organisms.

Routes of Entry: Skin absorption, ingestion, inhalation.

Harmful Effects and Symptoms: Conflicting information exists on this carbamate insecticide. One site describes this chemical as an eye irritant but not a skin irritant.

Short Term Exposure: Eye pupils are small; blurred vision; eye watering; runny nose; cough; shortness of breath; salivation; nausea, stomach cramps, diarrhea, and vomiting; increased blood pressure; profuse sweating; hypermotility, hallucinations; agitation; tingling of the skin; slow heartbeat; convulsions; fluid in lungs; loss of consciousness; incontinence; breathing stops; death. Carbamates inhibit the acetylcholinesterase enzymes and alter the way in which nervous impulses are transmitted. However, within several hours carbamates spontaneously detach from the enzymes. LD_{50} (oral, rat) = >10,000 mg/kg; LD_{50} (dermal, rat) = >2 g/kg.

Long Term Exposure: A potent acetylcholinesterase (AChE) inhibitor; cumulative effect is possible. This chemical may damage the nervous system with repeated exposure, resulting in convulsions, respiratory failure. May cause liver, kidney and thyroid damage.

Points of Attack: Respiratory system, lungs, liver, kidney, central nervous system, cardiovascular system, skin, eyes, plasma and red blood cell cholinesterase, thyroid.

Medical Surveillance: Medical observation is recommended for 24 to 48 hours following breathing overexposure, as pulmonary edema may be delayed. Cigarette smoking may exacerbate pulmonary injury and should be discouraged for at least 72 hours following exposure. Routine biological monitoring of pesticide applicators and field workers includes testing of plasma and red blood cell acetylcholinesterase levels (for enzyme poisoned by this chemical). These tests are normally accurate only if done within about two hours of exposure. If exposure stops, plasma levels return to normal in 1–2 weeks while red blood cell levels may be reduced for 1–3 months. When acetylcholinesterase enzyme levels are reduced by 25% or more below preemployment levels, risk of poisoning is increased, even if results are in lower ranges of "normal." Reassignment to work not involving organophosphate or carbamate pesticides is recommended until enzyme levels recover. Do not drink any alcoholic beverages before or during use. Also consider complete blood count and chest x-ray following acute overexposure.

First Aid: Speed in removing material from eyes and skin is of extreme importance. *Eyes:* Eye contact can cause dangerous amounts of these chemicals to be quickly absorbed through the mucous membrane into the bloodstream. Immediately and gently flush eyes with plenty of warm or cold water (NO hot water) for at least 15 minutes, occasionally lifting the upper and lower eyelids. Get medical aid immediately. *Skin:* Get medical aid. Dermal contact can cause dangerous amounts of these chemicals to be absorbed into the bloodstream. Wearing the appropriate PPE equipment and respirator for carbamate pesticides, immediately flush skin with plenty of soap and water for at least 15 minutes while removing contaminated clothing and shoes. Shampoo hair promptly if contaminated; protect eyes. *Ingestion:* Call poison control. Loosen all clothing. Never give anything by mouth to an unconscious person. Get medical aid. Do NOT induce vomiting. If conscious, alert, and able to swallow, rinse mouth and have victim drink 4 to 8 ounces of water. Check to see if poison control instructs you to use ipecac syrup, otherwise administer slurry of activated charcoal (2 oz in 8 oz of water). If victim is *UNCONSCIOUS OR HAVING CONVULSIONS,* do nothing except keep victim warm. *In some cases you may be specifically instructed by poison control to induce vomiting by way of 2 tablespoons of syrup of ipecac (adult) washed down with a cup of water*. Do NOT give activated charcoal before or with ipecac syrup. *Inhalation:* Get medical aid. Do not contaminate yourself. Wearing the appropriate PPE equipment and respirator for carbamate pesticides, immediately remove the victim from the contaminated area to fresh air. If the victim is not breathing, administer artificial respiration. Do not use mouth-to-mouth method if victim ingested or inhaled the substance; give artificial respiration with the aid of a pocket mask equipped with a one-way valve or other proper respiratory medical device. If breathing is difficult, administer oxygen through bag/mask apparatus until medical help arrives. Do not leave victim unattended. *Note to physician or authorized medical personnel.* Administer atropine, 2 mg (1/30 gr) intramuscularly or intravenously as soon as any local or systemic signs or symptoms of an intoxication are noted; repeat the administration of atropine every 3 to 8 minutes until signs of atropinization (mydriasis, dry mouth, rapid pulse, hot and dry skin) occur; initiate treatment in children with 0.05 mg mg/kg of atropine; repeat at 5 to 10 minute intervals. Watch respiration, and remove bronchial secretions if they appear to be obstructing the airway; intubate if necessary. *Medical note:* 2-PAMCI may be contraindicated in the case of some carbamate poisonings. As first aid for pulmonary edema, a doctor or authorized paramedic might consider administering a corticosteroid spray.

Personal Protective Methods: Wear protective gloves and clothing to prevent any reasonable probability of dermal and/or eye contact. Safety equipment suppliers/manufacturers can provide recommendations on the most protective glove/clothing material for your operation. DuPont™ Tychem® suit fabrics[88]. All protective clothing (suits, gloves, footwear, headgear) should be clean, available each day, and put on before work. Contact lenses should not be worn when working with this chemical. Wear dust-proof chemical goggles and face shield unless full facepiece respiratory protection is worn. Employees should wash immediately with soap when skin is wet or contaminated. Provide emergency showers and eyewash.

Respirator Selection: *At concentrations above the NIOSH REL, or where there is no REL, at any detectable concentration:* SCBAF:Pd,Pp (APF = 10,000): (any self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode); or SaF:Pd,Pp:ASCBA (APF = 10,000) (any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary self-contained positive-pressure breathing apparatus). *Escape*: GmFOv100 (APF = 50) [any air-purifying, full facepiece respirator (gas mask) with a chin-style, front- or back-mounted organic vapor canister having an N100, R100, or P100 filter]; or SCBAE (any appropriate escape-type, self-contained breathing apparatus).

Storage: Color Code-Blue: Health Hazard/Poison. Store in a secure poison location. Prior to working with this chemical you should be trained on its proper handling and storage. Store in tightly closed containers in a cool, well-ventilated area away from strong alkalis (such as sodium hydroxide, sodium bicarbonate, etc.). Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: Environmentally hazardous substances, solid or liquid, usually fall in Hazard Class 9.

Spill Handling: For solids, isolate spill or leak area in all directions for at least 25 meters/75 feet. Increase, in the downwind direction, as necessary. Do not touch damaged containers or spilled material unless wearing appropriate protective clothing. Stop leak if you can do it without risk. Prevent entry into waterways, sewers, basements or confined areas. Cover with plastic sheet to prevent spreading. Absorb or cover with dry earth, sand or other non-combustible material and transfer to containers. Do not allow water to get inside containers.

Fire Extinguishing: Hazardous decomposition includes oxides of nitrogen, sulfur, and carbon. As an immediate precautionary measure, isolate spill or leak area in all directions for at least 50 meters/150 feet for liquids and at least 25 meters/75 feet for solids. *Fire involving storage or vehicular tanks:* isolate for 800 meters/0.5 mile in all directions; also, consider initial evacuation for 800 meters / 0.5mile in all directions. *On a small fire:* use dry chemical, CO_2, water spray or regular foam. *On a large fire:* use water spray, fog or regular foam. Do not scatter spilled material with high-pressure streams of water. Move containers from fire area if you can do it without risk. Dike fire-control water for later disposal. *Fire involving tanks:* from a secure, explosion-proof location, use water spray to cool exposed containers. If cooling streams are ineffective (venting sound increases in volume and pitch, tank discolors, or shows any signs of deforming), withdraw immediately to a secure position. Always stay away from tanks engulfed in fire. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode.

Disposal Method Suggested: Do not discharge into drains or sewers. Dispose of waste material as hazardous waste using a licensed disposal contractor to an approved landfill. Consult with environmental regulatory agencies for guidance on acceptable disposal practices. Incineration with effluent gas scrubbing is recommended. Containers must be disposed of properly by following package label directions or by contacting your local or federal environmental control agency, or by contacting your regional EPA office.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- EXTOXNET, Extension Toxicology Network, “Pesticide Information Profile, Fenoxycarb,” Oregon State University, Corvallis, OR (June 1996). http://extoxnet.orst.edu/pips/fenoxyca.htm

Fenpyroximate F:0109

Use Type: Acaricide, Miticide, Insecticide

CAS Number: 134098-61-6

Formula: $C_{24}H_{27}N_3O_4$

Synonyms: *tert*-Butyl (*E*)-4-[((((1,3-dimethyl-5-phenoxy-1*H*-pyrazol-4-yl)methylene)amino)oxy)methyl]benzoate; *tert*-Butyl (*E*)-α-(1,3-dimethyl-5-phenoxypyrazol-4-methyleneaminooxy)-*p*-toluate; Benzoic acid, 4-[((((1,3-dimethyl-5-phenoxy-1*H*-pyrazol-4-yl)methylene)amino)oxy)methyl]-, 1,1-dimethylethyl ester, *(E)*-; 4-[((((1,3-Dimethyl-5-phenoxy-1*H*-pyrazol-4-yl)methylene)amino)oxy)methyl]benzoic acid

Trade Names: AKARI®; HOE® 555-02A; NNI®-850; SEQUEL®

Chemical Class: Pyrazole; Phenoxypyrazole

EPA/OPP PC Code: 129131

California DPR Chemical Code: 5784

HSDB Number: 7943

UN/NA & ERG Number: UN3082 (liquid)/171

RTECS® Number: DG9081200

Uses: Used to control spider mites in greenhouses.

U.S. Maximum Allowable Residue Levels for fenpyroximate and its isomer, (Z)-1,1-dimethylethyl 4-[[[[(1,3-dimethyl-5-phenoxy-1H-pyrazol-4-yl)methylene] amino]oxy] methyl]benzoate [40 CFR 180.566(a)(1)]: in or on the following commodities: Almond, hulls 3.0 ppm; berry, low growing, crop, subgroup 13-07G, 1.0 ppm; citrus, dried pulp 2.5 ppm; citrus, oil 10 ppm; cotton, gin byproducts 10 ppm; cotton, undelinted seed 0.10 ppm; cucumber 0.10 ppm; fruit, citrus, group 10, 0.60 ppm; fruit, pome, group 11, 0.40 ppm; grape 1.0 ppm; hop, dried cones 10 ppm; melon subgroup 9A, 0.10 ppm; nut, tree, group 14, 0.10 ppm; okra 0.20 ppm; peppermint, tops 7.0 ppm; pistachio 0.10 ppm; spearmint, tops 7.0 ppm; vegetable, fruiting, group 8, 0.20 ppm. ***[40 CFR 180.566(a)(2)]*** cattle, fat 0.03 ppm; cattle, meat 0.03 ppm; cattle, meat byproducts, except kidney and liver 0.03 ppm; goat, fat 0.03 ppm; goat, meat 0.03 ppm; goat, meat byproducts, except kidney and liver 0.03 ppm; horse, fat 0.03 ppm; horse, meat 0.03 ppm; horse, meat byproducts, except kidney and liver 0.03 ppm; milk 0.015 ppm; sheep, fat 0.03 ppm; sheep, meat 0.03 ppm; sheep, meat byproducts, except kidney and liver 0.03 ppm. ***[40 CFR 180.566(a)(3)]*** cattle, kidney 0.25 ppm; cattle, liver 0.25 ppm; goat, kidney 0.25 ppm; goat, liver 0.25 ppm; horse, kidney 0.25 ppm; horse, liver 0.25 ppm; sheep, kidney 0.25 ppm; sheep, liver 0.25 ppm. ***[40 CFR 180.566(b)]*** honey 0.10 ppm, expires: 12/31/13.

Regulatory Authority and Advisory Information: Acute Oral Category: 2, WARNING

Description: White crystalline solid or powder. Molecular weight = 421.49; Specific gravity (H_2O:1) = 1.14; Boiling point = (decomposes) 546 °C; Freezing/Melting point = 101 °C. Practically insoluble in water; solubility = 0.000015 ppm.

Determination in Water: Log K_{ow} = >5.0. Values above 3.0 are likely to bio-accumulate in marine organisms.

Harmful Effects and Symptoms

Short Term Exposure: Contact with eyes or skin may cause irritation or injury. Harmful if swallowed. Inhalation should be avoided; use NIOSH- or CEN (UK)-approved air-purifying respirators for pesticides.

LD_{50} (oral, rat) = 250 mg/kg[9]; LD_{50} (dermal, rat) = >2 g/kg.

Long Term Exposure: May cause reproductive and fetal effects.

Points of Attack: Reproductive system.

Medical Surveillance: In addition to comprehensive initial medical and work histories emphasizing reproductive experience and menstrual history, patient should have physical examination and testing of genito-urinary tract, sperm count, motility and morphology. If required, other tests, such as serum testosterone, serum follicle stimulating hormone (FSH), and serum lutenizing hormone (LH), may be indicated.

First Aid: If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least 15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately. If this chemical contacts the skin, remove contaminated clothing and wash immediately with soap and water. Seek medical attention immediately. If this chemical has been inhaled, remove from exposure, begin rescue breathing (using universal precautions) if breathing has stopped, and CPR if heart action has stopped. Transfer promptly to a medical facility. When this chemical has been swallowed, get medical attention. Give large quantities of water and induce vomiting. Do not make an unconscious person vomit.

Personal Protective Methods: Applicators and other handlers must wear: Coveralls worn over long-sleeved shirt and long pants; Chemical-resistant gloves such as DuPont™ Tychem® suit fabrics, barrier laminate, or Viton®; Chemical-resistant footwear plus socks; Protective eye wear; Chemical-resistant headgear for overhead exposure; Chemical-resistant apron when cleaning equipment, mixing, or loading[83]. Agricultural Use/Engineering Controls: When handlers use closed systems, enclosed cabs, or aircraft in a manner that meets the requirements listed in the Worker Protection Standard (WPS) for agricultural pesticides, ***40 CFR*** 170.240(d)(4-6), the handler PPE requirements may be reduced or modified as specified in the Worker Protection Standard. Firefighters should wear NIOSH approved self-contained breathing apparatus and full protective clothing.

Respirator Selection: Where the neat (undiluted) test chemical is weighed and diluted, wear a NIOSH-approved half-face respirator equipped with a combination filter cartridge, i.e. organic vapor/acid gas/HEPA (specific for organic vapors, HCl, acid gas, SO_2 and a high-efficiency particulate filter)[88].

Storage: Color Code-Blue: Health Hazard/Poison. Store in a tightly closed container in a dry, well-ventilated and secure poison location. Prior to working with this chemical you should be trained on its proper handling and storage. Where possible, automatically transfer material from other storage containers to process containers. Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: This material may be classified as Environmentally hazardous substances, solid, n. o. s. It usually falls in Hazard Class 9.

Spill Handling: Dampen the spilled material with water. Clean up with dampened absorbent paper and transfer material to a suitable trash container. Seal the absorbent paper and your clothing in a vapor-tight plastic bag for eventual disposal. Wash all contaminated surfaces with a soap and water solution. Do not reenter the contaminated area until an expert verifies that the area has been properly cleaned.

Fire Extinguishing: Hazardous decomposition includes oxides of nitrogen and carbon. As an immediate precautionary measure, isolate spill or leak area in all directions for at least 50 meters/150 feet for liquids and at least 25 meters/75 feet for solids. *Fire involving storage or vehicular tanks:* isolate for 800 meters/0.5 mile in all directions; also, consider initial evacuation for 800 meters/0.5 mile in all directions. *On a small fire:* use dry chemical, CO_2, water spray or regular foam. *On a large fire:* use water spray, fog or regular foam. Do not scatter spilled material with high-pressure streams of water. Move containers from fire area if you can do it without risk. Dike fire-control water for later disposal. *Fire involving tanks:* from a secure, explosion-proof location, use water spray to cool exposed containers. If cooling streams are ineffective (venting sound increases in volume and pitch, tank discolors, or shows any signs of deforming), withdraw immediately to a secure position. Always stay away from tanks engulfed in fire. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode.

Disposal Method Suggested: It is the responsibility of chemical waste generators to determine the toxicity and physical properties and of a discarded chemical and to properly identify its classification and certification as a hazardous waste and to determine the disposal method. U.S. EPA guidelines for the classification determination are listed in ***40 CFR*** Parts 261.3. Additionally, waste generators must consult and follow all regional, national, state and local hazardous waste laws to ensure complete and accurate classification and disposal methods.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- United States National Library of Medicine, ChemIDplus Advanced, Bethesda, MD. http://chem.sis.nlm.nih.gov/chemidplus/rn/134098-61-6

Fenthion F:0120

Use Type: Insecticide, Larvicide, Veterinary medicine

CAS Number: 55-38-9

Formula: $C_{10}H_{15}O_3PS_2$

Synonyms: Dimethyl 4-methylthio-m-tolyl phosphorothioate; DMTP; ENT 25540; Fenthion-methyl; *m*-Cresol, 4-(methylthio)-, o-ester with *O,O*-Dimethyl phosphorothioate; mercaptofos; NCI-C08651; *O,O*-Dimethyl o-(3-methyl-4-(methylthio) phenyl) es; *O,O*-Dimethyl o-(3-methyl-4-(methylthio) phenyl) ester, phosphorothioic acid; *O,O*-Dimethyl o-(3-methyl-4-methylmercaptophenyl) phosphorothioate; *O,O*-Dimethyl o-(3-methyl-4-methylthiophenyl) thiophosphate; *O,O*-Dimethyl o-(4-methylthio-3-methylphenyl) phosphorothioate; *O,O*-Dimethyl o-3-methyl-4-methylthiophenyl phosphorothioate; *O,O*-Dimethyl o-4-(methylmercapto)-3-methylphenyl phosphorothioate; *O,O*-Dimethyl o-4-(methylmercapto)-3-methylphenyl thiophosphate;

O,O-Dimethyl o-[3-methyl-4-(methylthio)phenyl] phosphorothioate; *O,O*-Dimethyl o-[4-(methylthio)-m-tolyl] phosphorothioate; *O,O*-dimethyl o-[4-(methylthio)-m-tolyl] thiophosphate; *O,O*-dimethyl-(o-(4-methylthio)-m-tolyl)phosphorothioic acidester; *O,O*-Dimethyl-o-(4-(methylthio)-m-tolyl)phosphorothioate; *O,O*-Dimethyl-o-3-methyl-4-methylthiophenyl phosphorothioate; *O,O*-dimethyl-o-4-(methylmercapto)-3-methylphenyl phosphorothioate; *O,O*-Dimethyl-o-4-(methylmercapto)-3-methylphenyl thiophosphate; Phosphorothioic acid ((H_3PO_3S)), *O,O*-dimethyl o-4-(methylthio)-m-tolyl ester; Phosphorothioic acid, dimethyl [4-(methylthio)-m-tolyl] ester; Phosphorothioic acid, *O,O*-dimethyl *o*-[4-(methylthio)-*m*-tolyl] ester

Trade Names: B 29493®; BACID®; BAY 29493®; BAYCID®; BAYER 29493®; BAYER 9007®; BAYER S-1752®; BAYTEX®; ENTEX®; LEBAYCID®; MPP®; MPP (pesticide) OMS 2®; PHENTHION®; PILARTEX®; QUELETOX®; S 1752®; SPOTTON®; SULFIDOPHOS®; TALODEX®; TIGUVON®

Chemical Class: Organophosphate

EPA/OPP PC Code: 053301

California DPR Chemical Code: 63 (CAS:55-38-9)

HSDB Number: 1403

UN/NA&ERG Number: UN3018 (liquid)/152

RTECS® Number: TF9625000

EC Number: 200-231-9 [*Annex I Index No.:* 015-048-00-8]

Uses: Not registered for use in the U.S. Not approved for use in EU countries[115]. Used in 20 countries including Australia. There are 23 global suppliers[97].

U.S. Maximum Allowable Residue Levels for Fenthion and its cholinesterase-inhibiting metabolites [40 CFR 180.214]: in or on the following raw agricultural commodities: alfalfa, 5 ppm; alfalfa (hay) 18 ppm; cattle (fat, meat, and meat byproducts) 0.1 ppm; grass 5 ppm; grass (hay) 18 ppm; hogs (fat, meat, and meat byproducts) 0.1 ppm; milk 0.01 ppm (negligible residue); poultry (fat, meat, and meat byproducts) 0.1 ppm; rice 0.1 ppm; and rice (straw) 0.5 ppm.

Regulatory Authority and Advisory Information:

Carcinogenicity[83]: EPA Group E, Not likely to be a human carcinogen

Acute Oral Category: 2, WARNING

Health Advisory: Nerve Toxin, Mutagen, Developmental/Reproductive Toxin

EPCRA Section 313 Form R *de minimis* concentration reporting level: 1.0%.

US DOT Regulated Marine Pollutant (49CFR172.101, appendix B), severe pollutant

Regulations: Hazard Symbol: T, Xn, N; risk phrases: R21/22; R23; R48/25; R68; R50/53; safety phrases: S1/2; S36/37; S45; S60; S61 (see Appendix 1)

WGK (German Aquatic Hazard Class): 3-Severe hazard to waters

Description: Yellow amber to brown oily liquid. May be colorless when pure. Musty or garlic-like odor. Available in various forms, including emulsifiable concentrates, granules and powders for dusting, ULV liquids and wettable powders. Molecular weight: 278.33; Specific gravity (H_2O:1) = 1.25 @ 20 °C; Boiling point = 80 °C; 105 °C @ 0.01 mmHg; Freezing point/Melting point = 7–7.5 °C; Vapor pressure: 2.8×10^{-6} mmHg at 20 °C; Flash point = 168 °C. Hazard Identification (based on NFPA-704 M Rating System): Health 3, Flammability 2, Reactivity 1. Low solubility in water; solubility = <1 mg/ml @ 22.5 °C. Physical and toxicological properties may be affected by carrier solvents in commercial formulations.

Incompatibilities: Combustible. Fenthion may react with strong alkaline materials, or reducing agents such as hydrides to generate highly toxic and flammable phosphine gas. Contact with oxidizing agents may result in the release of toxic phosphorus oxides.

Permissible Exposure Limits in Air: OSHA PEL: None

NIOSH REL: None. Appendix D (NIOSH Pocket Guide)

ACGIH TLV®[1]: 0.2 mg/m^3

Protective Action Criteria (PAC) Ver. 27[89]

PAC-1: 0.15 mg/m^3

PAC-2: 27 mg/m^3

PAC-3: 27 mg/m^3

DFG MAK: 0.2 mg/m^3, inhalable fraction TWA; Peak Limitation Category II(2) [skin]

Determination in Air: OSHA versatile sampler-2; Toluene/Acetone; Gas chromatography/Flame photometric detection for sulfur, nitrogen, or phosphorus; NIOSH Analytical Method (IV) Method #5600, Organophosphorus Pesticides.

Permissible Concentration in Water: No criteria found. Runoff from spills or fire control may cause water pollution.

Determination in Water: Log K_{ow} = >4.0. Values above 3.0 are likely to bioaccumulate in aquatic organisms.

Routes of Entry: Ingestion, inhalation, skin and/or eye absorption.

Harmful Effects and Symptoms

Short Term Exposure: Symptoms of exposure include nausea, vomiting, abdominal cramps, diarrhea, salivation; headache, dizziness, lassitude (weakness, exhaustion); rhinorrhea (discharge of thin mucus), chest tightness; blurred vision, miosis; cardiac irregularities; muscle fasciculation; dyspnea (breathing difficulty). LD_{50} (oral, rat) = 150–250 mg/kg; LD_{50} (dermal, rat) = >1500 mg/kg.

Long Term Exposure: May cause tumors. May be a neurotoxin. May damage central nervous, respiratory and cardiovascular systems. May cause reproductive and fetal effects.

Points of Attack: Respiratory system, central nervous system, cardiovascular system, plasma cholinesterase.

Medical Surveillance: Medical observation is recommended for 24 to 48 hours following breathing overexposure, as pulmonary edema may be delayed. Routine biological monitoring of pesticide applicators and field workers includes testing of plasma and red blood cell acetylcholinesterase levels (for enzyme poisoned by this chemical). These tests are normally accurate only if done within about two hours of exposure. If exposure stops, plasma levels return to normal in 1–2 weeks while red blood cell levels may be reduced for 1–3 months. When acetylcholinesterase enzyme levels are reduced by 25% or more below preemployment levels, risk of poisoning is increased, even if results are in lower ranges of "normal." Reassignment to work not involving organophosphate pesticides is recommended until enzyme levels recover. Do not drink any alcoholic beverages before or during use as it promotes absorption of organophosphates. Also consider complete blood count and chest x-ray following acute overexposure. In addition to comprehensive initial medical and work histories emphasizing reproductive experience and menstrual history, patient should have physical examination and testing of genito-urinary tract, sperm count, motility and morphology. If required, other tests, such as serum testosterone, serum follicle stimulating hormone (FSH), and serum lutenizing hormone (LH), may be indicated.

First Aid: **Treatment for organophosphate poisoning consists of thorough decontamination, cardiorespiratory support, and administration of the antidotes atropine and pralidoxime. In cases of severe poisoning, diazepam, an anticonvulsant, should also be administered. Antidotes should be administered as prevention even if the diagnosis is in doubt**. Speed in removing material from eyes and skin is of extreme importance. *Eyes:* Eye contact can cause dangerous amounts of these chemicals to be quickly absorbed through the mucous membrane into the bloodstream. Immediately and gently flush eyes with plenty of warm or cold water (NO hot water) for at least 15 minutes, occasionally lifting the upper and lower eyelids. Get medical aid immediately. *Skin:* Get medical aid. Dermal contact can cause dangerous amounts of these chemicals to be absorbed into the bloodstream. Wearing the appropriate PPE equipment and respirator for organophosphate/carbamate pesticides, immediately flush skin with plenty of soap and water for at least 15 minutes while removing contaminated clothing and shoes. Shampoo hair promptly if contaminated. The removed, contaminated clothing and shoes should be double-bagged and left in Hot Zone for later disposal by hazardous materials experts. Skin may also be decontaminated with diluted hypochlorite solution. *Inhalation:* Get medical aid. Do not contaminate yourself. Wearing the appropriate PPE equipment and respirator for organophosphate pesticides, immediately remove the victim from the contaminated area to fresh air. If the victim is not breathing, administer artificial respiration. Do not use mouth-to-mouth method if victim ingested or inhaled the substance; give artificial respiration with the aid of a pocket mask equipped with a one-way valve or other proper respiratory medical device. If breathing is difficult, administer oxygen through bag/mask apparatus until medical help arrives. Do not leave victim unattended. *Ingestion:* Call poison control. Loosen all clothing. Never give anything by mouth to an unconscious person. If victim is *unconscious or having convulsions,* do nothing except keep victim warm. Get medical aid. Transfer promptly to a medical facility. In cases of ingestion, **do not induce vomiting**. If the victim is alert and asymptomatic, administer a slurry of activated charcoal at a dose of 1 g/kg (infant, child, and adult dose). A soda can and straw may be of assistance when offering charcoal to a child. *In some cases you may be specifically instructed by poison control to induce vomiting by way of 2 tablespoons of syrup of ipecac (adult) washed down with a cup of water*. Do NOT give activated charcoal before or with ipecac syrup. *Note to physician or authorized medical personnel:* Treat cases of respiratory compromise, coma, or excessive pulmonary secretions with respiratory support using protocols and techniques available and within the scope of training. Some cases may necessitate procedures such as endotracheal intubation or cricothyrotomy by properly trained and equipped personnel. When possible, atropine (see *Antidotes*, below) should be given under medical supervision. Patients who are comatose, hypotensive, or having seizures or cardiac arrhythmias should be treated according to advanced life support protocols. *Antidotes:* Two antidotes are administered to treat organophosphate poisoning. Atropine is a competitive antagonist of acetylcholine at muscarinic receptors and is used to control the excessive bronchial secretions which are often responsible for death. Pralidoxime relieves both the nicotinic and muscarine effects of organophosphate poisoning by regenerating acetylcholinesterase and can reduce both the bronchial secretions and the muscle weakness associated with poisoning. The initial intravenous dose of atropine in adults should be determined by the severity of symptoms: An initial adult dose of 1.0 to 2.0 mg or pediatric dose of 0.01 mg/kg (minimum 0.01 mg) should be administered intravenously. If intravenous access cannot be established, atropine may also be given intramuscularly, subcutaneously or via endotracheal tube. Doses should be repeated every 15 minutes until excessive secretions and sweating have been controlled. Once bronchial secretion has been controlled, atropine administration should be repeated whenever the secretions begin to recur. In seriously poisoned patients, very large doses may be required. Alterations of pulse rate and pupillary size should not be used as indicators of treatment adequacy. Pralidoxime should be administered as early in poisoning as possible as its efficacy may diminish when given more than 24 to 36 hours after exposure. Doses are as follows: adult 1.0 g; pediatric 25 to 50 mg/kg. The drug should be administered intravenously over 30 to 60 minutes, but in a life-threatening situation one-half of the total dose can be given per minute for a total administration time of 2 minutes. Treatment should begin to take effect within 40 minutes with a reduction in symptoms and the amount of atropine necessary to control bronchial secretion. The initial dose can be repeated in 1 hour and then every 8 to 12 hours until the patient is clinically well and no longer requires atropine. If intravenous access cannot be established, pralidoxime may also be given intramuscularly. Early administration of diazepam in addition to the combined atropine and pralidoxime treatment may help prevent the onset of seizures and potential brain and cardiac morphologic damage following high-level organophosphate poisoning.

Personal Protective Methods: Wear protective gloves and clothing to prevent any reasonable probability of dermal and/or eye contact. Safety equipment suppliers/manufacturers can provide recommendations on the most protective glove/clothing material for your operation. One recommendation is the use of DuPont™ Tychem® suit fabrics[88]. All protective clothing (suits, gloves, footwear, headgear) should be clean, available each day, and put on before work. Contact lenses should not be worn when working with this chemical. Wear splash-proof chemical goggles and face shield unless full facepiece respiratory protection is worn. Employees should wash immediately with soap when skin is wet or contaminated. Provide emergency showers and eyewash.

Respirator Selection: SCBA >0.15 mg/m^3. Engineering controls should be used wherever feasible to maintain airborne concentrations of this chemical below the prescribed exposure limit. Respirators and protective equipment are less effective than engineering controls, and should be used only in non-routine or emergency situations which may result in exposure concentrations in excess of the TWA environmental limit. *At any concentrations above the NIOSH REL, or where there is no REL, at any detectable concentration:* SCBAF: Pd,Pp (APF = 10,000) (any NIOSH/MSHA- or European Standard EN 149-approved self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode); or SaF: Pd,Pp: ASCBA (APF = 10,000) (any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary, self-contained breathing apparatus operated in a pressure-demand or other positive-pressure mode).

Storage: Color Code-Blue: Health Hazard/Poison. Store in a secure poison location. Prior to working with this chemical you should be trained on its proper handling and storage. Where possible, automatically transfer material from other storage containers to process containers. Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: Organophosphorus pesticides, solid or liquid (nonflammable), require a "poisonous materials" label. This chemical falls in Hazard Class 6.1.

Spill Handling: As an immediate precautionary measure, isolate spill or leak area in all directions for at least 50 meters/150 feet for liquids and at least 25 meters/75 feet for solids. Increase, in the downwind direction, as necessary, the isolation distance shown above. *Eliminate* all ignition sources (no smoking, flares, sparks or flames in immediate area). Do not touch damaged containers or spilled material unless wearing appropriate protective clothing. Stop leak if you can do it without risk. Prevent entry into waterways, sewers, basements or confined areas. Cover with plastic sheet to prevent spreading. Absorb or cover with dry earth, sand or other non-combustible material and transfer to containers. *Do not get water inside containers*.

Fire Extinguishing: Hazardous decomposition includes oxides of phosphorus, sulfur, and nitrogen. May be fatal if inhaled, ingested or absorbed through skin. Inhalation or contact with some of these materials will irritate or burn skin and eyes. Vapors may cause dizziness or suffocation. Combustible material: may burn but does not ignite readily. Containers may explode when heated. Runoff may pollute waterways. *Fire involving tanks, tank trucks or vehicle loads*, *isolate* for 800 meters/0.5 mile in all directions; also, consider initial evacuation for 800 meters/0.5 mile in all directions. Highly toxic, may be fatal if inhaled, swallowed or absorbed through skin. Contact with molten substance may cause severe burns to skin and eyes. Avoid any skin contact. Effects of contact or inhalation may be delayed. Runoff from fire control or dilution water may be corrosive and/or toxic and cause pollution. *Small fire:* dry chemical, carbon dioxide or water spray. *Large fire:* dry chemical, carbon dioxide, or regular foam. Move containers from fire area if you can do it without risk. Dike fire-control water for later disposal; do not scatter the material. *Fire involving tanks or car/trailer loads:* fight fire from maximum distance or use unmanned hose holders or monitor nozzles. Do not get water inside containers. Cool containers with flooding quantities of water until well after fire is out. Withdraw immediately in the case of rising sound from venting safety devices or discoloration of tank. Always stay away from tanks engulfed in fire. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies.

Disposal Method Suggested: Destruction by alkali hydrolysis or incineration. Containers must be disposed of properly by following package label directions or by contacting your local or federal environmental control agency, or by contacting your regional EPA office.

Disposal Method Suggested: Do not discharge into drains or sewers. Dispose of waste material as hazardous waste using a licensed disposal contractor to an approved landfill. Consult with environmental regulatory agencies for guidance on acceptable disposal practices. Incineration with effluent gas scrubbing is recommended[22]. In accordance with ***40CFR165***, follow recommendations for the disposal of pesticides and pesticide containers. Noncombustible containers should be compacted and buried under more than 16 inches/40 cm. of soil[83]. Must be disposed properly by following package label directions or by contacting your local or federal environmental control agency, or by contacting your regional EPA office.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- New Jersey Department of Health and Senior Services, *Hazardous Substance Fact Sheet; Fenthion*, Trenton, NJ (May, 1986). http://www.state.nj.us/health/eoh/rtkweb/0916.pdf

Fenvalerate F:0128

Use Type: Insecticide
CAS Number: 51630-58-1
Formula: $C_{25}H_{22}ClNO_3$
Synonyms: A13-29235; Benzeneacetic acid, 4-chloro-α-(1-methylethyl)-, cyano(3-phenoxyphenyl)methyl ester; Caswell No. 077A; 4-Chloro-α-(1-methylethyl)benzeneacetic acid, cyano(3-phenoxyphenyl)methyl ester; α-Cyano-3-phenoxybenzyl-2-(4-chlorophenyl)-3-methybutyrate; Cyano(3-phenoxyphenyl)methyl ester of 4-chloro-α-(1-methylethyl)benzeneacetic acid; Cyano(3-phenoxyphenyl)methyl 4-chloro-α-(1-methylethyl)benzeneacetate; (IRS)-α-Cyano-3-phenoxybenzyl (RS)-2-(4-chlorophenyl)-3-methybutyrate; α-Cyano-*m*-phenoxybenzyl 2-(*p*-chlorophenyl)-3-methylbutyrate; α-Cyano-3-phenoxybenzyl 2-(4-chlorophenyl) isovalerate; Cyano-(3-phenoxybenzyl)methyl 2-(4-chlorophenyl)-3-methylbutyrate; Cyano-(3-phenoxyphenyl)methyl 4-chloro-α-(1-methylethyl)benzeneacetate; 4-Chloro-α-(1-methylethyl)benzeneacetic acid cyano(3-phenoxyphenyl) methyl ester; Fenvaleriato (Spanish); Phenvalerate
Trade Names: BELMARK®; ECTIN®; FENKILL®; EVERCIDE®; KORANDA®; PYDRIN®; S 5602®; SANMARTON®; SD 43775®; SUMICIDE®; SUMICIDIN®; SUMICIDINE®; SUMIFLEECE®; SUMIFLY®; SUMIPOWER®; SUMITICK®; TIRADE®; WL 43775®
Chemical Class: Pyrethroid
EPA/OPP PC Code: 109301 (former Nos. 295700 or 296700)
California DPR Chemical Code: 1963
HSDB Number: 6640
UN/NA & ERG Number: UN3352 (liquid)/151; UN3349 (solid)/151
RTECS® Number: CY1576300
EC Number: 257-326-3
Uses: Not approved for use in EU countries[115]. Fenvalerate is one of the most versatile synthetic pyrethroid insecticides. It is mostly used in agriculture and on cattle, but also in homes and gardens. It acts as a stomach poison against a wide variety of leaf and fruit-eating insects such as bollworm fruit and shoot borers and aphids. Crops on which it is used include cotton, cauliflower, okra, vines and fruits. It is also used in public health and animal husbandry. It is effective against pests whose strains are resistant to organochlorine, organophosphorus, and carbamate insecticides. Not registered for use in EU countries[115]. Not registered for use in the U.S. Used in 20 countries. There are 38 global suppliers[97].
U.S. Maximum Allowable Residue Levels for Fenvalerate [40 CFR 180.379(a)(1)]: Almond, hulls 15.0 ppm; almond 0.2 ppm; apple 2.0 ppm; artichoke, globe 0.2 ppm; bean, dry, seed 0.25 ppm; bean, snap, succulent 2.0 ppm; broccoli 2.0 ppm; blueberry 3.0 ppm; cabbage 10.0 ppm; caneberry subgroup 13A, 3.0 ppm; cantaloupe 1.0 ppm; carrot, roots 0.5 ppm; cattle, fat 1.5 ppm; cattle, meat byproducts 1.5 ppm; cattle, meat 1.5 ppm; cauliflower 0.5 ppm; collards 10.0 ppm; corn, grain 0.02 ppm; corn, forage 50.0 ppm; corn, stover 50.0 ppm; corn, sweet, kernel plus cob with husks removed 0.1 ppm; cotton, undelinted seed 0.2 ppm; cucumber 0.5 ppm; currant 3.0 ppm; eggplant 1.0 ppm; eldeberry 3.0 ppm; English walnut 0.2 ppm; fruit, stone 10.0 ppm; goat, fat 1.5 ppm; goat, meat byproducts 1.5 ppm; goat, meat 1.5 ppm; gooseberry 3.0 ppm; hazelnut 0.2 ppm; hog, fat 1.5 ppm; hog, meat byproducts 1.5 ppm; hog, meat 1.5 ppm; horse, fat 1.5 ppm; horse, meat byproducts 1.5 ppm; horse, meat 1.5 ppm; huckleberry 3.0 ppm; melon, honeydew 1.0 ppm; milk 0.3 ppm; milk, fat 7.0 ppm; muskmelon 1.0 ppm; peanut 0.02 ppm; pear 2.0 ppm; pea 1.0 ppm; pea, dry, seed 0.25 ppm; pecan 0.2 ppm; pepper 1.0 ppm; potato 0.02 ppm; pumpkin 1.0 ppm; radish, roots 0.3 ppm; radish, tops 8.0 ppm; sheep, fat 1.5 ppm; sheep, meat byproducts 1.5 ppm; sheep, meat 1.5 ppm; soybean 0.05 ppm; squash, summer 0.5 ppm; squash, winter 1.0 ppm; sugarcane, cane 2.0 ppm; sunflower, seed 1.0 ppm; tomato 1.0 ppm; turnip, greens 20.0 ppm; turnip, roots 0.5 ppm; watermelon 1.0 ppm. ***[40 CFR 180.379(a)(2)]*** 0.05 ppm (I) in or on food commodities (other than those already covered by a higher tolerance as a result of use on growing crops) in food-handling establishments where food products are held, processed, or prepared. (ii) Application of Fenvalerate shall be limited to space treatment with a maximum of 0.5 fluid ounce of a 0.05% active ingredient solution/1,000 ft^3 of space, or as a contact spray applied as a coarse wet spray at a maximum of 1 gallon of a 0.2% active ingredient solution/1,000 ft^2 of surface. Food must be removed or covered during treatment. Spray should not be applied directly to surfaces or utensils that may come into contact with food. Food-contact surfaces and equipment should be thoroughly cleaned with an effective cleaning compound and rinsed with potable water before using. (iii) Application of Fenvalerate shall be limited to space treatment with a maximum of 1.0 fluid ounce of a 0.25-percent active ingredient solution/1,000 ft^3 of space, or as a contact spray applied as a coarse wet spray at a maximum of 1 gallon of a 0.05-percent active ingredient solution per 1,000 ft^2 of surface, or as a pressurized spot/crack and crevice spray of a 0.25-percent solution. Food must be removed or covered during treatment. Spray should not be applied directly to surfaces or utensils that may come into contact with food. Food-contact surfaces and equipment should be thoroughly cleaned with an effective cleaning compound and rinsed with potable water before using. (iv) To assure safe use of the additive, its label and labeling shall conform to that registered with the U.S. Environmental Protection Agency, and it shall be used in accordance with such label and labeling. ***[40 CFR 180.379(a)(3)]*** in or on Soybean, hulls: 1.0 ppm. ***[40 CFR 185.300 (c)]*** in or on Okra: 0.1 ppm.
Human toxicity (long-term)[101]: Very low–175.00 ppb, Health Advisory
Fish toxicity (threshold)[101]: Extra high–0.01433 ppb, MATC (Maximum Acceptable Toxicant Concentration)

Regulatory Authority and Advisory Information: Carcinogenicity[83]: EPA Group E, evidence of non-carcinogenicity for humans; IARC, Group 3 not classifiable as to its carcinogenicity in humans.

Acute Oral Category: 2, WARNING

Health Advisory: Mutagen, Developmental/Reproductive Toxin, Endocrine disruptor (S!)

U.S. DOT Marine pollutant (49CFR, Subchapter 172.101, Appendix B), severe pollutant

WGK (German Aquatic Hazard Class): 3-Highly water polluting

Description: Yellowish to brown viscous liquid. Also available as an emulsifiable concentrate, which is corrosive. Technical grade is a brown viscous liquid. Faint chemical odor. Boiling point = decomposes. Molecular weight 419.93; Specific gravity (H_2O:1) = 1.17 @ 23 °C; Vapor pressure = 1.1×10^{-8} mmHg @ 25 °C; 3.7×10^{-7} mmHg @ 25 °C. Practically insoluble in water; solubility = 0.085 ppm @ 20 °C. Physical and toxicological properties may be affected by carrier solvents in commercial formulations.

Incompatibilities: Incompatible with oxidizers, chlorates, nitrates, peroxides, sulfuric acid, caustics, ammonia, aliphatic amines, alkanolamines, isocyanates, alkylene oxides, epichlorohydrin. Moisture may cause hydrolysis or other forms of decomposition. Emulsifiable concentrate is corrosive.

Permissible Exposure Limits in Air: NIOSH(2) IDLH = 5,000 ppm

OSHA PEL: 5 mg/m^3 TWA

NIOSH REL: 5 mg/m^3 TWA

ACGIH TLV®[1]: 5 mg/m^3 TWA

STEL set by HSE(33) = 10 mg/m^3.

Determination in Air: Collection by impinger or fritted bubbler, analysis by gas-liquid chromatography/ultraviolet. See NIOSH IV, Method #5008[18], as pyrethroid.

Permissible Concentration in Water: State Drinking Water Guidelines: Arizona 180 µg/L. Runoff from spills or fire control may cause water pollution. Acceptable Daily Intake (ADI) =0.02 mg/kg as pyrethroid.

Determination in Water: Collection by impinger or fritted bubbler, analysis by gas-liquid chromatography/ultraviolet. See NIOSH IV, Method #5008[18]. Log K_{ow} = >4.0. Values above 3.0 are likely to bioaccumulate in marine organisms.

Routes of Entry: Inhalation, absorbed through the skin.

Harmful Effects and Symptoms

Short Term Exposure: Pyrethrins can affect you when breathed in and by passing through your skin. Irritates the eyes and respiratory tract. High exposure can affect the nervous system causing headache, nausea, vomiting, fatigue, and restlessness, rhinorrhea (discharge of thin nasal mucous). Emulsifiable concentrate is corrosive to skin, eyes, and respiratory tract. LD_{50} (oral, rat) = <100 mg/kg; LD_{50} (dermal, rabbit) = >2.5 g/kg.

Long Term Exposure: May cause tumors. High or repeated exposure can cause lung allergy (with cough, wheezing and/or shortness of breath) or hay fever symptoms (sneezing, runny or stuffy nose). Allergic "pneumonia" can also occur with cough, chest pain, breathing difficulty and abnormal chest x-ray. Repeated attacks may lead to permanent scarring. Skin allergy may also develop with rash and itching, even with lower exposures. Dermal contact can cause rash with redness, blisters and intense itching. A severe generalized allergy can occur with weakness and collapse. Endocrine disruptor.

Points of Attack: Respiratory system, skin, central nervous system.

Medical Surveillance: Before beginning employment and at regular times after that, the following are recommended: Employees should be screened for history of certain medical conditions which might place the employee at increased risk from pyrethroid exposure. Chronic respiratory disease: In persons with chronic respiratory disease, especially asthma, the inhalation of pyrethroids might cause exacerbation of symptoms due to their sensitizing properties. Lung function tests. These may be normal if the person is not having an attack at the time of the test. Consider chest x-ray if lung symptoms are present. Skin disease: Pyrethroids can cause dermatitis which may be allergic in nature. Persons with pre-existing skin disorders may be more susceptible to the effects of this agent. Evaluation by a qualified allergist, including exposure history and testing, may help diagnose allergy. Any employee developing the above-listed conditions should be referred for further medical examination[9].

First Aid: If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least 15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately. If this chemical contacts the skin, remove contaminated clothing and wash immediately with soap and water. Seek medical attention immediately. If this chemical has been inhaled, remove from exposure, begin rescue breathing (using universal precautions) if breathing has stopped, and CPR if heart action has stopped. Transfer promptly to a medical facility. When this chemical has been swallowed, get medical attention. *Do not induce vomiting when formulations containing petroleum solvents are ingested*. Otherwise, give large quantities of water and induce vomiting. Do not make an unconscious person vomit.

Personal Protective Methods: Applicators and other handlers must wear: Coveralls worn over long-sleeved shirt and long pants; Chemical-resistant gloves such as DuPont™ Tychem® suit fabrics, barrier laminate, or Viton®; Chemical-resistant footwear plus socks; Protective eye wear; Chemical-resistant headgear for overhead exposure; Chemical-resistant apron when cleaning equipment, mixing, or loading[83]. Agricultural Use/Engineering Controls: When handlers use closed systems, enclosed cabs, or aircraft in a manner that meets the requirements listed in the Worker Protection Standard (WPS) for agricultural pesticides, ***40 CFR*** 170.240(d)(4-6), the handler PPE requirements may be reduced or modified as specified in the Worker Protection Standard. Firefighters should wear NIOSH approved self-contained breathing apparatus and full protective clothing.

Respirator Selection: NIOSH/OSHA *for pyrethrum*: *50 mg/m^3:* CcrOv95 (APF = 10) [any air-purifying half-mask respirator equipped with an organic vapor cartridge(s) in combination with an N95, R95, or P95 filter. The following filters may also be used: N99, R99, P99, N100, R100, P100]; or Sa (APF = 10) (any supplied-air respirator). *125 mg/m^3:* Sa:Cf (APF = 25) (any supplied-air respirator operated in a continuous-flow mode); or PaprOvHie (APF = 25) (any air-purifying full facepiece respirator equipped with an organic vapor cartridge in combination with a high-efficiency particulate filter). *250 mg/m^3:* CcrFOv100 (APF = 50) [any air-purifying full facepiece respirator equipped with organic vapor cartridge(s) in combination with an N100, R100, or P100 filter]; or PaprTOvHie (APF = 50) [any powered, air-purifying respirator with a tight-fitting face-piece and organic vapor cartridge(s) in combination with a high-efficiency particulate filter]; or SCBAF (APF = 50) (any self-contained breathing apparatus with full facepiece); or SaF (APF = 50) (any supplied-air respirator with a full facepiece). *5000 mg/m^3:* SaF:Pd,Pp (APF = 2000) (any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode). *Emergency or planned entry into unknown concentrations or IDLH conditions:* SCBAF:Pd,Pp (APF = 10,000) (any self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode); or SaF:Pd,Pp:ASCBA (APF = 10,000) (any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary self-contained breathing apparatus operated in a pressure-demand or other positive-pressure mode). *Escape:* GmFOv100 (APF = 50) [any air-purifying, full facepiece respirator (gas mask) with a chin-style, front- or back-mounted organic vapor canister having an N100, R100, or P100 filter]; or SCBAE (any appropriate escape-type, self-contained breathing apparatus). *Note:* Substance reported to cause eye irritation or damage; may require eye protection.

Storage: Color Code-Blue: Health Hazard/Poison. Store in a secure poison location. Prior to working with this chemical you should be trained on its proper handling and storage. Store in tightly closed containers in a cool, well-ventilated area. Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: Pesticides, liquid, toxic, n.o.s., require a shipping label of "poisonous materials." This material falls in DOT Hazard Class 6.1. Technical name required.

Spill Handling: First remove all sources of ignition. Evacuate persons not wearing protective equipment from area of spill or leak until clean up is complete. Ventilate area of spill or leak. Use water spray to reduce vapor. Absorb liquids in vermiculite, dry sand, earth, or a similar material and deposit in sealed containers. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable.

Fire Extinguishing: Hazardous decomposition includes oxides of nitrogen and oxygen and hydrogen chloride gas. *On a small fire:* use dry chemical, CO_2 or water spray. *On a large fire:* use water spray, fog or regular foam. Move containers from fire area if you can do it without risk. Dike fire-control water for later disposal; do not scatter the material. Use water spray or fog; do not use straight streams. *Fire involving storage or vehicular tanks:* isolate for 800 meters/0.5 mile in all directions; also, consider initial evacuation for 800 meters/0.5 mile in all directions. Fight fire from maximum distance or use unmanned hose holders or monitor nozzles. Do not get water inside containers. Cool containers with flooding quantities of water until well after fire is out. Withdraw immediately in the case of rising sound from venting safety devices or discoloration of tank. ALWAYS stay away from tanks engulfed in fire. For massive fire, use unmanned hose holders or monitor nozzles; if this is impossible, withdraw from area and let fire burn. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies.

Disposal Method Suggested: Incineration would be an effective disposal procedure where permitted. If an efficient incinerator is not available, the product should be mixed with large amounts of combustible material and contact with the smoke should be avoided. In accordance with ***40CFR165***, follow recommendations for the disposal of pesticides and pesticide containers.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- USEPA, Office of Pesticide Programs, Pesticide Residue Limits, "Fenvalerate," 40 CFR 180.533. http://www.epa.gov/pesticides/food/viewtols.htm
- International Programme on Chemical Safety (IPCS), "Health and Safety Guide, Fenvalerate," Geneva, Switzerland (1990). http://www.inchem.org/documents/ehc/ehc/ehc95.htm

Ferbam F:0130

Use Type: Fungicide
CAS Number: 14484-64-1
Formula: $C_9H_{18}FeN_3S_6$; $Fe[(CH_3)_2NCS_2]_3Fe$
Synonyms: Carbamic acid, aimethyldithio-, iron salt; Dimethylcarbamo dithioic acid, iron complex; Dimethylcarbamodithioic acid, iron(3+) salt; Dimethyldithiocarbamic acid, iron salt; Dimethyldithiocarbamic acid, iron(3+) salt; ENT 14,689; Ferbam, iron salt; Ferric dimethyl dithiocarbamate; Iron dimethyldithiocarbamate; Iron(III) dimethyldithio carbamate; Iron, tris(dimethylcarbamodithioato-*S,S*′)-, (OC-6-11)-; Iron, tris(dimethylcarbamodithioato-*S,S*′-)-; Iron, tris(dimethyldithiocarbamato)-; Iron tris(dimethyldithiocarbamate); Tris(dimethylcarbamo dithioato-*S,S*′) iron; (OC-6-11)-tris(Dimethylcarbamo dithioato-*S,S*′)iron; Tris(Dimethyldithiocarbamato)iron; Tris(*N,N*-dimethyldithiocarbamato)iron(III)
Trade Names: AI3-14689®; AAFERTIS®; APPLE DUST No. 1®[C]; BERCEMA FERTAM 50®; CASWELL No. 458®; FERBAM 50®; FERBECK®; FERMATE FERBAM FUNGICIDE®[C]; FERMOCIDE®; FERRADOUR®; FERRADOW®; FUKLASIN ULTRA®; HEXAFERB®; HOKMATE®; KARBAM BLACK®; KARBAM CARBAMATE®; KNOCKMATE®; NIACIDE®; STAUFFER FERBAM®; SUP'R-FLO FERBAM FLOWABLE®; TRICARBAMIX®[C]; TRIFUNGOL®; VANCIDE FE95®[C]
Chemical Class: Dithiocarbamate
EPA/OPP PC Code: 034801
California DPR Chemical Code: 288
HSDB Number: 1645
UN/NA & ERG Number: UN3077(solid)/171; UN2771(solid)/151
RTECS® Number: NO8750000
EC Number: 238-484-2 [*Annex I Index No.:* 006-051-00-5]
Uses: Registered for use in the U.S. and Canada. Not approved for use in EU countries[115]. A dimethyl-dithiocarbamate fungicide. It is widely used, together with other fungicides, to control Postbloom Fruit Drop (PFD) on citrus crops, and as a foliar protectant against scab, rust, mold and many fungus disease on fruits, vegetables, melons and ornamentals. It is registered in several states for use on currents and gooseberries to control leaf spot disease, and on apple, crabapple, hawthorn and quince to control cedar-apple rust disease. It is used to control rust disease on shrubs and ornamentals.
U.S. Maximum Allowable Residue Levels for Ferbam (40 CFR 180.114): In or on apple 7 ppm; apricot 7 ppm; asparagus 7 ppm; bean 7 ppm; blackberry 7 ppm; blueberry 7 ppm; boysenberry 7 ppm; cabbage 7 ppm; cherry 7 ppm; cranberry 7 ppm; cucumber 7 ppm; dewberry 7 ppm; fruit, stone, group 12, 7 ppm; grape 7 ppm; guava 7 ppm; lettuce 7 ppm; loganberry 7 ppm; mango 7 ppm; nectarine 7 ppm; papaya 7 ppm; pea 7 ppm; peach 7 ppm; pear 7 ppm; raspberry 7 ppm; squash 7 ppm; tomato 7 ppm; youngberry 7 ppm.
Human toxicity (long-term)[101]: Very low–140.00 ppb, Health Advisory
Fish toxicity (threshold)[101]: Low–437.01653 ppb, MATC (Maximum Acceptable Toxicant Concentration)
Regulatory Authority and Advisory Information:
Carcinogenicity[83]: IARC, Group 3 not classifiable as to its carcinogenicity in humans. Acute Oral Category: 4, Caution, not acutely toxic
Health Advisory: Mutagen, Developmental/Reproductive Toxin
EPA Hazardous Waste Number (RCRA No.): U396
EPCRA Section 313 Form R *de minimus* concentration reporting level: 1.0%
European/International Regulations: Hazard Symbol: Xi, N; risk phrases: R36/37/38; R50/53; safety phrases: S2; S60; S61 (see Appendix 1)
Description: Ferbam is a dark brown to black powder or granular solid. Odorless. Molecular weight = 416.5[9]; Specific gravity (H_2O:1) = 0.6; Boiling point = (decomposes)[9]; Freezing/Melting point = (decomposes) 180 °C[9]; Vapor pressure = ~0 mmHg @ 20 °C[9]. Practically insoluble in water; solubility = 0.01% @ 20 °C[9].
Incompatibilities: May be a combustible material. Dust may form explosive mixture in air. Water, acid, oxidizing materials. Heat, or contact with moisture or acids causes rapid decomposition and the generation of toxic and flammable hydrogen sulfide and carbon disulfide. Flammable gases are generated by reaction with aldehydes, nitrides, and hydrides. Incompatible with oxidizers including peroxides, acids, acid halides, mercury[88]. Decomposition products in fire include oxides of nitrogen and sulfur. Corrosive to iron, copper brass and zinc metals, especially in the presence of moisture. Heat alkalies (lime), moisture can cause decomposition. Decomposes on prolonged storage. Degradation produces ethylene thiourea.
Permissible Exposure Limits in Air: OSHA PEL: 15 mg/m^3 (total dust) TWA
NIOSH REL: 10 mg/m^3 TWA
ACGIH TLV®[1]: 5 mg/m^3, inhalable fraction, TWA; not classifiable as a human carcinogen
NIOSH IDLH: 800 mg/m^3
DFG MAK: Danger of skin sensitization (dithiocarbamates used as rubber components).
Determination in Air: Collection by filter; Gravimetric; NIOSH IV, Method #0500, Particulates NOR (total)[18].
Permissible Concentration in Water: State Drinking Water Guidelines: Maine: 4 ppb.
Determination in Water: EPA EMSLC Method 630. The Determination of Dithiocarbamate Pesticides in Municipal and Industrial Wastewater by UV-VIS Spectrophotometry. Log K_{ow} = ranges from negative to <2. Unlikely to bioaccumulate in marine organisms.
Routes of Entry: Inhalation, ingestion, eye and/or dermal and/or eye contact.
Harmful Effects and Symptoms
Short Term Exposure: Ferbam can affect you when breathed in. Breathing ferbam can irritate the nose and throat. Ferbam can cause skin and eye irritation. High exposure to ferbam may affect the nervous system and

thyroid; dizziness, confusion, loss of coordination, seizures, paralysis, and coma. Unlike carbamates the dithiocarbamates are not cholinesterase inhibitors, but some of them may react with recently ingested alcohol or alcohol-containing products including wine, medications, and cold remedies such as cough-syrups.

LD_{50} (oral, rat) = >1000 mg/kg; LD_{50} (dermal, rat) = >4000 mg/kg.

Long Term Exposure: May cause tumors. Repeated or prolonged contact with skin may cause allergy with skin rash and itching. Exposure to ferbam may damage the kidneys and liver. Ferbam may damage the developing fetus.

Points of Attack: Eyes, skin, respiratory system, gastrointestinal tract.

Medical Surveillance: For those with frequent or potentially high exposure (half the TLV or greater), the following are recommended before beginning work and at regular times after that: Kidney function tests. Liver function tests. Evaluation by a qualified allergist, including exposure history and testing, may help diagnose allergy.

First Aid: If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least 15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately. If this chemical contacts the skin, remove contaminated clothing and wash immediately with soap and water. Seek medical attention immediately. If this chemical has been inhaled, remove from exposure, begin rescue breathing (using universal precautions) if breathing has stopped, and CPR if heart action has stopped. Transfer promptly to a medical facility. When this chemical has been swallowed, get medical attention. Give large quantities of water and induce vomiting. Do not make an unconscious person vomit.

Personal Protective Methods: Reacts with the following absorbent materials: Cellulose-Based; Mineral- and Clay-Based; Dirt/Earth[88]. Applicators and other handlers must wear: Coveralls worn over long-sleeved shirt and long pants; Chemical-resistant gloves such as DuPont™ Tychem® suit fabrics, barrier laminate, or Viton®; Chemical-resistant footwear plus socks; Protective eye wear; Chemical-resistant headgear for overhead exposure; Chemical-resistant apron when cleaning equipment, mixing, or loading[83]. Agricultural Use/Engineering Controls: When handlers use closed systems, enclosed cabs, or aircraft in a manner that meets the requirements listed in the Worker Protection Standard (WPS) for agricultural pesticides, ***40 CFR*** 170.240(d)(4-6), the handler PPE requirements may be reduced or modified as specified in the Worker Protection Standard. Firefighters should wear NIOSH approved self-contained breathing apparatus and full protective clothing.

Respirator Selection: Where the neat (undiluted) test chemical is weighed and diluted, wear a NIOSH-approved half face respirator equipped with an organic vapor/acid gas cartridge (specific for organic vapors, hydrogen chloride (HCl), acid gas and SO_2) with a dust/mist filter. Splash-proof safety goggles should be worn while handling this chemical. Alternatively, a full-face respirator, equipped as above, may be used to provide simultaneous eye and respiratory protection[88].

Shipping: Environmentally hazardous substances, solid or liquid, usually fall in Hazard Class 9. Dithiocarbamate pesticides, solid, toxic, require a label of "poisonous materials." They usually fall in Hazard Class 6.1.

Spill Handling: First remove all sources of ignition. Evacuate persons not wearing protective equipment from area of spill or leak until clean up is complete. Collect powdered material in the most convenient and safe manner and deposit in sealed containers. Ventilate area after clean up is complete. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable.

Fire Extinguishing: Hazardous decomposition includes oxides of nitrogen and sulfur. Combustible. Extinguish fire using an agent suitable for type of surrounding fire. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies. From a secure, explosion-proof location, use water spray to cool exposed containers. If cooling streams are ineffective (venting sound increases in volume and pitch, tank discolors, or shows any signs of deforming), withdraw immediately to a secure position. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode.

Disposal Method Suggested: Do not discharge into drains or sewers. Dispose of waste material as hazardous waste using a licensed disposal contractor to an approved landfill. Consult with environmental regulatory agencies for guidance on acceptable disposal practices. Generators of waste containing this contaminant (≥100 kg/mo) must conform with EPA regulations governing storage, transportation, treatment, and waste disposal. A potential candidate for liquid injection incineration at a temperature range of 650 to 1600 °C and a residence time 0.1 to 2 seconds. Also, a potential candidate for rotary kiln incineration at a temperature range of 820 to 1600 °C and residence times of seconds for liquids and gases, and hours for solids[83]. In accordance with ***40CFR165***, follow recommendations for the disposal of pesticides and pesticide containers. Containers must be disposed of properly by following package label directions or by contacting your local or federal environmental control agency, or by contacting your regional EPA office.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank

(HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov

- Pesticide Education Management Program, “Ferbam Chemical Profile 2/85,” Cornell University, Ithaca, NY. (February 1985). http://pmep.cce.cornell.edu/profiles/fung-nemat/febuconazole-sulfur/ferbam/fung-prof-ferbam.html
- USEPA, Office of Pesticide Programs, Pesticide Residue Limits, “ Ferbam,” 40 CFR 180.114. http://www.epa.gov/pesticides/food/viewtols.htm
- New Jersey Department of Health and Senior Services, “Hazardous Substance Fact Sheet: Ferbam,” Trenton, NJ (April 1999). http://www.state.nj.us/health/eoh/rtkweb/0917.pdf
- Sax, N. I., Ed., “Dangerous Properties of Industrial Materials Report,” 1, No. 6, 56-58 (1981) and 8, No. 6, 57-63 (1988)

Ferric sulfate F:0180

Use Type: Herbicide, Molluscicide, Agricultural product constituent

CAS Number: 10028-22-5

Formula: $Fe_2O_{12}S_3$

Synonyms: Diiron trisulfate; Iron persulfate; Iron sesquisulfate; Iron(III) sulfate; Iron sulfate (2:3); Iron (3+) sulfate; Iron tersulfate; Sulfato ferrico (Spanish); Sulfuric acid, iron(III) salt (3:2); Sulfuric acid, iron(3+) salt (3:2)

Trade Names: GREENMASTER AUTUMN®; MAXICROP MOSS KILLER®; VITAX MICRO GRAN®; VITAX TURF TONIC®

Chemical Class: Inorganic

EPA/OPP PC Code: 034902

California DPR Chemical Code: 1811

HSDB Number: 6311

UN/NA & ERG Number: UN3077(solid)/171

RTECS® Number: NO8505000

EC Number: 233-072-9

Uses: Ferric sulfate is used on forage alfalfa, almonds, nurseries and structural pest control. This material is also used in pigments, textile dyeing, water treatment, and metal pickling

Regulatory Authority and Advisory Information: Acute Oral Category: 3, CAUTION
Health Advisory: Mutagen
Clean Water Act: Section 311 Hazardous Substances/RQ 40CFR117.3 (same as CERCLA, see below)
Superfund/EPCRA 40CFR302.4 RQ: CERCLA, 1000 lb (454 kg)
WGK (German Aquatic Hazard Class): 1-Low hazard to waters

Description: Ferric sulfate is a grayish-white powder or yellow lumpy crystals. Molecular weight = 399.88; Boiling point = (decomposes); Freezing/Melting point = (decomposes) 480 °C. Hazard Identification (based on NFPA-704 M Rating System): Health 1, Flammability 0, Reactivity 0. Slightly soluble in water.

Incompatibilities: Hydrolyzed slowly in aqueous solution. Incompatible with magnesium, aluminum. Corrosive to copper and its alloys, mild and galvanized steel. Light sensitive.

Permissible Exposure Limits in Air: OSHA PEL: None
NIOSH REL: 1 mg[Fe]/m^3 TWA
ACGIH TLV®[1]: 1 mg[Fe}/m^3 TWA; 0.1 mg/m^3 TWA *as persulfates*
Protective Action Criteria (PAC) Ver. 27[89]
PAC-1: 6.1 mg/m^3
PAC-2: 6.1 mg/m^3
PAC-3: 35 mg/m^3

Determination in Air: Filter; Acid; Inductively coupled plasma; NIOSH IV, Method #7300, Elements[18].

Permissible Concentration in Water: Federal Drinking Water Standards: EPA 300(Fe)μg/L

Routes of Entry: Inhalation, ingestion, skin and/or eye contact.

Harmful Effects and Symptoms

Short Term Exposure: *Inhalation:* May cause irritation of nose and throat, coughing and difficulty in breathing 0.075 mg/m^3 for 2 hours did not cause any change in breathing functions. Inhaling iron oxide fumes may cause a pneumoconiosis in the lungs. Iron oxide fumes can cause “metal fume fever.” Irritation of eyes, skin, mucous membrane; abdominal pain, diarrhea, vomiting. *Skin:* Contact causes irritation. Remove promptly. *Eyes:* Contact causes irritation. *Ingestion:* May cause irritation of mouth and stomach, nausea, vomiting, diarrhea, drowsiness, liver damage, coma and death. The estimated lethal dose is 30 g (one ounce).

Long Term Exposure: Excessive intake of iron compounds may result in increased accumulation of iron in the body, especially the liver, spleen and lymphatic system. May cause nausea, vomiting, stomach pain, constipation, and black bowel movements. Inhalation of iron dusts may cause mottling of the lung. Prolonged or repeated high exposure may cause liver damage. Prolonged eye contact can cause a brownish discoloration of the eye. Repeated overexposure may cause kidney stones. May cause reproductive and fetal effects.

Points of Attack: Eyes, skin, respiratory system, liver, lungs, gastrointestinal tract.

Medical Surveillance: Preliminary medical exam to detect chronic diseases of central nervous system, liver, heart, kidneys, lung and skin, as well as endocrinological or immunological disturbances, should protect susceptible individuals. Periodical medical exams of internal organs, skin and eyes are important to avoid chronic occupational intoxications. They should include lab and patch tests when necessary[83]. In addition to comprehensive initial medical and work histories emphasizing reproductive experience and menstrual history, patient should have physical examination and testing of genito-urinary tract, sperm count, motility and morphology. If required, other tests, such as serum testosterone, serum follicle stimulating hormone (FSH), and serum lutenizing hormone (LH), may be indicated. If symptoms develop or overexposure is suspected, the following may be useful: Blood test for iron level (serum iron). Liver function tests. Lung function tests. For those exposed to this chemical, taking dietary supplements or vitamins containing iron is not recommended without medical advice.

First Aid: If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least 15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately. If this chemical contacts the skin, remove contaminated clothing and wash immediately with soap and water. Seek medical attention immediately. If this chemical has been inhaled, remove from exposure, begin rescue breathing (using universal precautions) if breathing has stopped, and CPR if heart action has stopped. Transfer promptly to a medical facility. When this chemical has been swallowed, get medical attention. Give large quantities of water and induce vomiting. Do not make an unconscious person vomit. The symptoms of metal fume fever may be delayed for 4–12 hours following exposure: it may last <36 hours.

Personal Protective Methods: Wear protective gloves and clothing to prevent any reasonable probability of dermal and/or eye contact. Safety equipment suppliers/manufacturers can provide recommendations on the most protective glove/clothing material for your operation. All protective clothing (suits, gloves, footwear, headgear) should be clean, available each day, and put on before work. Contact lenses should not be worn when working with this chemical. Wear dust-proof chemical goggles and face shield unless full facepiece respiratory protection is worn. Employees should wash immediately with soap when skin is wet or contaminated. Provide emergency showers and eyewash.

Respirator Selection: Where potential exists for exposures *over 1 mg/m³* of iron, use an NIOSH/MSHA- or European Standard EN 149-approved respirator equipped with particulate (dust/fume/mist) filters. *Where potential for high exposures exists*, use an NIOSH/MSHA- or European Standard EN 149-approved supplied-air respirator with a full facepiece operated in the positive-pressure mode, or with a full facepiece, hood, or helmet in the continuous-flow mode; or use an NIOSH/MSHA- or European Standard EN 149-approved self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive-pressure mode.

Storage: Color Code-Green: General storage may be used. Prior to working with this chemical you should be trained on its proper handling and storage. Store in tightly closed containers in a cool, well-ventilated area away from light, moisture, aluminum, magnesium, copper and its alloys, zinc, galvanized and mild steels. Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: Environmentally hazardous substances, solid or liquid, usually fall in Hazard Class 9.

Spill Handling: Evacuate and restrict persons not wearing protective equipment from area of spill or leak until cleanup is complete. Ventilate area of spill or leak. Absorb liquids containing ferric sulfate in vermiculite, dry sand, earth, or a similar material and deposit in sealed containers. Collect powdered material in the most convenient manner and deposit in sealed containers. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable.

Fire Extinguishing: Hazardous decomposition includes oxides of sulfur and iron. As an immediate precautionary measure, isolate spill or leak area in all directions for at least 50 meters/150 feet for liquids and at least 25 meters/75 feet for solids. *Fire involving storage or vehicular tanks:* isolate for 800 meters/0.5 mile in all directions; also, consider initial evacuation for 800 meters/0.5 mile in all directions. *On a small fire:* use dry chemical, CO_2, water spray or regular foam. *On a large fire:* use water spray, fog or regular foam. Do not scatter spilled material with high-pressure streams of water. Move containers from fire area if you can do it without risk. Dike fire-control water for later disposal. *Fire involving tanks:* from a secure, explosion-proof location, use water spray to cool exposed containers. If cooling streams are ineffective (venting sound increases in volume and pitch, tank discolors, or shows any signs of deforming), withdraw immediately to a secure position. Always stay away from tanks engulfed in fire. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode.

Disposal Method Suggested: It is the responsibility of chemical waste generators to determine if a discarded chemical is classified as a hazardous waste. See ***40 CFR*** Parts 261.3 for U.S. EPA guidelines for the classification determination. Additionally, in order to ensure complete and accurate classification, waste generators must consult state and local hazardous waste regulations. Ultimate disposal of the chemical must consider: the material's impact on air quality; potential migration in soil or water; effects on animal, aquatic, and plant life; and conformance with environmental and public health regulations. For heptahydrate, treat with soda ash or dilute NaOH to precipitate iron. Separate any precipitate and landfill.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov

- New Jersey Department of Health and Senior Services, “Hazardous Substance Fact Sheet: Ferric Sulfate,” Trenton, NJ(March1999). http://www.state.nj.us/health/eoh/rtkweb/0925.pdf
- New York State Department of Health, “Chemical Fact Sheet: Iron (III) Sulfate,” Albany, NY, Bureau of Toxic Substance Assessment (March 1986)
- Sax, N. I., Ed., “Dangerous Properties of Industrial Materials Report,” 3, No. 4, 45-47 (1983) and 7, No. 2, 75-79 (1987)

Fipronil F:0243

Use Type: Insecticide, Veterinary medicine

CAS Number: 120068-37-3

Formula: $C_{12}H_4Cl_2F_6N_4OS$

Synonyms: 5-Amino-1-(2,6-dichloro-4-(trifluoromethyl) phenyl)-4-(1,*R,S*)-(trifluoromethyl)sulfinyl-1*H*-pyrazole-3-carbonitrile; 5-Amino-3-cyano-1-(2,6-dichloro-4-trifluoromethylphenyl)-4-trifluoromethylsulfinylpyrazole; (±)-5-Amino-1-(2,6-dichloro-α,α,α-trifluoro-*p*-tolyl)-4-trifluoromethylsulfinylpyrazole-3-carbonitrile; 1*H*-Pyrazole-3-carbonitrile, 5-amino-1-(2,6-dichloro-4-(trifluoromethyl)phenyl)-4-[(trifluoromethyl) sulfinyl]-

Trade Names: BES® 602; CEASEFIRE®; CHIPCO®; COMBAT®; FRONTLINE; MB-46030®; H&G®; ICON®; MAXFORCE® ANT STATION; MAXFORCE® ROACH STATION; REGENCY SOFION®; REGENT®; REGENT® 500-FS; TERMIDOR® L VI-NIL

Chemical Class: Pyrazole; Phenylpyrazole; Organofluorine

EPA/OPP PC Code: 129121

California DPR Chemical Code: 3995

HSDB Number: 7051

UN/NA & ERG Number: UN2588 (Pesticide, solid, poisonous, n.o.s.)/151; UN2902 (Pesticide, liquid, poisonous, n.o.s.)/151

RTECS® Number: UQ4430250

EC Number: [*Annex I Index No.:* 608-055-00-8[

Uses: Not approved for use in EU countries[115]. Fipronil was introduced into the U.S. in 1996 for use in animal health and indoor pest control. It is the constituent of many products for controlling a wide spectrum of domestic animal and residential pests.

U.S. Maximum Allowable Residue Levels for Fipronil and its metabolites 5-amino-1-[2,6-dichloro-4-(trifluoromethyl)phenyl]-4-[(trifluoromethyl) sulfonyl] -1H-pyrazole-3-carbonitrile and 5-amino-1-[2,6-dichloro-4-(trifluoromethyl)phenyl]-4-(trifluoromethyl)thio)-1H-p yrazole-3-carbonitrile and its photodegradate 5-amino-1-[2,6-dichloro-4-(trifluoromethyl)phenyl]-4-[(1R,S)-(trifluoromethyl)]-1H-pyrazole-3-carbonitrile [40 CFR 180.517 (a)]: in or on the following items at the levels specifies: corn, field, grain 0.02 ppm; corn, field, stover 0.30 ppm; corn, field, forage 0.15 ppm; egg 0.03 ppm; fat of cattle, goat, horse and sheep 0.40 ppm; hog fat 0.04 ppm; hog liver 0.02 ppm; hog meat 0.01 ppm; hog meat byproducts, except liver 0.01 ppm; liver of cattle, goat, horse and sheep 0.10 ppm; milk, fat (reflecting 0.05 ppm in whole milk) 1.50 ppm; meat byproducts, except liver of cattle, goat, horse and sheep 0.04 ppm; meat of cattle, goat, horse and sheep 0.04 ppm; poultry fat 0.05 ppm; poultry meat 0.02 ppm; poultry meat byproducts 0.02 ppm; rice, grain 0.04 ppm; rice, straw 0.10 ppm.

Human toxicity (long-term)[101]: Extra high–0.14 ppb, Health Advisory

Fish toxicity (threshold)[101]: Extra high–0.31368 ppb, MATC (Maximum Acceptable Toxicant Concentration)

Regulatory Authority and Advisory Information:

Carcinogenicity[83]: EPA Group C, Possible human carcinogen

Acute Oral Category: 2, WARNING

Health Advisory: Endocrine disruptor (S!)

EPA Oral reference dose (RfD) = 2.0×10 mg/kg/day based on the NOAEL for chronic toxicity (0.500 ppm or 0.019 mg/kg/day).

European/International Regulations: Hazard Symbol: T, N; risk phrases: R23/24/25; R48/25; R50/53; safety phrases: S1/2; S24; S28; S36/37; S38; S45; S60; S61 (see Appendix 1)

Description: White crystalline solid. Molecular weight = 437.16; Specific gravity (H_2O:1) = 1.5–1.7; Boiling point = (decomposes); Freezing/Melting point = 201 °C; Vapor pressure = 3 00×10^{-8} mmHg @ 25 °C. Hazard Identification (based on NFPA-704 M Rating System): Health 3, Flammability 0, Reactivity 0. Low solubility in water; solubility = 1.9 ppm.

Determination in Water: Log K_{ow} = >3.5. Values above 3.0 are likely to bioaccumulate in marine organisms.

Routes of Entry: Inhalation, dermal and eye contact, ingestion.

Harmful Effects and Symptoms

Short Term Exposure: Highly toxic. Contact with eyes or skin may cause irritation or injury. Harmful if swallowed. LD_{50} (oral, rat) = 100 mg/kg; LD_{50} (dermal, rabbit) = 354 mg/kg. Fipronil-desulfinyl (breakdown product): LD_{50} (oral, rat) = 15 (female) –18 (male) mg/kg.

Long Term Exposure: Fluorides may cause bone disease (pain and tenderness of the bones); mottled teeth in children. Kidney, liver and thyroid toxin. Neurotoxin. Animal tests indicated that this chemical may cause reproductive and fetal effects. Bioconcentrates in tissues.

Points of Attack: Thyroid, bones, kidney, liver, testicular. Central nervous system.

Medical Surveillance: This chemical is a suspected or known human carcinogen. Exposed persons should contact a physician for advice regarding the possible long term health effects and advice for medical monitoring. Examination of the nervous system. Liver and kidney function tests. More than light alcohol consumption may exacerbate liver damage. In addition to comprehensive initial medical and work histories emphasizing reproductive experience and menstrual history, patient should have physical examination and testing of genito-urinary tract, sperm count, motility and morphology. If required, other tests, such as serum testosterone, serum follicle stimulating hormone (FSH), and serum lutenizing hormone (LH), may be indicated.

First Aid: Give artificial respiration if victim is not breathing. *Do not* use mouth-to-mouth method if victim ingested or inhaled the substance; give artificial respiration with the aid of a pocket mask equipped with a one-way valve or other proper respiratory medical device. Administer oxygen if breathing is difficult. Remove and isolate contaminated clothing and shoes. In cases of contact with substance, immediately flush skin or eyes with running water for at least 20 minutes. For minor skin contact, avoid spreading material on unaffected skin. Keep victim warm and quiet. Effects of exposure (inhalation, ingestion or skin contact) to substance may be delayed. Ensure that medical personnel are aware of the material(s) involved and take precautions to protect themselves.

Personal Protective Methods: Applicators and other handlers must wear: Coveralls worn over long-sleeved shirt and long pants; Chemical-resistant gloves such as DuPont™ Tychem® suit fabrics, barrier laminate, or Viton®; Chemical-resistant footwear plus socks; Protective eye wear; Chemical-resistant headgear for overhead exposure; Chemical-resistant apron when cleaning equipment, mixing, or loading[83]. Agricultural Use/Engineering Controls: When handlers use closed systems, enclosed cabs, or aircraft in a manner that meets the requirements listed in the Worker Protection Standard (WPS) for agricultural pesticides, ***40 CFR*** 170.240(d)(4-6), the handler PPE requirements may be reduced or modified as specified in the Worker Protection Standard. Firefighters should wear NIOSH approved self-contained breathing apparatus and full protective clothing.

Respirator Selection: *At concentrations above the NIOSH REL, or where there is no REL, at any detectable concentration:* SCBAF:Pd,Pp (APF = 10,000): (any self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode); or SaF:Pd,Pp:ASCBA (APF = 10,000) (any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary self-contained positive-pressure breathing apparatus). *Escape*: GmFOv100 (APF = 50) [any air-purifying, full facepiece respirator (gas mask) with a chin-style, front- or back-mounted organic vapor canister having an N100, R100, or P100 filter]; or SCBAE (any appropriate escape-type, self-contained breathing apparatus).

Storage: Color Code-Blue: Health Hazard/Poison. Store in a secure poison location. Prior to working with this chemical you should be trained on its proper handling and storage. Store in tightly closed containers in a cool, well-ventilated area. Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: Pesticides, solid, toxic/poisonous, n.o.s require a shipping label of "poisonous materials" and fall in Hazard Class 6.1. Technical name required.

Spill Handling: First remove all sources of ignition. Evacuate persons not wearing protective equipment from area of spill or leak until clean up is complete. Ventilate area of spill or leak. Use water spray to reduce vapor. Absorb liquids in vermiculite, dry sand, earth, or a similar material and deposit in sealed containers. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable.

Fire Extinguishing: Hazardous decomposition includes oxides of nitrogen and carbon, hydrogen chloride, and hydrogen fluoride. *On a small fire:* use dry chemical, CO_2 or water spray. *On a large fire:* use water spray, fog or regular foam. Move containers from fire area if you can do it without risk. Dike fire-control water for later disposal; do not scatter the material. Use water spray or fog; do not use straight streams. *Fire involving storage or vehicular tanks:* isolate for 800 meters/0.5 mile in all directions; also, consider initial evacuation for 800 meters/0.5 mile in all directions. Fight fire from maximum distance or use unmanned hose holders or monitor nozzles. Do not get water inside containers. Cool containers with flooding quantities of water until well after fire is out. Withdraw immediately in the case of rising sound from venting safety devices or discoloration of tank. ALWAYS stay away from tanks engulfed in fire. For massive fire, use unmanned hose holders or monitor nozzles; if this is impossible, withdraw from area and let fire burn. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies.

Disposal Method Suggested: It is the responsibility of chemical waste generators to determine the toxicity and physical properties and of a discarded chemical and to properly identify its classification and certification as a hazardous waste and to determine the disposal method. U.S. EPA guidelines for the classification determination are listed in ***40 CFR*** Parts 261.3. Additionally, waste generators must consult and follow all regional, national, state and local hazardous waste laws to ensure complete and accurate classification and disposal methods.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov

- USEPA, Office of Pesticide Programs, Pesticide Residue Limits, “Fipronil,” 40 CFR 180.517. http://www.epa.gov/pesticides/food/viewtols.htm
- Jackson, D.; Cornell, C. B.; Luukinen, B.; Buhl, K.; Stone, D., *Fipronil Technical Fact Sheet*; National Pesticide Information Center, Oregon State University Extension Services, Corvallis, OR (2009)

Fluazifop-butyl F:0244

Use Type: Herbicide

CAS Number: 69806-50-4; 79241-46-6 (*p*-butyl isomer)

Formula: $C_{19}H_{20}F_3NO_4$

Synonyms: Butyl(*RS*)-2-[4-((5-(trifluoromethyl)-2-pyridinyl)oxy)phenoxy]propanoate;(±)-Butyl-2-[4-(((5-trifluoro-methyl)-2-pyridinyl)oxy)phenoxy]propanoate; Butyl 2-[4-((5-(trifluoromethyl)-2-pyridyl)oxy)phenoxy]propionate; Caswell No. 460C; Propanoic acid, 2-[4-((5-(trifluoromethyl)-2-pyridinyl)oxy)phenoxy]-,butyl ester; Propionic acid, 2-[*p*-((5-(trifluoromethyl)-2-pyridyl)oxy)phenoxy]-, butylester; (*RS*)-2-[4-(5-Trifluoromethyl-2-pyridyloxy)]-phenoxy] propanoic acid, butyl ester; 2-[4-((5-(Trifluoromethyl)-2-pyridinyl)oxy)-phenoxy]propanoic acid, butyl ester

Trade Names: FUSILADE®[C]; FUSILADE® MAX (P-butyl); FUSION®; GRASS-B-GONE®; Greencrop; HACHE UNO SUPER®; HORIZON®; ICI-A0009®; ONESIDE®; ONESIDE EC®; ORNAMEC®; PP 009®; SL-236®; TF 1169®; TS-7236®; TORNADO®

Chemical Class: Aryloxyphenoxypropionate; Organofluorine

EPA/OPP PC Code: 122805 (Fluazifop-butyl); 122809 (Fluazifop-*p*-butyl)

California DPR Chemical Code: 2186 (Fluazifop-butyl)

HSDB Number: 6644; 5815 (Fluazifop-*p*-butyl)

UN/NA & ERG Number: UN3082 (liquid)/171

RTECS® Number: UA3000000

EC Number: 274-125-6 607-304-00-8

Uses: Fluazifop-butyl is a selective post-emergence herbicide. Its principal uses in California is on rights-of-way, landscapes, almonds, cotton, and outdoor container nurseries. Not approved for use in EU countries[115]. Not registered for use in the U.S. Used in southeast Asia. There are 18 global suppliers[97].

U.S. Maximum Allowable Residue Levels for Fluazifop-butyl (+ or -)-2-(4-(5-(trifluoromethyl)-2-pyridinyl)oxy) phenoxy propanoic acid (fluazifop), both free and conjugated and of (+ or -)-2-(4-(-(trifluoromethyl)-2-pyridinyl) oxy)phenoxy propanoate (fluazifop-butyl), all expressed as fluazifop [40 CFR 180.411(a)]: in or on the following raw agricultural commodities: cattle, fat 0.05 ppm; cattle, meat 0.05 ppm; cattle, meat byproducts 0.05 ppm; cottonseed 0.1 ppm; eggs 0.05 ppm; goats, fat 0.05 ppm; goats, meat 0.05 ppm; goats, meat byproducts 0.05 ppm; hogs, fat 0.05 ppm; hogs, meat 0.05 ppm; hogs, meat byproducts 0.05 ppm; horses, fat 0.05 ppm; horses, meat 0.05 ppm; horses, meat byproducts 0.05 ppm; milk 0.05 ppm; poultry, fat 0.05 ppm; poultry, meat 0.05 ppm; poultry, meat byproducts 0.05 ppm; sheep, fat 0.05 ppm; sheep, meat 0.05 ppm; sheep, meat byproducts 0.05 ppm; and soybeans 1.0 ppm. ***Regional registration, as defined in section 180.1(n) [40 CFR 180.411(b)]:*** in or on the following raw agricultural commodities: peppers, tabasco 1.0 ppm. ***[40 CFR 180.411(c)]***: in or on the raw agricultural commodity: carrots 2.0 ppm; endive 6.0 ppm; macadamia nuts 0.1 ppm; onions (bulb) 0.5 ppm; pecans 0.05 ppm; spinach 6.0 ppm; stone fruits 0.05 ppm; and sweet potatoes 0.5 ppm. ***[40 CFR 180.411(d)]***: in or on the raw agricultural commodities: asparagus 3.0 ppm; coffee 0.1 ppm; and rhubarb 0.5 ppm.

Human toxicity (long-term)[101]: Low–70.00 ppb, Health Advisory

Fish toxicity (threshold)[101]: Intermediate–62.61862 ppb, MATC (Maximum Acceptable Toxicant Concentration)

Regulatory Authority and Advisory Information:

California Prop.65: Listed; Developmental toxin

Toxicity (oral) Category 3, Caution, Slightly toxic

Health Advisory: Developmental/Reproductive Toxin, Skin irritant/sensitizer, Developmental toxin (TRI)

AB 2588-Air Toxics “Hot Spots” Chemicals (CAL) as chlorophenoxy pesticides

EPCRA Section 313 Form R *de minimus* concentration reporting level: 1.0% as Fluazifop-butyl

Hazard Codes: T, N; risk phrases: R61; R50/53; safety phrases: S53; S45; S60; S61 (see Appendix 1); *P-isomer*: Hazard Codes: Xi; risk phrases: R43; R63; safety phrases: S2; S29; S36/37; S46; S60; S61 (see Appendix 1)

Description: Pale yellow liquid. Odorless. Molecular weight = 383.37; Specific gravity (H_2O:1) = 1.214; Boiling point = 164.5 °C; (P-isomer decomposes before boiling); Freezing/Melting point = 4.8 °C; 13 °C; (P-isomer is <1 °C); Vapor pressure = 4.1×10^{-7} mmHg @ 20 °C; 0.055 mmHg @ 20 °C; Flash point = 37 °C. Slightly soluble in water (both isomers); solubility = <1 mg/L @ 25 °C.

Permissible Concentration in Water: Federal Drinking Water Standards: EPA 4000 μg[Fl]/L; Federal Drinking Water Guidelines: EPA 2000 μg[Fl]/L; State Drinking Water Standards: California 2000 μg[Fl]/L; Delaware 2000 μg[Fl]/L; State Drinking Water Guidelines: Arizona 4000 μg[Fl]/L; Maine 1680 μg[Fl]/L. The EPA maximum contaminant level (MCL) in water is 0.7 mg/L and is enforceable.

Determination in Water: Log K_{ow} = >4.5. Values above 3.0 are likely to bioaccumulate in marine organisms. According to Fluoride Action Network Pesticide Project, “the potential for bioconcentration in aquatic organisms is very high. Highly toxic to zooplankton.”

Routes of Entry: Inhalation, ingestion, absorbed through the skin.

Harmful Effects and Symptoms

Short Term Exposure: Poisonous; may be fatal if inhaled, swallowed, or absorbed through skin. Severely irritates eyes, skin and respiratory tract, with burning sensation, pain, redness and swelling. Metabolic stimulant. If inhaled, causes coughing, dilated pupils, headache, profuse perspiration, intense thirst, extreme fatigue, rapid pulse, high fever, clammy, flushed skin, rapid breathing, nausea, vomiting, cyanosis (bluish tint to skin and lips), anxiety and confusion, convulsions, risk of lung edema. If swallowed, face and lips turn bluish. Liver injury with associated jaundice, kidney failure, and cardiac arrhythmias are commonly noted. Nerve damage, which may be delayed, may include swelling of legs and feet, muscle twitch and stupor. Severe exposure can cause death from heart failure. Dust or liquid left in contact with the skin for several hours may be absorbed. This may result in severe delayed symptoms as listed above. These symptoms may last for months or years. LD_{50} (oral, rat) = 2000–4000+ mg/kg; LD_{50} (dermal, rabbit) = >2 g/kg. Both isomers have low toxicity; the P-isomer is slightly less toxic.

Long Term Exposure: Fluorides may cause bone disease (pain and tenderness of the bones); mottled teeth in children. May cause reproductive and fetal effects. May cause skin sensitization.

Points of Attack: Eyes, skin, respiratory system, central nervous system, cardiovascular system, liver, kidney, reproductive system, bones. *P-isomer:* Possible skin sensitizer. Kidney, spleen and liver toxin. May cause eye cataracts.

Medical Surveillance: Preliminary medical exam to detect chronic diseases of central nervous system, liver, heart, kidneys, lung and skin, as well as endocrinological or immunological disturbances, should protect susceptible individuals. Periodical medical exams of internal organs, skin and eyes are important to avoid chronic occupational intoxications. They should include lab and patch tests when necessary[83]. If symptoms develop or overexposure is suspected, the following may be useful: Liver and kidney function tests. Exam of the nervous system. Evaluation by a qualified allergist, including exposure history and testing, may help diagnose allergy. In addition to comprehensive initial medical and work histories emphasizing reproductive experience and menstrual history, patient should have physical examination and testing of genito-urinary tract, sperm count, motility and morphology. If required, other tests, such as serum testosterone, serum follicle stimulating hormone (FSH), and serum lutenizing hormone (LH), may be indicated. Evaluation by a qualified allergist, including exposure history and testing, may help diagnose allergy.

First Aid: If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least 15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately. If this chemical contacts the skin, remove contaminated clothing and wash immediately with soap and water. Seek medical attention immediately. If this chemical has been inhaled, remove from exposure, begin rescue breathing (using universal precautions) if breathing has stopped, and CPR if heart action has stopped. Transfer promptly to a medical facility. When this chemical has been swallowed, get medical attention. *Do not induce vomiting when formulations containing petroleum solvents are ingested*. Otherwise, give large quantities of water and induce vomiting. Do not make an unconscious person vomit.

Personal Protective Methods: Applicators and other handlers must wear: Coveralls worn over long-sleeved shirt and long pants; Chemical-resistant gloves such as DuPont™ Tychem® suit fabrics, barrier laminate, or Viton®; Chemical-resistant footwear plus socks; Protective eye wear; Chemical-resistant headgear for overhead exposure; Chemical-resistant apron when cleaning equipment, mixing, or loading[83]. Agricultural Use/Engineering Controls: When handlers use closed systems, enclosed cabs, or aircraft in a manner that meets the requirements listed in the Worker Protection Standard (WPS) for agricultural pesticides, ***40 CFR*** 170.240(d)(4-6), the handler PPE requirements may be reduced or modified as specified in the Worker Protection Standard. Firefighters should wear NIOSH approved self-contained breathing apparatus and full protective clothing.

Respirator Selection: Wherever and whenever workplace conditions warrant respirator use, a respiratory protection program must be followed that meets one or more of the following government standards: OSHA's 29 CFR 1910.134, ANSI Z88.2, or European Standard EN 149.

Spill Handling: First remove all sources of ignition. Evacuate persons not wearing protective equipment from area of spill or leak until clean up is complete. Stay upwind; keep out of low areas. Ventilate area of spill or leak. Remove and isolate contaminated clothing at the site. Do not touch spilled material; stop leak if you can do so without risk. Use water spray to reduce vapors. *Small spills:* absorb with sand or other noncombustible absorbent material and place into containers for later disposal. *Large spills:* dike far ahead of spill for later disposal. Collect powdered material in the most convenient and safe manner and deposit in sealed containers. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable. Seek professional environmental engineering assistance from the U.S. EPA Environmental Response Team at (908) 548-8730 (24-hour response line).

Fire Extinguishing: Hazardous decomposition includes fluorine and oxides of nitrogen and carbon. As an immediate precautionary measure, isolate spill or leak area in all directions for at least 50 meters/150 feet for liquids and at least 25 meters/75 feet for solids. *Fire involving storage or vehicular tanks:* isolate for 800 meters/0.5 mile in all directions; also, consider initial evacuation for 800 meters/0.5 mile in all directions. *On a small fire:* use dry chemical, CO_2, water spray or regular foam. *On a large fire:* use water spray, fog or regular foam. Do not scatter spilled material with high-pressure streams of water. Move containers from fire area if you can do it without risk. Dike fire-control water for later disposal. *Fire involving tanks:* from a secure, explosion-proof location, use water spray to cool exposed containers. If cooling streams are ineffective (venting sound increases in volume and pitch, tank discolors, or shows any signs of deforming), withdraw immediately to a secure position. Always stay away from tanks engulfed in fire. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode.

Fire Extinguishing: Hazardous decomposition includes fluorine and nitrogen oxides. Use dry chemical, carbon dioxide; or alcohol-resistant foam extinguishers. Vapors are heavier than air and will collect in low areas. Vapors may travel long distances to ignition sources and flashback. Vapors in confined areas may explode when exposed to fire. Storage containers and parts of containers may rocket great distances, in many directions. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies. From a secure, explosion-proof location, use water spray to cool exposed containers. If cooling streams are ineffective (venting sound increases in volume and pitch, tank discolors, or shows any signs of deforming), withdraw immediately to a secure position. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode.

Disposal Method Suggested: In accordance with ***40CFR165***, follow recommendations for the disposal of pesticides and pesticide containers. Containers must be disposed of properly by following package label directions or by contacting your local or federal environmental control agency, or by contacting your regional EPA office.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- USEPA, Office of Pesticide Programs, Pesticide Residue Limits, "Fluazifop Butyl," 40 CFR 180.411. http://www.ehso.com/ehso.php
- EXTOXNET, Extension Toxicology Network, "Pesticide Information Profile, Fluazifop-p-butyl," Oregon State University, Corvallis, OR (June 1996). http://extoxnet.orst.edu/pips/fluazifo.htm

Fluazinam F:0245

Use Type: Fungicide

CAS Number: 79622-59-6

Formula: $C_{13}H_4Cl_2F_6N_4O_4$

Synonyms: 3-Chloro-*N*-[3-chloro-2,6- dinitro-4-(trifluoromethyl)phenyl]-5-(trifluoromethyl)-2-pyridinamine; 2-*N*-(3-Chloro-5-trifluoromethyl-2-pyridyl)-2,6-dinitro-3-chloro-4-trifluoromethylaniline; 3-Chloro-*N*-(3-chloro-5-trifluoromethyl-2-pyridinyl)-α,α,α-trifluoro-2,6-dinitro-*p*-toluidine; Pyridinamine, 3-chloro-*N*-[3-chloro-2,6-dinitro-4-(trifluoromethyl)phenyl]-5-(trifluoromethyl)-

Trade Names: FLUAZINAM 50 WP®; FROWNCIDE®; IKF-1216®; ICIA-192®; OMEGA; PP-192®; SHIRLAN®

Chemical Class: Phenylpyridinamine

EPA/OPP PC Code: 129098

California DPR Chemical Code: 3898

HSDB Number: 7264

UN/NA & ERG Number: UN3082 (liquid)/171

RTECS® Number: UR8085000

Uses: Used to control *Sclerotinia* blight on peanuts and late blight and white mold on potatoes.

U.S. Maximum Allowable Residue Levels for Fluazinam [40 CFR 180.574 (a)]: peanuts 0.02 ppm; potatoes 0.02 ppm.

Regulatory Authority and Advisory Information:

Carcinogenicity[83]: EPA, Suggested evidence of human carcinogenicity

Toxicity (oral) Category: 3, CAUTION: Category: 4, Caution (depending on formulation)

Description: Light yellow crystalline solid or powder. Pungent odor. Commercial product may be a soluble concentrate. Molecular weight = 464.99; 465.09; Specific gravity (H_2O:1) = 1.259 @ 25 °C; 1.81; Freezing/Melting point = 116 °C. Slightly soluble in water. Physical and toxicological properties may be affected by carrier solvents in commercial formulations.

Determination in Water: Log K_{ow} = >3.5. Values above 3.0 are likely to bioaccumulate in aquatic organisms.

Harmful Effects and Symptoms

Short Term Exposure: Contact with eyes or skin may cause irritation or injury. Inhalation should be avoided; use NIOSH- or CEN (UK)-approved air-purifying respirators for pesticides. May be harmful if swallowed. LD_{50} (oral, rat) = >4000 mg/kg.

Long Term Exposure: Skin and possible lung sensitizer. May cause asthma and dermatitis or acne. May cause liver damage.

Points of Attack: Liver, skin, lungs.

Medical Surveillance: Evaluation by a qualified allergist, including exposure history and testing, may help diagnose lung and skin allergy. Liver function tests.

First Aid: If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least 15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately. If this chemical contacts the skin, remove contaminated clothing and wash immediately with soap and water. Seek medical attention immediately. If this chemical has been inhaled, remove from exposure, begin rescue breathing (using universal precautions) if breathing has stopped, and CPR if heart action has stopped. Transfer promptly to a medical facility. When this chemical has been swallowed, get medical attention.

Give large quantities of water and induce vomiting. Do not make an unconscious person vomit.

Personal Protective Methods: Applicators and other handlers must wear: Coveralls worn over long-sleeved shirt and long pants; Chemical-resistant gloves such as DuPont™ Tychem® suit fabrics, barrier laminate, or Viton®; Chemical-resistant footwear plus socks; Protective eye wear; Chemical-resistant headgear for overhead exposure; Chemical-resistant apron when cleaning equipment, mixing, or loading[83]. Agricultural Use/Engineering Controls: When handlers use closed systems, enclosed cabs, or aircraft in a manner that meets the requirements listed in the Worker Protection Standard (WPS) for agricultural pesticides, ***40 CFR*** 170.240(d)(4-6), the handler PPE requirements may be reduced or modified as specified in the Worker Protection Standard. Firefighters should wear NIOSH approved self-contained breathing apparatus and full protective clothing.

Respirator Selection: *At concentrations above the NIOSH REL, or where there is no REL, at any detectable concentration:* SCBAF:Pd,Pp (APF = 10,000): (any self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode); or SaF:Pd,Pp:ASCBA (APF = 10,000) (any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary self-contained positive-pressure breathing apparatus). *Escape*: GmFOv100 (APF = 50) [any air-purifying, full facepiece respirator (gas mask) with a chin-style, front- or back-mounted organic vapor canister having an N100, R100, or P100 filter]; or SCBAE (any appropriate escape-type, self-contained breathing apparatus).

Shipping: This material may be classified as Environmentally hazardous substances, solid, n. o. s. It usually falls in Hazard Class 9.

Spill Handling: If a spill occurs, clean it up promptly. Don't wash it away. Instead, sprinkle the spill with sawdust, vermiculite, or kitty litter. Sweep it into a plastic garbage bag, and dispose of it as directed on the pesticide product label. Wash all contaminated surfaces with a soap and water solution. Do not reenter the contaminated area until an expert verifies that the area has been properly cleaned.

Fire Extinguishing: Hazardous decomposition includes oxides of nitrogen and carbon and hydrogen fluoride and hydrogen chloride gases. As an immediate precautionary measure, isolate spill or leak area in all directions for at least 50 meters/150 feet for liquids and at least 25 meters/75 feet for solids. *Fire involving storage or vehicular tanks:* isolate for 800 meters/0.5 mile in all directions; also, consider initial evacuation for 800 meters/0.5 mile in all directions. *On a small fire:* use dry chemical, CO_2, water spray or regular foam. *On a large fire:* use water spray, fog or regular foam. Do not scatter spilled material with high-pressure streams of water. Move containers from fire area if you can do it without risk. Dike fire-control water for later disposal. *Fire involving tanks:* from a secure, explosion-proof location, use water spray to cool exposed containers. If cooling streams are ineffective (venting sound increases in volume and pitch, tank discolors, or shows any signs of deforming), withdraw immediately to a secure position. Always stay away from tanks engulfed in fire. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode.

Disposal Method Suggested: Recycle any unused portion of the material for its approved use or return it to the manufacturer or supplier. Ultimate disposal of the chemical must consider: the material's impact on air quality; potential migration in soil or water; effects on animal, aquatic, and plant life; and conformance with environmental and public health regulations[83]. It is the responsibility of chemical waste generators to determine the toxicity and physical properties and of a discarded chemical and to properly identify its classification and certification as a hazardous waste and to determine the disposal method. U.S. EPA guidelines for the classification determination are listed in ***40 CFR*** Parts 261.3. Additionally, waste generators must consult and follow all regional, national, state and local hazardous waste laws to ensure complete and accurate classification and disposal methods.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- USEPA, Office of Pesticide Programs, "Pesticide Fact Sheet, Fluazinam," (August 10, 2001). http://www.epa.gov/opprd001/factsheets/fluazinam.pdf
- USEPA, Office of Pesticide Programs, Pesticide Residue Limits, "Fluazinam," 40 CFR 180.574. http://www.epa.gov/fedrgstr/EPA-PEST/2002/April/Day-18/p9497.htm

Fluchloralin F:0246

Use Type: Herbicide

CAS Number: 33245-39-5

Formula: $C_{12}H_{13}ClF_3N_3O_4$

Synonyms: Benzenamine, *N*-(2-chloroethyl)-2,6-dinitro-*N*-propyl-4-(trifluoromethyl)-; *N*-(2-Chloroethyl)-2,6-dinitro-*N*-propyl-4-(trifluoromethyl)aniline; *N*-(2-Chloroethyl)-2,6-dinitro-*N*-propyl-4-(trifluoromethyl) benzenamide; *N*-(2-Chloroethyl)-α,α,α-trifluoro-2,6-dinitro-*N*-propyl-*p*-toluidine; *N*-(2-Chloroethyl)-2,6-dinitro-*N*-propyl-4-(trifluoromethyl)benzenamine; *N*-Propyl-*N*-(2-chloroethyl)-2,6-dinitro-4-trifluoromethylaniline; *N*-Propyl-*N*-(2-chloroethyl)-α,α,α-trifluoro-2,6-dinitro-*p*-toluidine

Trade Names: BAS 392-H®; BASALIN®[C]

Chemical Class: Chloroaniline

EPA/OPP PC Code: 108701

California DPR Chemical Code: 1848

HSDB Number: 3919

UN/NA & ERG Number: UN3077(solid)/171; UN1590/153

RTECS® Number: XU5160000

EC Number: 251-426-0

Uses: A pre-emergence herbicide used on dry and succulent peas and beans, okra, peanuts, soybeans, sunflowers and cotton. Not currently registered in the U.S. Not listed for use in EU countries[115]. Used in India. There are 16 global suppliers[97].

Human toxicity (long-term)[101]: Very low–46200.00 ppb, Health Advisory

Fish toxicity (threshold)[101]: High–7.09937 ppb, MATC (Maximum Acceptable Toxicant Concentration)

Regulatory Authority and Advisory Information: Health Advisory: Mutagen

Acute Oral Category: 3, CAUTION

Description: Orange-yellow crystalline solid. Faint, unusual odor. Commercial products may be available as flammable liquid concentrates. Molecular weight = 355.71; Freezing/Melting point = 42 °C; Vapor pressure = 4×10^{-5} mmHg @ 20 °C; Flash point = 29.5 °C. Low solubility in water; solubility = 10 ppm; <1 ppm @ 20 °C. Physical and toxicological properties may be affected by carrier solvents in commercial formulations.

Incompatibilities: Slowly hydrolyzes in water, releasing ammonia and forming acetate salts. Forms toxic fumes of nitrogen oxides, chlorine, and fluorine when heated to decomposition. Light may cause slow decomposition. Slightly corrosive, especially in the presence of moisture.

Determination in Air: Filter; none; Gravimetric; NIOSH IV[18] [Particulates NOR; #0500 (total), #0600 (respirable)]

Determination in Water: Log K_{ow} = >5.0. Values above 3.0 are likely to bioaccumulate in aquatic organisms.

Harmful Effects and Symptoms

Short Term Exposure: Contact with eyes or skin may cause irritation or injury. May be harmful if swallowed; potential liver toxin. A skin sensitizer. LD_{50} (oral, rat) = 3 g/kg; LD_{50} (dermal, rat) = >4 g/kg.

Long Term Exposure: Fluorides may cause bone disease (pain and tenderness of the bones); mottled teeth in children. May cause contact dermatitis and/or asthma; liver problems. May cause reproductive and fetal effects.

Points of Attack: Skin, lungs, liver, bones, reproductive system.

Medical Surveillance: Preliminary medical exam to detect chronic diseases of central nervous system, liver, heart, kidneys, lung and skin, as well as endocrinological or immunological disturbances, should protect susceptible individuals. Periodical medical exams of internal organs, skin and eyes are important to avoid chronic occupational intoxications. They should include lab and patch tests when necessary[83]. Evaluation by a qualified allergist, including exposure history and testing, may help diagnose allergy. In addition to comprehensive initial medical and work histories emphasizing reproductive experience and menstrual history, patient should have physical examination and testing of genito-urinary tract, sperm count, motility and morphology. If required, other tests, such as serum testosterone, serum follicle stimulating hormone (FSH), and serum lutenizing hormone (LH), may be indicated.

First Aid: If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least 15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately. If this chemical contacts the skin, remove contaminated clothing and wash immediately with soap and water. Seek medical attention immediately. If this chemical has been inhaled, remove from exposure, begin rescue breathing (using universal precautions) if breathing has stopped, and CPR if heart action has stopped. Transfer promptly to a medical facility. When this chemical has been swallowed, get medical attention. Give large quantities of water and induce vomiting. Do not make an unconscious person vomit. Do not induce vomiting when formulations containing petroleum solvents are ingested

Personal Protective Methods: *Clothing:* Avoid dermal contact with chloroaniline. Wear solvent-resistant gloves and clothing. Safety equipment suppliers/manufacturers can provide recommendations on the most protective glove, clothing material for your operation. All protective clothing (suits, gloves, footwear, headgear) should be clean, available each day and put on before work. *Eye protection:* Wear splash-proof chemical goggles and face shield when working with liquid, unless full facepiece respiratory protection is worn. Wear dust-proof goggles and face shield when working with powders or dust, unless full facepiece respiratory protection is worn.

Respirator Selection: Where potential exists for exposures to chloroaniline, use a NIOSH/MSHA- or European Standard EN149-approved supplied-air respirator with a full facepiece operated in the positive-pressure mode, or with a full facepiece, hood, or helmet in the continuous-flow mode; or use a NIOSH/MSHA- or European Standard EN149-approved self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive-pressure mode. All respirators selected must be approved by NIOSH under the provisions of 42 CFR 84. The current listing of NIOSH-certified respirators can be found in theNIOSH/NPPTL Certified Equipment List, which is available on the NIOSH web site.

Storage: Color Code-Blue: Health Hazard/Poison. Store in a secure poison location. Prior to working with this chemical you should be trained on its proper handling and storage. Store in tightly closed containers in a cool, well-ventilated area away from oxidizers (such as perchlorates, peroxides, permanganates, chlorates and nitrates), since violent reactions occur. A regulated, marked area should be established where this chemical is handled, used, or stored in compliance with OSHA Standard 1910.1045. Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: Environmentally hazardous substances, solid or liquid, usually fall in Hazard Class 9.

Spill Handling: Evacuate and restrict persons not wearing protective equipment from area of spill or leak until clean up is complete. Ventilate area of spill or leak. Absorb liquids in vermiculite, dry sand, earth, peat, carbon, or a similar material and deposit in sealed containers. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable. *p-isomer:* First remove all sources of ignition. Evacuate persons not wearing protective equipment from area of spill or leak until clean up is complete. Collect powdered material in the most convenient and safe manner and deposit in sealed containers. Ventilate area after clean up is complete. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable

Fire Extinguishing: Hazardous decomposition includes oxides of nitrogen and carbon and hydrogen fluoride and hydrogen chloride. As an immediate precautionary measure, isolate spill or leak area in all directions for at least 50 meters/150 feet for liquids and at least 25 meters/75 feet for solids. *Fire involving storage or vehicular tanks:* isolate for 800 meters/0.5 mile in all directions; also, consider initial evacuation for 800 meters/0.5 mile in all directions. *On a small fire:* use dry chemical, CO_2, water spray or regular foam. *On a large fire:* use water spray, fog or regular foam. Do not scatter spilled material with high-pressure streams of water. Move containers from fire area if you can do it without risk. Dike fire-control water for later disposal. *Fire involving tanks:* from a secure, explosion-proof location, use water spray to cool exposed containers. If cooling streams are ineffective (venting sound increases in volume and pitch, tank discolors, or shows any signs of deforming), withdraw immediately to a secure position. Always stay away from tanks engulfed in fire. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode.

Disposal Method Suggested: Dissolve in a combustible solvent, such as alcohol or benzene, and spray into a furnace equipped with afterburner and scrubber[24]. Alternatively, pour into a mixture of sand and soda ash and burn in a furnace with paper as a fuel. In accordance with ***[40CFR165]***, follow recommendations for the disposal of pesticides and pesticide containers. Containers must be disposed of properly by following package label directions or by contacting your local or federal environmental control agency, or by contacting your regional EPA office.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- Pesticide Management Education Program, “Fluchloralin (Basalin) Herbicide Profile 6/85,” Cornell University, Ithaca, NY (June 30, 1985). http://pmep.cce.cornell.edu/profiles/herb-growthreg/fatty-alcohol-monuron/fluchloralin/herb-prof-fluchloralin.html

Flucythrinate F:0248

Use Type: Insecticide, Acaricide

CAS Number: 70124-77-5

Formula: $C_{26}H_{23}F_2NO_4$

Synonyms: AC 222705; Benzeneacetic acid, 4-(difluoromethoxy)-α-(1-methylethyl)-, cyano(3-phenoxyphenyl)methyl ester; (±)-Cyano(3-phenoxyphenyl)methyl(+)-4-(difluoromethoxy)-α(1-methylethyl)benzeneacetate; (+)-Cyano-(3-phenoxyphenyl)methyl (+)-4-(difluoromethoxy)-α-(1-methylethyl) benzene acetate; (RS)-Cyano-(3-phenoxyphenyl)methyl (S)-4-(difluoromethoxy)-α-(1-methylethyl)-benzeneacetate; (+)-α-Cyano-*m*-phenoxybenzyl alcohol ester of (+)-2-(*p*-difluoromethoxy)phenyl-3-methylbutyric acid; (RS)-α-Cyano-3-phenoxybenzyl (S)-2-(4-difluoromethoxyphenyl)-3-methylbutyrate; Fluorocythrin; OMS 2007

Trade Names: AASTAR®[C]; CYBOLT®; CYTHRIN®; FUCHING JUJR®; GUARDIAN®[C]; PAYOFF®[C]; STOCK GUARD®; TOMAHAWK®

Chemical Class: Pyrethroid

EPA/OPP PC Code: 118301

California DPR Chemical Code: 2168

HSDB Number: 6647

UN/NA & ERG Number: UN3352 (liquid)/151; UN3349 (solid)/151

RTECS® Number: CY15782000

EC Number: 274-322-7

Uses: Not approved for use in EU countries[115]. Not currently registered in the U.S. This is a synthetic pyrethroid used to control pests in apples, cabbage, head lettuce, pears, corn and cotton, but it was used primarily on cotton.

Human toxicity (long-term)[101]: Very low–140.00 ppb, Health Advisory

Fish toxicity (threshold)[101]: Extra high–0.00707 ppb, MATC (Maximum Acceptable Toxicant Concentration)

Regulatory Authority and Advisory Information: Acute

Oral Category: 1, DANGER–POISON

Health Advisory: Endocrine disruptor (Possible)

Description: Dark amber, viscous liquid. Faint odor, like esters. Commercial product may be powders or emulsifiable concentrates. Molecular weight = 451.47; Specific gravity (H_2O:1) = 1.188 @ 22 °C; Boiling point = 108 °C @ 0.35 mmHg; Vapor pressure = 8.7×10^{-9} mmHg @ 20 °C; 1.16×10^{-8} mmHg @ 25 °C; 0.0012 mmHg @ 25 °C; Flash point = 45 °C. Practically insoluble in water; solubility = 0.5 ppm @ 21 °C. Physical and toxicological properties may be affected by carrier solvents in commercial formulations.

Incompatibilities: Keep away from alkaline materials. Incompatible with oxidizers, sulfuric acid, caustics, ammonia, aliphatic amines, alkanolamines, isocyanates, alkylene oxides, epichlorohydrin. Contact with moisture may cause hydrolysis or other forms of decomposition.

Permissible Exposure Limits in Air: NIOSH(2) IDLH = 5,000 ppm

OSHA PEL: 5 mg/m^3 TWA

NIOSH REL: 5 mg/m^3 TWA

ACGIH TLV®[1]: 5 mg/m^3 TWA

STEL set by HSE(33) = 10 mg/m^3.

Determination in Air: Collection by impinger or fritted bubbler, analysis by gas-liquid chromatography/ultraviolet. See NIOSH IV, Method #5008[18], as pyrethroid.

Permissible Concentration in Water: Acceptable Daily Intake (ADI) =0.02 mg/kg as pyrethroid

Determination in Water: Collection by impinger or fritted bubbler, analysis by gas-liquid chromatography/ultraviolet. See NIOSH IV, Method #5008[18]. Log K_{ow} = >4.5. Values above 3.0 are likely to bioaccumulate in marine organisms.

Routes of Entry: Inhalation, absorbed through the skin

Harmful Effects and Symptoms

Short Term Exposure: Flucythrinate can cause extreme eye irritation. May be fatal if inhaled or through dermal absorption. Pyrethrins can affect you when breathed in and by passing through your skin. Irritates the eyes and respiratory tract. High exposure can affect the nervous system causing headache, nausea, vomiting, fatigue, and restlessness, rhinorrhea (discharge of thin nasal mucous). LD_{50} (oral, rat) = 67 mg/kg; LD_{50} (dermal, rabbit) = >1000 mg/kg.

Long Term Exposure: Fluorides may cause bone disease (pain and tenderness of the bones); mottled teeth in children. High or repeated exposure may cause lung allergy with cough, wheezing and/or shortness of breath or hay fever symptoms with sneezing, runny or stuffy nose. Allergic "pneumonia" can also occur with cough, chest pain, breathing difficulty and abnormal chest x-ray. Repeated attacks may lead to permanent scarring. Skin allergy may also develop with rash and itching, even with lower exposures. Dermal contact may cause rash with redness, blisters and intense itching. A severe generalized allergy can occur with weakness and collapse. A possible neurotoxin.

Points of Attack: Respiratory system, skin, eyes and central nervous system.

Medical Surveillance: Before beginning employment and at regular times after that, the following are recommended: Employees should be screened for history of certain medical conditions which might place the employee at increased risk from pyrethroid exposure. Chronic respiratory disease: In persons with chronic respiratory disease, especially asthma, the inhalation of pyrethroids might cause exacerbation of symptoms due to their sensitizing properties. Lung function tests. These may be normal if the person is not having an attack at the time of the test. Consider chest x-ray if lung symptoms are present. Skin disease: Pyrethroids can cause dermatitis which may be allergic in nature. Persons with pre-existing skin disorders may be more susceptible to the effects of this agent. Evaluation by a qualified allergist, including exposure history and testing, may help diagnose allergy. Any employee developing the above-listed conditions should be referred for further medical examination[9].

First Aid: If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least 15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately. If this chemical contacts the skin, remove contaminated clothing and wash immediately with soap and water. Seek medical attention immediately. If this chemical has been inhaled, remove from exposure, begin rescue breathing (using universal precautions) if breathing has stopped, and CPR if heart action has stopped. Transfer promptly to a medical facility. When this chemical has been swallowed, get medical attention. *Do not induce vomiting when formulations containing petroleum solvents are ingested*. Otherwise, give large quantities of water and induce vomiting. Do not make an unconscious person vomit.

Personal Protective Methods: Applicators and other handlers must wear: Coveralls worn over long-sleeved shirt and long pants; Chemical-resistant gloves such as DuPont™ Tychem® suit fabrics, barrier laminate, or Viton®; Chemical-resistant footwear plus socks; Protective eye wear; Chemical-resistant headgear for overhead exposure; Chemical-resistant apron when cleaning equipment, mixing, or loading[83]. Agricultural Use/Engineering Controls: When handlers use closed systems, enclosed cabs, or aircraft in a manner that meets the requirements listed in the Worker Protection Standard (WPS) for agricultural pesticides, ***40 CFR*** 170.240(d)(4-6), the handler PPE requirements may be reduced or modified as specified in the Worker Protection Standard. Firefighters should wear NIOSH approved self-contained breathing apparatus and full protective clothing.

Respirator Selection: NIOSH/OSHA *for pyrethrum*: *50 mg/m^3:* CcrOv95 (APF = 10) [any air-purifying half-mask respirator equipped with an organic vapor cartridge(s) in combination with an N95, R95, or P95 filter. The following filters may also be used: N99, R99, P99, N100, R100, P100]; or Sa (APF = 10) (any supplied-air respirator). *125 mg/m^3:* Sa:Cf (APF = 25) (any supplied-air respirator operated in a continuous-flow mode); or PaprOvHie (APF = 25) (any air-purifying full facepiece respirator equipped with an organic vapor cartridge in combination with a high-efficiency particulate filter). *250 mg/m³:* CcrFOv100 (APF = 50) [any air-purifying full facepiece respirator equipped with organic vapor cartridge(s) in combination with an N100, R100, or P100 filter]; or PaprTOvHie (APF = 50) [any powered, air-purifying respirator with a tight-fitting face-piece and organic vapor cartridge(s) in combination with a high-efficiency particulate filter]; or SCBAF (APF = 50) (any self-contained breathing apparatus with full facepiece); or SaF (APF = 50) (any supplied-air respirator with a full facepiece). *5000 mg/m³:* SaF:Pd,Pp (APF = 2000) (any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode). *Emergency or planned entry into unknown concentrations or IDLH conditions:* SCBAF:Pd,Pp (APF = 10,000) (any self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode); or SaF:Pd,Pp:ASCBA (APF = 10,000) (any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary self-contained breathing apparatus operated in a pressure-demand or other positive-pressure mode). *Escape:* GmFOv100 (APF = 50) [any air-purifying, full facepiece respirator (gas mask) with a chin-style, front- or back-mounted organic vapor canister having an N100, R100, or P100 filter]; or SCBAE (any appropriate escape-type, self-contained breathing apparatus).

Note: Substance reported to cause eye irritation or damage; may require eye protection.

Storage: Color Code-Blue: Health Hazard/Poison. Store in a secure poison location. Prior to working with this chemical you should be trained on its proper handling and storage. Store in tightly closed containers in a cool, well-ventilated area. Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: This material is a toxic pesticide and should be labeled "poisonous materials." It falls into Hazard Class 6.1. PG III

Spill Handling: First remove all sources of ignition. Evacuate persons not wearing protective equipment from area of spill or leak until clean up is complete. Ventilate area of spill or leak. Use water spray to reduce vapor. Absorb liquids in vermiculite, dry sand, earth, or a similar material and deposit in sealed containers. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable.

Fire Extinguishing: Heat of decomposition releases oxides of nitrogen and carbon and hydrogen fluoride gas. *On a small fire:* use dry chemical, CO_2 or water spray. *On a large fire:* use water spray, fog or regular foam. Move containers from fire area if you can do it without risk. Dike fire-control water for later disposal; do not scatter the material. Use water spray or fog; do not use straight streams. *Fire involving storage or vehicular tanks:* isolate for 800 meters/0.5 mile in all directions; also, consider initial evacuation for 800 meters/0.5 mile in all directions. Fight fire from maximum distance or use unmanned hose holders or monitor nozzles. Do not get water inside containers. Cool containers with flooding quantities of water until well after fire is out. Withdraw immediately in the case of rising sound from venting safety devices or discoloration of tank. ALWAYS stay away from tanks engulfed in fire. For massive fire, use unmanned hose holders or monitor nozzles; if this is impossible, withdraw from area and let fire burn. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies.

Disposal Method Suggested: Incineration would be an effective disposal procedure where permitted. If an efficient incinerator is not available, the product should be mixed with large amounts of combustible material and contact with the smoke should be avoided. In accordance with ***[40CFR165]***, follow recommendations for the disposal of pesticides and pesticide containers.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- EXTOXNET, Extension Toxicology Network, "Pesticide Information Profile, Flucythrinate," Oregon State University, Corvallis, OR (June 1996). http://extoxnet.orst.edu/pips/flucythr.htm
- International Programme on Chemical Safety (IPCS), "Health and Safety Guide, Flucythrinate," Geneva, Switzerland. http://www.inchem.org/documents/jmpr/jmpmono/v85pr09.htm

Flumetralin F:0253

Use Type: Plant growth regulator/inhibitor/modifier

CAS Number: 62924-70-3

Formula: $C_{16}H_{12}ClF_4N_3O_4$

Synonyms: Benzenemethanamine, 2-chloro-*N*-[2,6-dinitro-4-(trifluoromethyl)phenyl]-*N*-ethyl-6-fluoro-; 2-Chloro-*N*-[2,6-dinitro-4-(trifluoromethyl)phenyl]-*N*-ethyl-6-fluoro-benzenemethanamine; *N*-(2-Chloro-6-fluorobenzyl)-*N*-ethyl-α,α,α-trifluoro-2,6-dinitro-*p*-toluidine; *N*-[(2-Chloro-6-fluorophenyl) methyl]-*N*-ethyl-2,6-dinitro-4-(trifluoromethyl)aniline;

2-Chloro-6-fluoro-*N*-(2,6-dinitro-4-(trifluoromethyl) phenyl)-*N*-ethylbenzenemethanamine

Trade Names: CGA-41065; FROG; PODOS; PREMIER; PRIME; PRIME+EC

Chemical Class: Dinitroaniline

EPA/OPP PC Code: 123001

California DPR Chemical Code: 5085

HSDB Number: Not assigned

UN/NA&ERG Number: UN1596/153

RTECS® Number: DA4391600

EC Number: [*Annex I Index No.:* 612-144-00-7]

Uses: Commonly used on tobacco. Not listed for use in EU countries[115]. Registered for use in the U.S.

Fish toxicity (threshold): Hazardous (toxic) to fish and invertebrates.

Regulatory Authority and Advisory Information: RCRA: it is ignitable (D001) and may contain xylene U239

SARA 312/313 hazard Class: Acute, Chronic, and Fire Hazard

Health Advisory: Mutagen, Developmental/Reproductive Toxin, Skin irritant/sensitizer

U.S. DOT Marine pollutant (49CFR, Subchapter 172.101, Appendix B), severe pollutant

European/International Regulations: Hazard Symbol: Xi, N; risk phrases: R36/38; R43; R50/53; safety phrases: S2; S36/37; S60; S61 (see Appendix 1)

Description: Yellow crystalline solid. Solution in water is reddish-brown. Solvent-like odor. Molecular weight = 421.735; Boiling point = (decomposes); Freezing/Melting point = 102 °C; Vapor pressure = 3.2×10^{-2} mmHg; Flash point = (solid) >250 °C; ~ 60 °C (solution); Autoignition in solvent such as xylene = (est.) 400 °C. Hazard Identification (based on NFPA-704 M Rating System): Health 3, Flammability 2, Reactivity 0. Low solubility in water; solubility = 0.1 mg/L @ 25 °C. Physical and toxicological (including NFPA) properties may be affected by carrier solvents in commercial formulations.

Incompatibilities: Dust may form explosive mixture with air. Dintroanilines can be explosive and are strong oxidizers. Contact with reducing agents, other strong oxidizers or, nitrosylsulfuric acid may cause fire or explosion.

Determination in Water: Log K_{ow} = >5.0. Values above 3.0 are likely to bioaccumulate in aquatic organisms.

Routes of Entry: Inhalation, ingestion, skin and eyes.

Harmful Effects and Symptoms

Short Term Exposure: Irritates the eyes, skin and respiratory tract. Inhalation can cause coughing and wheezing. High levels can cause methemoglobinemia, causing headache, dizziness, and blue color to the skin and lips. Higher levels can cause difficult breathing; collapse and possible death. LD_{50} (oral, rat) = 3100 mg/kg; LD_{50} (dermal, rat) = >2 g/kg.

Long Term Exposure: Fluorides may cause bone disease (pain and tenderness of the bones); mottled teeth in children. May cause skin sensitization. May cause liver and kidney damage.

Points of Attack: Skin, bones, blood, liver, kidneys.

Medical Surveillance: Blood methemoglobin level. Liver and kidney function tests. Evaluation by a qualified allergist, including exposure history and testing, may help diagnose allergy.

First Aid: If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least 15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately. If this chemical contacts the skin, remove contaminated clothing and wash immediately with soap and water. Seek medical attention immediately. If this chemical has been inhaled, remove from exposure, begin rescue breathing (using universal precautions, including resuscitation mask) if breathing has stopped and CPR if heart action has stopped. Transfer promptly to a medical facility. When this chemical has been swallowed, get medical attention. Give large quantities of water and induce vomiting. Do not make an unconscious person vomit. In the case of poisoning, special first aid is required; antidotes for the formation of met hemoglobin should be available, including instructions.

Note to physician: Treat for methemoglobinemia. Spectrophotometry may be required for precise determination of levels of methemoglobinemia in urine.

Personal Protective Methods: Dinitroanilines react with cellulose-based and expanded polymeric absorbents[88]. Wear protective gloves and clothing to prevent any reasonable probability of dermal and/or eye contact. Safety equipment suppliers/manufacturers can provide recommendations on the most protective glove/clothing material for your operation. All protective clothing (suits, gloves, footwear, headgear) should be clean, available each day, and put on before work. Contact lenses should not be worn when working with this chemical. Wear dust-proof chemical goggles and face shield unless full facepiece respiratory protection is worn. Employees should wash immediately with soap when skin is wet or contaminated. Provide emergency showers and eyewash.

Respirator Selection: Follow regulations in OSHA 29CFR1910.134 or European Standard EN149. Use a NIOSH/MSHA- or European Standard EN149-approved respirator; or use an approved supplied-air respirator with a full facepiece operated in the positive-pressure mode, or with a full facepiece, hood, or helmet in the continuous-flow mode; or use a NIOSH/MSHA- or European Standard EN149-approved self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive-pressure mode.

Storage: (1) Color Code-Yellow Stripe: Reactivity Hazard. Store separately in a area isolated from flammables, combustibles, or other yellow coded materials. (2) Color Code-Blue: Health Hazard/Poison. Store in a secure poison location. Prior to working with this chemical you should be trained on its proper handling and storage. Before entering confined space where this chemical may be present, check to make sure that an explosive concentration does not exist. Store in tightly closed containers in a cool, well-ventilated area away from oxidizers, strong acids; strong bases and other incompatible materials listed above. Metal containers involving the transfer of this chemical should be grounded and bonded. Drums must be equipped with self-closing valves, pressure vacuum bungs, and flame arresters. Use only non-sparking tools and equipment, especially when opening and closing containers of this chemical. If this material contains a flammable carrier, sources of ignition, such as smoking and open flames, are prohibited where this chemical is used, handled, or stored in a manner that could create a potential fire or explosion hazard. Wherever this chemical is used, handled, manufactured, or stored, use explosion-proof electrical equipment and fittings. Also corrosive. Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: Dinitroanilines require a label of "poisonous materials." They usually fall into Hazard Group 6.1.

Spill Handling: First remove all sources of ignition. Evacuate persons not wearing protective equipment from area of spill or leak until clean up is complete. Do not dry sweep. Collect powdered material in the most convenient and safe manner and deposit in sealed containers. Ventilate area after clean up is complete. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable.

Fire Extinguishing: Heat of decomposition releases oxides of nitrogen and carbon and hydrogen fluoride and hydrogen chloride gasses. This chemical is a combustible solid but does not readily ignite. However, moderate heat causes decomposition that produces toxic vapors that form an explosive mixture with air. Use dry chemical, carbon dioxide; water spray; alcohol foam or polymer foam extinguishers. Hazardous decomposition includes carbon monoxide and nitrogen oxides. Heated vapors in confined spaces can explode. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies. Containers may explode in fire. From a secure, explosion-proof location, use water spray to cool exposed containers. If cooling streams are ineffective (venting sound increases in volume and pitch, tank discolors, or shows any signs of deforming), withdraw immediately to a secure position. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- United States National Library of Medicine, *ChemIDplus Advanced*, Bethesda, MD. http://chem.sis.nlm.nih.gov/chemidplus/rn/62924-70-3

Fluometuron F:0270

Use Type: Herbicide
CAS Number: 2164-17-2
Formula: $C_{10}H_{11}F_3N_2O$
Synonyms: *N,N*-Dimethyl-*N'*-[3-(trifluoromethyl)phenyl]urea; 1,1-Dimethyl-3-(3-trifluoromethylphenyl) urea; Meturone; NCI-C08695; *N*-(*m*-Trifluoromethylphenyl)-*N',N'*-dimethylurea; *N*-(3-Trifluoromethylphenyl)-*N',N'*-dimethylurea; 3-(3-Trifluoromethylphenyl)-1,1-dimethylurea; 3-(*m*-Trifluoromethylphenyl)-1,1-dimethylurea; Urea, *N,N*-dimethyl-*N'*-[3-(trifluoromethyl)phenyl]-; Urea, 1,1-dimethyl-3-(α,α,α-trifluoro-m-tolyl)-
Trade Names: C 2059®; CIBA 2059®; COTORAN®; COTORAN® 50SC; COTORAN MULTI 50WP®; COTOREX®; COTTONEX®; COTTONEX® 50SC; DREXEL CROAK®; FLO-MET®; FLUOMETURON® 50SC; HERBICIDE C-2059®; HIGALCOTON®; LANEX®[C]; METURON 80 DF®; PAKHTARAN®; SETRE FLUOMETURON 80 WP®
Chemical Class: Phenylurea
EPA/OPP PC Code: 035503
California DPR Chemical Code: 166
HSDB Number: 1721
UN/NA & ERG Number: UN2767 (Phenyl urea pesticides, solid, toxic)/151
RTECS® Number: YT1575000
EC Number: 218-500-4

Uses: A General Use Pesticide (GUP). Fluometuron is a selective herbicide which acts on susceptible plants by inhibiting photosynthesis. Fluometuron is registered by EPA exclusively for use on cotton and sugarcane. It can be applied pre-emergence, for weed control before planting, or post-emergence, after target crops and weeds come up, and may have residual activity for several months. Fluometuron is available in liquid, dry flowable, and wettable powder formulations.

U.S. Maximum Allowable Residue Levels for Fluometuron (40 CFR 180.229): cotton, undelinted seed 0.1 ppm.

Regulatory Authority and Advisory Information:
Carcinogenicity[83]: EPA Group C, Possible human carcinogen; IARC: Group 3, unclassifiable as to its carcinogenicity in humans.
Acute Oral Category: 2, WARNING
Health Advisory: Mutagen, Tumorigen
Potential Ground Water Pollutant [California FAC Section 13145(d)/12811, inactive)
EPCRA Section 313 Form R *de minimus* concentration reporting level: 1.0%

Description: Fluometuron is a colorless or white crystalline solid. It is often used in liquid solution that may be flammable. Molecular weight = 232.23; Boiling point = 275 °C; Freezing/Melting point = 151–153 °C;

163–165 °C; Vapor pressure = 9.0×10^{-7} mmHg @ 20 °C. Hazard Identification (based on NFPA-704 M Rating System): Health 1, Flammability 1, Reactivity 0. Slightly soluble in water; solubility = 22 mg/L @ 22 °C[83,USDA].

Incompatibilities: Liquid solutions are incompatible with oxidizers.

Permissible Concentration in Water: Federal Drinking Water Guidelines: 90 ppb[93]. State Drinking Water Guidelines: Florida 91 μg/L; Maine 90 μg/L.

Determination in Water: Log K_{ow} = <2.5. Unlikely to bioaccumulate in marine organisms.

Routes of Entry: Inhalation, dermal contact; may penetrate unbroken skin.

Harmful Effects and Symptoms

Short Term Exposure: Contact can cause eye and skin irritation. Inhalation can irritate the respiratory tract. Symptoms of exposure include increased leukocyte content in circulation blood. The material is a mild cholinesterase inhibitor. LD_{50} (oral, rat) = 1450 mg/kg; LD_{50} (dermal, rat) = >2 g/kg.

Long Term Exposure: Fluorides may cause bone disease (pain and tenderness of the bones); mottled teeth in children. May cause skin allergy. Mild cholinesterase inhibitor; cumulative effect is possible. Repeated exposure may cause hemolytic anemia, a reduction in blood pressure and a decrease in the red blood cell count. May cause liver damage; convulsions or coma. May be mutagenic.

Points of Attack: Respiratory system, lungs, central nervous system, skin, eyes, plasma and red blood cell cholinesterase. Liver, bones.

Medical Surveillance: Preliminary medical exam to detect chronic diseases of central nervous system, liver, heart, kidneys, lung and skin, as well as endocrinological or immunological disturbances, should protect susceptible individuals. Periodical medical exams of internal organs, skin and eyes are important to avoid chronic occupational intoxications. They should include lab and patch tests when necessary[83]. This chemical is a suspected or known human carcinogen. Exposed persons should contact a physician for advice regarding the possible long term health effects and advice for medical monitoring. Liver function tests. Complete blood count. Evaluation by a qualified allergist

First Aid: *Dermal contact:* Flood all areas of body that have contacted the substance with water. Don't wait to remove contaminated clothing; do it under the water stream. Use soap to help ensure removal. Isolate contaminated clothing when removed to prevent contact by others. *Eye contact:* Remove any contact lenses at once. Flush eyes well with copious quantities of water or normal saline for at least 20–30 minutes. Seek medical attention. *Inhalation:* Leave contaminated area immediately; breathe fresh air. Proper respiratory protection must be supplied to any rescuers. If coughing, difficult breathing or any other symptoms develop, seek medical attention at once, even if symptoms develop many hours after exposure. *Ingestion:* Consult a physician, hospital or poison center at once. If the victim is unconscious or convulsing, do not induce vomiting or give anything by mouth. Ensure that the airway is open, lay on side and keep head lower than body and transport immediately to medical facility. If conscious and not convulsing, give a glass of water to dilute the substance. Do not induce vomiting without a physician's advice.

Personal Protective Methods: Safety equipment suppliers/manufacturers can provide recommendations on the most protective glove/clothing material for your operation. All protective clothing (suits, gloves, footwear, headgear) should be clean, available each day, and put on before work. Contact lenses should not be worn when working with this chemical. Wear dust-proof chemical goggles and face shield unless full facepiece respiratory protection is worn. Employees should wash immediately with soap when skin is wet or contaminated. Provide emergency showers and eyewash.

Respirator Selection: Follow regulations in OSHA 29CFR1910.134 or European Standard EN149. Use a NIOSH/MSHA- or European Standard EN149-approved respirator; or use an approved supplied-air respirator with a full facepiece operated in the positive-pressure mode, or with a full facepiece, hood, or helmet in the continuous-flow mode; or use a NIOSH/MSHA- or European Standard EN149-approved self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive-pressure mode.

Storage: Color Code-Blue: Health Hazard/Poison. Store in a secure poison location. Prior to working with this chemical you should be trained on its proper handling and storage. Store in a refrigerator or a cool, dry place and protect from exposure to ultraviolet light. Keep liquid away from oxidizers. Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: Phenyl urea pesticides, solid, toxic, require a label of "poisonous materials." Hazard Class 6.1.

Spill Handling: *Dry material:* First remove all sources of ignition. Evacuate persons not wearing protective equipment from area of spill or leak until clean up is complete. Dampen spilled material with 60–70% acetone and avoid airborne dust. Collect powdered material in the most convenient and safe manner and deposit in sealed containers. Ventilate area after clean up is complete. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable.

Liquid: Evacuate and restrict persons not wearing protective equipment from area of spill or leak until cleanup is complete. Ventilate area of spill or leak. Absorb liquids in vermiculite, dry sand, earth, peat, carbon, or a similar material and deposit in sealed containers. Oil-skimming equipment may be used to remove slicks from water. Keep this chemical out of a confined space, such as a sewer, because of the possibility of an explosion, unless the sewer is designed to prevent the build-up of explosive concentrations. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable.

Fire Extinguishing: Hazardous decomposition includes hydrogen fluoride and nitrogen and carbon oxides. *Dry material:* use dry chemical, carbon dioxide; water spray; or alcohol foam extinguishers. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies. From a secure, explosion-proof location, use water spray to cool exposed containers. If cooling streams are ineffective (venting sound increases in volume and pitch, tank discolors, or shows any signs of deforming), withdraw immediately to a secure position. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode. *Combustible solution:* Hazardous decomposition includes nitrogen oxides and fluorine. Use dry chemical, carbon dioxide; or alcohol foam extinguishers. Vapors are heavier than air and will collect in low areas. Vapors may travel long distances to ignition sources and flashback. Vapors in confined areas may explode when exposed to fire. Containers may explode in fire. Storage containers and parts of containers may rocket great distances, in many directions. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies. From a secure, explosion-proof location, use water spray to cool exposed containers. If cooling streams are ineffective (venting sound increases in volume and pitch, tank discolors, or shows any signs of deforming), withdraw immediately to a secure position. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode.

Disposal Method Suggested: Containers must be disposed of properly by following package label directions or by contacting your local or federal environmental control agency, or by contacting your regional EPA office. If this material cannot be disposed of according to label instructions, it may be dissolved or mixed with a combustible solvent and burned in a chemical incinerator equipped with an afterburner and scrubber. In accordance with ***[40CFR165]***, follow recommendations for the disposal of pesticides and pesticide containers.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- EXTOXNET, Extension Toxicology Network, "Pesticide Information Profile, Fluometuron," Oregon State University, Corvallis, OR. (June 1996). http://extoxnet.orst.edu/pips/fluometu.htm
- USEPA, Office of Pesticide Programs, Pesticide Residue Limits, "Fluometuron," 40 CFR 180.229. http://www.epa.gov/pesticides/food/viewtols.htm
- USEPA, "Health Advisory: Fluometuron," Washington DC, Office of Drinking Water (August 1987)
- New Jersey Department of Health and Senior Services, "Hazardous Substance Fact Sheet, FLUMETURON," Trenton, NJ (April 1999). http://www.state.nj.us/health/eoh/rtkweb/0935.pdf

Fluopicolide F:0275

Use Type: Fungicide

CAS Number: 239110-15-7

Formula: $C_{14}H_8Cl_3F_3N_2O$

Synonyms: 2,6-Dichloro-*N*-[3-chloro-5-(trifluoromethyl)-2-pyridylmethyl]benzamide; 2,6-Dichloro-*N*-[[3-chloro-5-(trifluoromethyl)-2-pyridyl]amethyl]benzamide

Trade names: INFINITO®, Bayer; PRECIDIO

Chemical Class: Benzamide

EPA/OPP PC Code: 027412

California DPR Chemical Code: 5949

HSDB Number: 7886

UN/NA & ERG Number: UN3077(solid)/171

RTECS® Number: None assigned

EC Number: Not assigned

Uses: Fluopicolide is targeted for control of oomycete fungal diseases on turf, ornamentals, and several food uses including grapes and six crop groupings (leafy vegetables, fruiting vegetables, brassica vegetables, root and tuber vegetables, bulb vegetables, and cucurbits) that may be grown throughout the U.S[83].

U.S. Maximum Allowable Residue Levels for fluopicolide and its metabolite, 2,6-dichlorobenzamide (BAM): [40 CFR 180.627(a)]: Brassica, head and stem, subgroup 5A, 5.0 ppm; grape 2.0 ppm; grape, raisin 6.0 ppm; vegetable, bulb, crop group 3-07, 7.0 ppm; vegetable, cucurbit, group 9, 0.50 ppm; vegetable, fruiting, group 8, 1.60 ppm; vegetable, leafy, except brassica, group 4, 25 ppm; vegetable, leaves of root and tuber, group 2, 15.0 ppm; vegetable, root, subgroup 1A, except sugar beet and carrot 0.15 ppm; vegetable, tuberous and corm (except potato), subgroup 1D, 0.02 ppm.

Regulatory Authority and Advisory Information: WGK (German Aquatic Hazard Class): No value assigned

Description: Beige solid or powder. Commercial product is available as an emulsifiable concentrate. Practically odorless.

Molecular weight = 383.58; Specific gravity (H_2O:1) = 1.65 @ 20 °C; Boiling point = (decomposes) 320 °C; Freezing/Melting point = 148.8 °C; Vapor pressure = 1×10^{-7} mmHg @ 25 °C; Autoignition temperature = >450 °C. Low solubility in water. Physical and toxicological properties may be affected by carrier solvents in commercial formulations.

Incompatibilities: May react with strong oxidizers such as chlorates, peroxides, nitrates, etc. May form explosive mixture with air.

Permissible Concentration in Water: Runoff from spills or fire control may cause water pollution.

Determination in Water: Log K_{ow} = 2.86 mg/L @ pH 4; 2.80 mg/L@ pH 7; 2.80 mg/L @ pH 9 @ 20 °C to >3.0.[83] Values above 3.0 are likely to bioaccumulate in aquatic organisms.

Determination in Water: Log K_{ow} = Unlikely to bioaccumulate in marine organisms.

Routes of Entry: Inhalation, ingestion, derma or eye contact.

Harmful Effects and Symptoms

Short Term Exposure: May cause irritation of the eyes, skin and respiratory tract. Low toxicity but harmful if ingested. LD_{50} (oral, rat) = >5 g/kg; LD_{50} (dermal, rat) = >5 g/kg.

Long Term Exposure: Fluorides may cause bone disease (pain and tenderness of the bones); mottled teeth in children. Possible liver, kidney and spleen toxicity.

Points of Attack: Liver, kidney, spleen, bones.

Medical Surveillance: Consider the points of attack in preplacement and periodic physical examinations. Liver, kidney and spleen function tests.

First Aid: *Eyes*: First check the victim for contact lenses and remove if present. Flush victim's eyes with water or normal saline solution for 20 to 30 minutes while simultaneously calling a hospital or poison control center. Do not put any ointments, oils, or medication in the victim's eyes without specific instructions from a physician. *Immediately* transport the victim after flushing eyes to a hospital even if no symptoms (such as redness or irritation) develop. *Skin: Immediately* flood affected skin with water while removing and isolating all contaminated clothing. Gently wash all affected skin areas thoroughly with soap and water. If symptoms such as redness or irritation develop, *immediately* call a physician and be prepared to transport the victim to a hospital for treatment. *Inhalation*: *Immediately* leave the contaminated area; take deep breaths of fresh air. If symptoms (such as wheezing, coughing, shortness of breath, or burning in the mouth, throat, or chest) develop, call a physician and be prepared to transport the victim to a hospital. Provide proper respiratory protection to rescuers entering an unknown atmosphere. Ingestion: *do not induce vomiting*. If the victim is conscious and not convulsing, give 1 or 2 glasses of water to dilute the chemical and *immediately* call a hospital or poison control center. Be prepared to transport the victim to a hospital if advised by a physician. If the victim is convulsing or unconscious, do not give anything by mouth, ensure that the victim's airway is open and lay the victim on his/her side with the head lower than the body. *Do not induce vomiting*. Immediately transport the victim to a hospital[88].

Personal Protective Methods: Wear positive-pressure self-contained breathing apparatus (SCBA). Wear chemical protective clothing that is specifically recommended by the manufacturer. DuPont™ Tychem® Suit Fabrics is recommended by one government source[88]. It may provide little or no thermal protection. Structural firefighters' protective clothing provides limited protection in fire situations ONLY; it is not effective in spill situations where direct contact with the substance is possible.

Respirator Selection: Wherever and whenever workplace conditions warrant respirator use, a respiratory protection program must be followed that meets one or more of the following government standards: OSHA's 29 CFR 1910.134, ANSI Z88.2, or European Standard EN 149.

Storage: Color Code-Blue: Health Hazard/Poison: Store in a tightly closed container in a dry, well-ventilated and secure poison location and refrigerate 2 to 8 °C. Prior to working with this chemical you should be trained on its proper handling and storage. Where possible, automatically transfer material from other storage containers to process containers. Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: Environmentally hazardous substances, solid or liquid, usually fall in Hazard Class 9.

Spill Handling: Small spills and leakage: should a spill occur while you are handling this chemical, first remove all sources of ignition, then you should dampen the solid spill material with 60–70% ethanol and transfer the dampened material to a suitable container. Use absorbent paper dampened with 60–70% ethanol to pick up any remaining material. Seal the absorbent paper, and any of your clothes, which may be contaminated, in a vapor-tight plastic bag for eventual disposal. Solvent wash all contaminated surfaces with 60–70% ethanol followed by washing with a soap and water solution. Do not reenter the contaminated area until the safety officer (or other responsible person) has verified that the area has been properly cleaned.

Fire Extinguishing: Decomposition in fire releases toxic oxides of nitrogen and carbon and hydrogen chloride, hydrogen cyanide, and hydrogen fluoride gasses. As an immediate precautionary measure, isolate spill or leak area in all directions for at least 50 meters/150 feet for liquids and at least 25 meters/75 feet for solids. *Fire involving storage or vehicular tanks:* isolate for 800 meters/0.5 mile in all directions; also, consider initial evacuation for 800 meters/0.5 mile in all directions. *On a small fire:* use dry chemical, CO_2, water spray or regular foam. *On a large fire:* use water spray, fog or regular foam. Do not scatter spilled material with high-pressure streams of water. Move containers from fire area if you can do it without risk. Dike fire-control water for later disposal. *Fire involving tanks:* from a secure, explosion-proof location, use water spray to cool exposed containers. If cooling streams are ineffective (venting sound increases in volume and pitch, tank discolors, or shows any signs of deforming), withdraw immediately to a secure position. Always stay away from tanks engulfed in fire. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode.

Disposal Method Suggested: Do not discharge into drains or sewers. Dispose of waste material as hazardous waste using a licensed disposal contractor to an approved landfill. Consult with environmental regulatory agencies for guidance on acceptable disposal practices. If allowed, incineration with effluent gas scrubbing is recommended. Containers must be disposed of properly by following package label directions or by contacting your local or federal environmental control agency, or by contacting your regional EPA office.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- United States National Library of Medicine, *ChemIDplus Advanced*, Bethesda, MD. http://chem.sis.nlm.nih.gov/chemidplus/rn/239110-15-7

Fluridone F:0393

Use Type: Herbicide

CAS Number: 59756-60-4

Formula: $C_{19}H_{14}F_3NO$

Synonyms: Fluridon; 1-Methyl-3-phenyl-5-[3-(trifluoromethyl)phenyl]-4(1*H*)-pyridinone; 4(1*H*)-Pyridinone, 1-methyl-3-phenyl-5-[3-(trifluoromethyl)phenyl]-

Trade Names: AVAST®; EL 171®; PRIDE®; SONAR®; SONAR AS®

Chemical Class: Organic fluoride compound.

EPA/OPP PC Code: 112900; (215900 use code No. 112900)

California DPR Chemical Code: 2279

HSDB Number: 6653

UN/NA & ERG Number: UN3077(solid)/171

RTECS® Number: UU77865000

EC Number: 261-916-6

Uses: Used is horticulture, ornamental, aquatic and greenhouse environments. It is used as an aquatic herbicide to treat large areas of water (lakes, ponds, reservoirs, etc.) for Eurasian watermilfoil. Not used on food crops. Not approved for use in EU countries[115]. Registered for use in the U.S.

Human toxicity (long-term)[101]: Very low–560.00 ppb, Health Advisory

Fish toxicity (threshold)[101]: Very low–678.82839 ppb, MATC (Maximum Acceptable Toxicant Concentration)

Regulatory Authority and Advisory Information: Carcinogenicity[83]: EPA Group E, evidence of non-carcinogenicity for humans

Description: White to tan crystalline solid. Some commercial formulations are a light tan viscous liquid, possibly in a propylene glycol carrier. Slight odor. Molecular weight = 329.33; Specific gravity (H_2O:1) = 1.15 @ 25 °C; Boiling point = 100 °C; Freezing/Melting point = 154 °C; Vapor pressure = 1×10^{-7} mmHg @ 20 °C; Flash point (liquid) = >93.3 °C; Hazard Identification (based on NFPA-704 M Rating System): Health 1, Flammability 0, Reactivity 0. Low solubility in water. Physical and toxicological properties may be affected by carrier solvents in commercial formulations.

Incompatibilities: Decomposes in temperature >200 °C. May react with strong oxidizers such as chlorates, peroxides, nitrates, etc.

Permissible Concentration in Water: Federal Drinking Water Standards (minimum reporting level): EPA 0.90 μg/L[83]. State Drinking Water Guidelines: Florida 560 μg/L.

Determination in Water: Log K_{ow} = <2.0. Unlikely to bioaccumulate in marine organisms.

Harmful Effects and Symptoms

Short Term Exposure: Contact with eyes or skin may cause irritation or injury. Inhalation should be avoided; use NIOSH- or CEN (UK)-approved air-purifying respirators for pesticides. May be harmful if swallowed. LD_{50} (oral, rat) = >5,000 mg/kg; >10,000 mg/kg. Low toxicity.

Long Term Exposure: Fluorides may cause bone disease (pain and tenderness of the bones); mottled teeth in children.

Points of Attack: Bones.

Medical Surveillance: Preliminary medical exam to detect chronic diseases of central nervous system, liver, heart, kidneys, lung and skin, as well as endocrinological or immunological disturbances, should protect susceptible individuals. Periodical medical exams of internal organs, skin and eyes are important to avoid chronic occupational intoxications. They should include lab and patch tests when necessary[83].

First Aid: If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least 15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately. If this chemical contacts the skin, remove contaminated clothing and wash immediately with soap and water. Seek medical attention immediately. If this chemical has been inhaled, remove from exposure, begin rescue breathing (using universal precautions) if breathing has stopped, and CPR if heart action has stopped. Transfer promptly to a medical facility. When this chemical has been swallowed, get medical attention. Give large quantities of water and induce vomiting. Do not make an unconscious person vomit.

Personal Protective Methods: Applicators and other handlers must wear: Coveralls worn over long-sleeved shirt and

long pants; Chemical-resistant gloves such as butyl rubber (0.4–0.7 mm thickness/ >480 minutes; DuPont™ Tychem® suit fabrics, barrier laminate, or Viton®; Chemical-resistant footwear plus socks; Protective eye wear; Chemical-resistant headgear for overhead exposure; Chemical-resistant apron when cleaning equipment, mixing, or loading[83]. Agricultural Use/Engineering Controls: When handlers use closed systems, enclosed cabs, or aircraft in a manner that meets the requirements listed in the Worker Protection Standard (WPS) for agricultural pesticides, ***[40 CFR]*** 170.240(d)(4-6), the handler PPE requirements may be reduced or modified as specified in the Worker Protection Standard. Firefighters should wear NIOSH approved self-contained breathing apparatus and full protective clothing.

Respirator Selection: Specific respirator(s) have not been recommended by NIOSH. However, based on potential carcinogenicity, and where the potential exists for exposure, the following might be considered: *At any detectable concentration:* SCBAF: Pd,Pp (APF = 10,000) (any MSHA/NIOSH/MSHA- or European Standard EN 149-approved self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode); or SaF: Pd,Pp: ASCBA (APF = 10,000) (any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary, self-contained breathing apparatus operated in a pressure-demand or other positive-pressure mode). *Escape:* 100F (APF = 50) (any air-purifying, full facepiece respirator with an N100, R100, or P100 filter) or SCBAE (any appropriate escape-type, self-contained breathing apparatus).

Storage: Color Code-Blue: Health Hazard/Poison. Store in a secure poison location. Store in a refrigerator and protect from exposure to oxidizers or moisture[52]. A regulated, marked area should be established where this chemical is handled, used, or stored in compliance with OSHA Standard 1910.1045. Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: Environmentally hazardous substances, solid or liquid, usually fall in Hazard Class 9.

Spill Handling: Evacuate and restrict persons not wearing protective equipment from area of spill or leak until cleanup is complete. Dampen spilled material with alcohol to avoid dust. Collect powdered material in the most convenient and safe manner and deposit in sealed containers. Ventilate area of spill or leak after clean up is complete. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable.

Fire Extinguishing: Decomposes >200 °C. Hazardous decomposition includes hydrogen fluoride, carbon, and sulfur oxides. As an immediate precautionary measure, isolate spill or leak area in all directions for at least 50 meters/150 feet for liquids and at least 25 meters/75 feet for solids. *Fire involving storage or vehicular tanks:* isolate for 800 meters/0.5 mile in all directions; also, consider initial evacuation for 800 meters/0.5 mile in all directions. *On a small fire:* use dry chemical, CO_2, water spray or regular foam. *On a large fire:* use water spray, fog or regular foam. Do not scatter spilled material with high-pressure streams of water. Move containers from fire area if you can do it without risk. Dike fire-control water for later disposal. *Fire involving tanks:* from a secure, explosion-proof location, use water spray to cool exposed containers. If cooling streams are ineffective (venting sound increases in volume and pitch, tank discolors, or shows any signs of deforming), withdraw immediately to a secure position. Always stay away from tanks engulfed in fire. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode.

Disposal Method Suggested: Safe Disposal of Pesticides. An empty pesticide container can be as hazardous as a full one because of residues left inside. Never reuse such a container. When empty, a pesticide container should be rinsed carefully three times and the rinsewater thoroughly drained back onto the sprayer or the container previously used to mix the pesticide. Use the rinse water as a pesticide, following label directions. Replace the cap or closure securely. Dispose of the container according to label instructions. Do not puncture or burn a pressurized container like an aerosol – it could explode. Do cut or puncture other empty pesticide containers made of metal or plastic to prevent someone from reusing them. Wrap the empty container and put it in the trash after you have rinsed it[83]. Do not discharge into drains or sewers. Dispose of waste material as hazardous waste using a licensed disposal contractor to an approved landfill. Consult with environmental regulatory agencies for guidance on acceptable disposal practices. In accordance with ***[40CFR165]***, follow recommendations for the disposal of pesticides and pesticide containers. Containers must be disposed of properly by following package label directions or by contacting your local or federal environmental control agency, or by contacting your regional EPA office.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov

- United States National Library of Medicine, *ChemIDplus Advanced*, Bethesda, MD. http://chem.sis.nlm.nih.gov/chemidplus/rn/59756-60-4

Fluroxypyr F:0395

Use Type: Herbicide
CAS Number: 69377-81-7; 81406-37-3 (1-methyheptyl ester)
Formula: $C_7H_5Cl_2FN_2O_3$
Synonyms: 1-Methylheptyl[(4-amino-3,5-dichloro-6-fluoro-2-pyridinyl)oxy]acetate; Acetic acid, [(4-amino-3,5-dichloro-6-fluoro-2-pyridinyl)oxy]-,1-methylheptyl ester; [(4-Amino-3,5-dichloro-6-fluoro-2-pyridinyl)oxy] acetic acid, 1-methylheptyl ester
Trade Names: *methyl ester*: AGROSTAR; BOFIX FFC®; CABADEX®; CASCADE®; DOWCO® 433 MHE; FOREFRONT®; GALAXY GL184®; PARADIGM®; PASTUREGARD®; STARANE®; TOMAHAWK®; VISTA®; WIDEMATCH®, (fluroxypyr+clopyralid); XRM-5084®
Chemical Class: Pyridinecarboxylic acid; Pyridine compound
EPA/OPP PC Code: 128969; 128968 (-methyl ester)
California DPR Chemical Code: 5918
HSDB Number: 6655
UN/NA&ERG Number: UN3077(solid)/171
RTECS® Number: AF2503000
EC Number: [Annex I Index No.: 607-255- 00-2]; 279-752-9 [Annex I Index No.: 607-272-00-5] (-methy ester).
U.S. Maximum Allowable Residue Levels for Fluroxypyr 1-methylheptyl ester [40 CFR 180.535(a)]: Barley, grain 0.5 ppm; barley, forage 12.0 ppm; barley, hay 20.0 ppm; barley, straw 12.0 ppm; cattle, fat 0.1 ppm; cattle, kidney 1.5 ppm; cattle, meat 0.1 ppm; cattle, meat byproducts 0.1 ppm; corn, field, forage 1.0 ppm; corn, field, grain 0.02 ppm; corn, field, stover 0.5 ppm; corn, sweet, forage 1.0 ppm; corn, sweet, kernel plus cob, with husks removed 0.02 ppm; corn, sweet, stover 2.0 ppm; goat, fat 0.1 ppm; goat, kidney 1.5 ppm; goat, meat 0.1 ppm; goat, meat byproducts 0.1 ppm; grain, aspirated fractions 0.6 ppm; grass, forage 120 ppm; grass, hay 160 ppm; hog, fat 0.1 ppm; hog, kidney 1.5 ppm; hog, meat 0.1 ppm; hog, meat byproducts 0.1 ppm; horse, fat 0.1 ppm; horse, kidney 1.5 ppm; horse, meat 0.1 ppm; horse, meat byproducts 0.1 ppm; milk 0.3 ppm; oat, forage 12.0 ppm; oat, grain 0.5 ppm; oat, hay 20.0 ppm; oat, straw 12.0 ppm; sheep, fat 0.1 ppm; sheep, kidney 1.5 ppm; sheep, meat 0.1 ppm; sheep, meat byproducts 0.1 ppm; sorghum, grain, forage 2.0 ppm; sorghum, grain, grain 0.02 ppm; sorghum, grain, stover 4.0 ppm; wheat, forage 12.0 ppm; wheat, grain 0.5 ppm; wheat, hay 20.0 ppm; wheat, straw 12.0 ppm.
Regulatory Authority and Advisory Information:
Carcinogenicity[83]: EPA, Not likely to be carcinogenic to humans
European/International Regulations: Hazard Symbol: N; risk phrases: R52/R53; safety phrases: S2; S60; S61 (see Appendix 1); (1-methyheptyl ester): Hazard Symbol: N; risk phrases: R50/R53; safety phrases: S2; S60; S61 (see Appendix 1)
Description: White crystalline solid. Molecular weight = 255.03; 367.23 (-methyl ester); Specific gravity (H_2O:1) = 1.1 @ 25 °C; Boiling point = (decomposes); Freezing/Melting point = 232 °C; Vapor pressure = 4×10^{-6} mmHg @ 25 °C. Highly soluble in water.
Incompatibilities: May not be compatible with nitrates. Moisture may cause hydrolysis or other forms of decomposition; forming a strong acid. Temperatures above 250 °C can cause decomposition. *Methyl ester*: Esters react with acids to liberate heat along with alcohols and acids. Strong oxidizing acids may cause a vigorous reaction that is sufficiently exothermic to ignite the reaction products. Heat is also generated by the interaction of esters with caustic solutions. Flammable hydrogen is generated by mixing esters with alkali metals and hydrides.
Determination in Water: Log K_{ow} = <2.0. Unlikely to bioaccumulate in marine organisms.
Routes of Entry: Inhalation, dermal and/or eye contact.
Harmful Effects and Symptoms
Short Term Exposure: Contact with eyes or skin may cause irritation or injury. Inhalation should be avoided; use NIOSH- or CEN (UK)-approved air-purifying respirators for pesticides. May be harmful if swallowed. LD_{50} (oral, rat) = 2405–3650 mg/kg; LD_{50} (dermal, rat) = >2 g/kg.
Long Term Exposure: Possible kidney damage.
Points of Attack: Kidney, adrenal and testicular glands.
Medical Surveillance: Preliminary medical exam to detect chronic diseases of central nervous system, liver, heart, kidneys, lung and skin, as well as endocrinological or immunological disturbances, should protect susceptible individuals. Periodical medical exams of internal organs, skin and eyes are important to avoid chronic occupational intoxications. They should include lab and patch tests when necessary[83].
First Aid: If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least 15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately. If this chemical contacts the skin, remove contaminated clothing and wash immediately with soap and water. Seek medical attention immediately. If this chemical has been inhaled, remove from exposure, begin rescue breathing (using universal precautions) if breathing has stopped, and CPR if heart action has stopped. Transfer promptly to a medical facility. When this chemical has been swallowed, get medical attention. Give large quantities of water and induce vomiting. Do not make an unconscious person vomit.
Personal Protective Methods: Wear protective gloves and clothing to prevent any reasonable probability of dermal and/or eye contact. Safety equipment suppliers/manufacturers can provide recommendations on the most protective glove/clothing material for your operation. All protective clothing (suits, gloves, footwear, headgear) should be clean, available each day, and put on before work. Contact lenses should not be worn when working

with this chemical. Wear dust-proof chemical goggles and face shield unless full facepiece respiratory protection is worn. Employees should wash immediately with soap when skin is wet or contaminated. Provide emergency showers and eyewash.

Respirator Selection: Wherever and whenever workplace conditions warrant respirator use, a respiratory protection program must be followed that meets one or more of the following government standards: OSHA's 29 CFR 1910.134, ANSI Z88.2, or European Standard EN 149.

Storage: Color Code-Blue: Health Hazard/Poison. Store in a tightly closed container in a dry, well-ventilated and secure poison location. Prior to working with this chemical you should be trained on its proper handling and storage. Where possible, automatically transfer material from other storage containers to process containers. Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: Depending on formulation, the dry material may be classified as Environmentally hazardous substances, solid, n.o.s. It usually falls in Hazard Class 9.

Spill Handling: If a spill occurs, clean it up promptly. Don't wash it away. Instead, sprinkle the liquid spill with sawdust, vermiculite, or kitty litter. Sweep it into a plastic garbage bag, and dispose of it as directed on the pesticide product label. Wash all contaminated surfaces with a soap and water solution.

Fire Extinguishing: Hazardous decomposition includes oxides of nitrogen and carbon, hydrogen chloride and chlorine gases. As an immediate precautionary measure, isolate spill or leak area in all directions for at least 50 meters/150 feet for liquids and at least 25 meters/75 feet for solids. *Fire involving storage or vehicular tanks:* isolate for 800 meters/0.5 mile in all directions; also, consider initial evacuation for 800 meters/0.5 mile in all directions. *On a small fire:* use dry chemical, CO_2, water spray or regular foam. *On a large fire:* use water spray, fog or regular foam. Do not scatter spilled material with high-pressure streams of water. Move containers from fire area if you can do it without risk. Dike fire-control water for later disposal. *Fire involving tanks:* from a secure, explosion-proof location, use water spray to cool exposed containers. If cooling streams are ineffective (venting sound increases in volume and pitch, tank discolors, or shows any signs of deforming), withdraw immediately to a secure position. Always stay away from tanks engulfed in fire. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode.

Disposal Method Suggested: Containers must be disposed of properly by following package label directions or by contacting your local or federal environmental control agency, or by contacting your regional EPA office. Dissolve or mix the material with a combustible solvent and burn in a chemical incinerator equipped with an afterburner and scrubber. In accordance with ***[40CFR165]***, follow recommendations for the disposal of pesticides and pesticide containers.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- USEPA, Office of Pesticide Programs, Pesticide Residue Limits, "Fluroxypyr 1-methylheptyl Ester", 40 CFR 180.535. http://www.epa.gov/pesticides/food/viewtols.htm

Fluvalinate F:0398

Use Type: Insecticide

CAS Number: 69409-94-5; 102851-06-9 (*Tau*-τ)

Formula: $C_{26}H_{22}ClF_3N_2O_3$

Synonyms: AI3-29426; Caswell No. 934; *N*-2-Chloro-α,α,α-(trifluoro-*p*-tolyl)-*dl*-valinealpha-cyanophenoxybenzyl ester; *N*-(2-Chloro-4-(trifluoromethyl) phenyl-*dl*-valinecyano(3-phenoxylphenyl)methyl ester; *N*-[2-chloro-4-(trifluoromethyl)phenyl]-*dl*-valine(±)-cyano(3-phenoxylphenyl)methyl ester; (RS)-α-(Cyano-3-phenoxybenzyl *n*-(2-chloro-α,α,α-trifluoro-*p*-tolyl)-d-valinate; (RS)-α-Cyano-3-phenoxybenzyl (R)-2-[2-chloro-4-(trifluoromethyl)anilino]-3-methylbutanoate; Cyano(3-phenoxyphenyl)methyl*N*-[((2-chloro-4-trifluoromethyl) phenyl)]-d-valinate; *dl*-Valine,n-[2-chloro-4-(trifluoromethyl)phenyl]-cyano(3-phenoxylphenyl)methyl ester; D-Valine, *N*-(2-chloro-4-(trifluoromethyl)phenyl)-, cyano(3-phenoxyphenyl)methyl ester

Trade Names: APISTAN®; KARTAN®; KLARTAN®; MAVRIK®; MAVRIK AQUAFLOW®; SPUR®[C]; TAUFLUALINATE®; YARDER®; ZEOCON®; ZR 3210®

Chemical Class: Pyrethroid

EPA/OPP PC Code: 109302

California DPR Chemical Code: 2195

HSDB Number: 6659

UN/NA & ERG Number: UN3352 (liquid)/151; UN3082 (liquid)/171

RTECS® Number: YV9397100

Uses: Not listed for use in EU countries[115]. Some applications may be classified as a U.S. EPA restricted Use Pesticide (RUP). Used as a broad-spectrum insecticide to control moths, beetles and other pests on cereals, potatoes, fruit trees, vegetables, cotton, turf and ornamentals. It is used in Apistan® to control varroa mites in honey bees.

U.S. Maximum Allowable Residue Levels for Fluvalinate (40 CFR 180.427): Honey 0.05 ppm.

Human toxicity (long-term)[101]: Low–70.00 ppb, Health Advisory

Fish toxicity (threshold)[101]: Extra high–0.09863 ppb, MATC (Maximum Acceptable Toxicant Concentration)

Regulatory Authority and Advisory Information:
California Proposition 65 Chemical: Developmental/Reproductive toxin (11/6/1998)
Acute Oral Category: 3, CAUTION
Acceptable Daily Intake (ADI): EPA Oral reference dose (RfD) = 0.01 mg/kg
Health Advisory: Developmental/Reproductive Toxin, Skin irritant/sensitizer, Endocrine disruptor (S!)
EPCRA Section 313 Form R *de minimis* concentration reporting level: 1.0%

Description: Yellow to yellow-amber, viscous oil. Sweet, weak odor. Molecular weight = 502.92; Specific gravity (H_2O:1) = 1.30 @25 °C; Specific gravity (H_2O:1) = 1.29 @ 25 °C; Freezing/Melting point = 25 °C; Vapor pressure = 1×10^{-7} mmHg @ 25 °C. Henry's Law constant = 1.5×10^{-8} atm-m^3/mol @ 25 °C (est)[83]. Practically insoluble in water; solubility = 0.005 ppm @ 20–25 °C.

Incompatibilities: Corrosive to some metals. Keep away from strong oxidizers and alkaline materials. Decomposes in temperatures above 350 °C releasing toxic vapors of hydrogen chloride, nitrogen oxides, and hydrogen fluoride.

Permissible Exposure Limits in Air: NIOSH(2)
IDLH = 5,000 ppm
OSHA PEL: 5 mg/m^3 TWA
NIOSH REL: 5 mg/m^3 TWA
ACGIH TLV®[1]: 5 mg/m^3 TWA
STEL set by HSE(33) = 10 mg/m^3.

Determination in Air: Collection by impinger or fritted bubbler, analysis by gas-liquid chromatography/ultraviolet. See NIOSH IV, Method #5008[18]. (pyrethrum)

Permissible Concentration in Water: Acceptable Daily Intake (ADI) = 0.02 mg/kg as pyrethroid

Determination in Water: Collection by impinger or fritted bubbler, analysis by gas-liquid chromatography/ultraviolet. See NIOSH IV, Method #5008[18]. Log K_{ow} = >3.5. Values above 3.0 are likely to bioaccumulate in aquatic organisms.

Routes of Entry: Inhalation, absorbed through the skin.

Harmful Effects and Symptoms

Short Term Exposure: Pyrethrins can affect you when breathed in and by passing through your skin. Irritates the eyes and respiratory tract. High exposure can affect the nervous system, causing headache, nausea, vomiting, fatigue, and restlessness, rhinorrhea (discharge of thin nasal mucous). LD_{50} (oral, rat) = <300 mg/kg; LD_{50} (dermal, rat) = >2 g/kg.

Long Term Exposure: Fluorides may cause bone disease (pain and tenderness of the bones); mottled teeth in children. High or repeated exposure can cause lung allergy (with cough, wheezing and/or shortness of breath) or hay fever symptoms (sneezing, runny or stuffy nose). Allergic "pneumonia" can also occur with cough, chest pain, breathing difficulty and abnormal chest x-ray. Repeated attacks may lead to permanent scarring. Skin allergy may also develop with rash and itching, even with lower exposures. Dermal contact can cause rash with redness, blisters and intense itching. A severe generalized allergy can occur with weakness and collapse. May be a liver and kidney toxin.

Points of Attack: Respiratory system, skin, central nervous system, kidneys, liver, bones.

Medical Surveillance: Comprehensive physical examination with emphasis on the genito-urinary tract analysis to include sperm count, motility and morphology. Other tests, such as serum testosterone, serum follicle stimulating hormone (FSH), and serum lutenizing hormone (LH), may be carried out if, in the opinion of a physician, they are indicated. Before beginning employment and at regular times after that, the following are recommended: Employees should be screened for history of certain medical conditions which might place the employee at increased risk from pyrethroid exposure. Chronic respiratory disease: In persons with chronic respiratory disease, especially asthma, the inhalation of pyrethroids might cause exacerbation of symptoms due to their sensitizing properties. Lung function tests. These may be normal if the person is not having an attack at the time of the test. Consider chest x-ray if lung symptoms are present. Skin disease: Pyrethroids can cause dermatitis which may be allergic in nature. Persons with pre-existing skin disorders may be more susceptible to the effects of this agent. Evaluation by a qualified allergist, including exposure history and testing, may help diagnose allergy. Any employee developing the above-listed conditions should be referred for further medical examination[9].

First Aid: If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least 15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately. If this chemical contacts the skin, remove contaminated clothing and wash immediately with soap and water. Seek medical attention immediately. If this chemical has been inhaled, remove from exposure, begin rescue breathing (using universal precautions) if breathing has stopped, and CPR if heart action has stopped. Transfer promptly to a medical facility. When this chemical has been swallowed, get medical attention. *Do not induce vomiting when formulations containing petroleum solvents are ingested*. Otherwise, give large quantities of water and induce vomiting. Do not make an unconscious person vomit.

Personal Protective Methods: Applicators and other handlers must wear: Coveralls worn over long-sleeved shirt and long pants; Chemical-resistant gloves such as DuPont™ Tychem® suit fabrics, barrier laminate, or Viton®; Chemical-resistant footwear plus socks; Protective eye wear; Chemical-resistant headgear for overhead exposure; Chemical-resistant apron when cleaning equipment, mixing, or loading[83]. Agricultural Use/Engineering Controls: When handlers use closed systems, enclosed cabs, or aircraft in a manner that meets the requirements listed in the Worker Protection Standard (WPS) for agricultural pesticides, ***[40 CFR]*** 170.240(d)(4-6), the handler PPE requirements may be reduced or modified as specified in the Worker Protection Standard. Firefighters should wear NIOSH approved self-contained breathing apparatus and full protective clothing.

Respirator Selection: NIOSH/OSHA *for pyrethrum*: *50 mg/m^3:* CcrOv95 (APF = 10) [any air-purifying half-mask respirator equipped with an organic vapor cartridge(s) in combination with an N95, R95, or P95 filter. The following filters may also be used: N99, R99, P99, N100, R100, P100]; or Sa (APF = 10) (any supplied-air respirator). *125 mg/m^3:* Sa:Cf (APF = 25) (any supplied-air respirator operated in a continuous-flow mode); or PaprOvHie (APF = 25) (any air-purifying full facepiece respirator equipped with an organic vapor cartridge in combination with a high-efficiency particulate filter). *250 mg/m^3:* CcrFOv100 (APF = 50) [any air-purifying full facepiece respirator equipped with organic vapor cartridge(s) in combination with an N100, R100, or P100 filter]; or PaprTOvHie (APF = 50) [any powered, air-purifying respirator with a tight-fitting face-piece and organic vapor cartridge(s) in combination with a high-efficiency particulate filter]; or SCBAF (APF = 50) (any self-contained breathing apparatus with full facepiece); or SaF (APF = 50) (any supplied-air respirator with a full facepiece). *5000 mg/m^3:* SaF:Pd,Pp (APF = 2000) (any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode). *Emergency or planned entry into unknown concentrations or IDLH conditions:* SCBAF:Pd,Pp (APF = 10,000) (any self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode); or SaF:Pd,Pp:ASCBA (APF = 10,000) (any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary self-contained breathing apparatus operated in a pressure-demand or other positive-pressure mode). *Escape:* GmFOv100 (APF = 50) [any air-purifying, full facepiece respirator (gas mask) with a chin-style, front- or back-mounted organic vapor canister having an N100, R100, or P100 filter]; or SCBAE (any appropriate escape-type, self-contained breathing apparatus). *Note:* Substance reported to cause eye irritation or damage; may require eye protection.

Storage: Color Code-Blue: Health Hazard/Poison. Store in a secure poison location at temperature <35 °C and away from alkaline materials. Prior to working with this chemical you should be trained on its proper handling and storage. Store in tightly closed containers in a cool, well-ventilated area. Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: This material may be classified as Environmentally hazardous substances, liquid or solid, n.o.s. It usually falls in Hazard Class 9.

Spill Handling: First remove all sources of ignition. Evacuate persons not wearing protective equipment from area of spill or leak until clean up is complete. Ventilate area of spill or leak. Use water spray to reduce vapor. Absorb liquids in vermiculite, dry sand, earth, or a similar material and deposit in sealed containers. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable.

Fire Extinguishing: Heat of decomposition releases oxides of nitrogen, hydrogen chloride, and hydrogen fluoride gas. *On a small fire:* use dry chemical, CO_2 or water spray. *On a large fire:* use water spray, fog or regular foam. Move containers from fire area if you can do it without risk. Dike fire-control water for later disposal; do not scatter the material. Use water spray or fog; do not use straight streams. *Fire involving storage or vehicular tanks:* isolate for 800 meters/0.5 mile in all directions; also, consider initial evacuation for 800 meters/0.5 mile in all directions. Fight fire from maximum distance or use unmanned hose holders or monitor nozzles. Do not get water inside containers. Cool containers with flooding quantities of water until well after fire is out. Withdraw immediately in the case of rising sound from venting safety devices or discoloration of tank. ALWAYS stay away from tanks engulfed in fire. For massive fire, use unmanned hose holders or monitor nozzles; if this is impossible, withdraw from area and let fire burn. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies.

Disposal Method Suggested: Incineration would be an effective disposal procedure where permitted. If an efficient incinerator is not available, the product should be mixed with large amounts of combustible material and contact with the smoke should be avoided. In accordance with ***[40CFR165]***, follow recommendations for the disposal of pesticides and pesticide containers.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- EXTOXNET, Extension Toxicology Network, "Pesticide Information Profile, Fluvalinate," Oregon State University, Corvallis, OR (June 1996). http://extoxnet.orst.edu/pips/fluvalin.htm
- USEPA, Office of Pesticide Programs, Pesticide Residue Limits, "Fluvalinate," 40 CFR 180.427. http://www.epa.gov/pesticides/food/viewtols.htm

Fomesafen F:0399

Use Type: Herbicide

AS Number: 72178-02-0; 108731-70-0 (sodium salt)
Formula: $C_{15}H_{10}ClF_3N_2O_6S$
Synonyms: Benzamide, 5-[2-chloro-4-(trifluoromethyl)phenoxy]-*N*-(methylsulfonyl)-2-nitro-; 5-[2-Chloro-4-(trifluoromethyl)phenoxy]-*N*-methylsulfonyl)-2-nitrobenzamide; 5-(2-Chloro-0,α α-trifluoro-*p*-tolyloxy)-*N*-methylsulfonyl-2-nitrobenzamide; 5-[2-Chloro-4-(trifluoromethyl) phenoxy]-*N*-(methylsulphonyl)-2-nitrobenzamide
Trade Names: BAS 530 04®; FASTER®; FLEX®; FLEXSTAR; FOMESAFEN® SODIUM; PP 021®; REFLEX®; REFLEX® 2LC Herbicide (sodium salt); TORNADO®[C]; TWISTE®[C]; TYPHOON®
Chemical Class: Diphenyl ether; Chlorophenoxy
EPA/OPP PC Code: 123802 (sodium salt)
California DPR Chemical Code: 5083 (sodium salt)
HSDB Number: 6660
RTECS® Number: CV2475000
EC Number: 276-439-9 [*Annex I Index No.:* 604-040-00-5]
Uses: After July 25, 2003, flumesafen was not permitted in many countries to be used as an active ingredient on crops except to control weeds in soybean crops, and white, kidney and snap beans. Not approved for use in EU countries[115]. Registered for use in the U.S.
U.S. Maximum Allowable Residue Levels for Fomesafen sodium salt (40 CFR 180.433): bean, dry 0.05 ppm; bean, snap, succulent 0.05 ppm; cotton, gin byproducts 0.025 ppm; cotton, undelinted seed 0.025 ppm; pepper, bell 0.025 ppm; pepper, non-bell 0.025 ppm; potato 0.025 ppm; soybean 0.05 ppm; tomato 0.025 ppm.
Human toxicity (long-term)[101]: (sodium salt) High–1.75 ppb, Health Advisory
Fish toxicity (threshold)[101]: (sodium salt) Very low–69325.01943 ppb, MATC (Maximum Acceptable Toxicant Concentration)
Regulatory Authority and Advisory Information:
Carcinogenicity[83]: EPA Group C, Possible human carcinogen
Acute Oral Category: 3, CAUTION
AB 2588-Air Toxics "Hot Spots" Chemicals (CAL) as chlorophenoxy pesticides
Safe Drinking Water Act: Priority List (55 FR 1470)
EPCRA Section 313 Form R *de minimis* concentration reporting level: 1.0%
European/International Regulations: Hazard Symbol: Xn; risk phrases: R22; safety phrases: S2 (see Appendix 1)
Description: White crystalline solid or powder. Molecular weight = 438.76; Specific gravity (H_2O:1) = 1.29 @ 20 °C; Freezing/Melting point = 220 °C; Disassociation constant = pKa 2.827; Vapor pressure = 3.5×10^{-5} mmHg @ 25 °C; Henry's Law constant = 7.53×10^{-13} atm-m^3/mol @ 25 °C (est)[83]. Moderately soluble in water; solubility = 60 mg/L @25 °C.
Incompatibilities: Slowly hydrolyzes in water, releasing ammonia and forming acetate salts.
Determination in Water: EPA Method D3086. GC method with ECD for the determination of organochlorine pesticides in water and wastewater. Log K_{ow} = negative. Unlikely to bioaccumulate in marine organisms.
Routes of Entry: Inhalation, ingestion, absorbed through the skin.
Harmful Effects and Symptoms
Short Term Exposure: Poisonous; may be fatal if inhaled, swallowed, or absorbed through skin. Severely irritates eyes, skin and respiratory tract, with burning sensation, pain, redness and swelling. Metabolic stimulant. If inhaled, causes coughing, dilated pupils, headache, profuse perspiration, intense thirst, extreme fatigue, rapid pulse, high fever, clammy, flushed skin, rapid breathing, nausea, vomiting, cyanosis (bluish tint to skin and lips), anxiety and confusion, convulsions, risk of lung edema. If swallowed, face and lips turn bluish. Liver injury with associated jaundice, kidney failure, and cardiac arrhythmias are commonly noted. Nerve damage, which may be delayed, may include swelling of legs and feet, muscle twitch and stupor. Severe exposure can cause death from heart failure. Dust or liquid left in contact with the skin for several hours may be absorbed. This may result in severe delayed symptoms as listed above. These symptoms may last for months or years. LD_{50} (oral, rat) = 1–2 g/kg; LD_{50} (dermal, rat) = 1 g/kg.
Long Term Exposure: Fluorides may cause bone disease (pain and tenderness of the bones); mottled teeth in children. Workers exposed to chlorophenoxy compounds over a 5 to 10 year period at levels above 10 mg/m^3 complained of weakness, rapid fatigue, headache and vertigo. Liver damage, low blood pressure and slowed heartbeat were also found. Based on animal tests, may affects human reproduction.
Points of Attack: Eyes, skin, respiratory system, central nervous system, cardiovascular system, liver, kidney, bones.
Medical Surveillance: Preliminary medical exam to detect chronic diseases of central nervous system, liver, heart, kidneys, lung and skin, as well as endocrinological or immunological disturbances, should protect susceptible individuals. Periodical medical exams of internal organs, skin and eyes are important to avoid chronic occupational intoxications. They should include lab and patch tests when necessary[83]. This chemical is a suspected or known human carcinogen. Exposed persons should contact a physician for advice regarding the possible long term health effects and advice for medical monitoring. If symptoms develop or overexposure is suspected, the following may be useful: Liver and kidney function tests. Exam of the nervous system.
First Aid: If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least 15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately. If this chemical contacts the skin, remove contaminated clothing and wash immediately with soap and water. Seek medical attention immediately. If this chemical has been inhaled, remove from exposure, begin rescue breathing (using universal precautions) if breathing has stopped, and CPR if heart action has stopped. Transfer promptly to a medical facility. When

this chemical has been swallowed, get medical attention. *Do not induce vomiting when formulations containing petroleum solvents are ingested*. Otherwise, give large quantities of water and induce vomiting. Do not make an unconscious person vomit.

Personal Protective Methods: Wear protective gloves and clothing to prevent any reasonable probability of dermal and/or eye contact. Safety equipment suppliers/manufacturers can provide recommendations on the most protective glove/clothing material for your operation. DuPont™ Tychem® suit fabrics[88]. All protective clothing (suits, gloves, footwear, headgear) should be clean, available each day, and put on before work. Contact lenses should not be worn when working with this chemical. Wear dust-proof chemical goggles and face shield unless full facepiece respiratory protection is worn. Employees should wash immediately with soap when skin is wet or contaminated. Provide emergency showers and eyewash.

Respirator Selection: Where the neat (undiluted) test chemical is weighed and diluted, wear a NIOSH-approved half face respirator equipped with an organic vapor/acid gas cartridge (specific for organic vapors: Hydrogen chloride, acid gas and SO_2) with a dust/mist filter. Wherever and whenever workplace conditions warrant respirator use, a respiratory protection program must be followed that meets one or more of the following government standards: OSHA's 29 CFR 1910.134, ANSI Z88.2, or European Standard EN 149.

Storage: Color Code-Blue: Health Hazard/Poison. Store in a secure poison location. Prior to working with fomesafen you should be trained on its proper handling and storage. Before entering confined space where this chemical may be present, check to make sure that an explosive concentration does not exist. Store in tightly closed containers in a cool, well-ventilated area away from oxidizers and heat. Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: No information.

Spill Handling: For leaks or spills, use water spray to disperse vapor and to flush spills. Liquid containing this material should be absorbed in vermiculite, dry sand, earth. Do not touch spilled material; stop leak if you can do it without risk. Establish forced ventilation to keep levels below explosive limit. *Small dry spills*: collect powdered material in the most convenient and safe manner and deposit in sealed containers; move containers from spill area. *Large spills*: dike far ahead of spill for later disposal. Keep unnecessary people away; isolate hazard area and deny entry. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable.

Fire Extinguishing: Hazardous decomposition includes oxides of nitrogen, hydrogen chloride, and hydrogen fluoride gas. As an immediate precautionary measure, isolate spill or leak area in all directions for at least 50 meters/150 feet for liquids and at least 25 meters/75 feet for solids. *Fire involving storage or vehicular tanks:* isolate for 800 meters/0.5 mile in all directions; also, consider initial evacuation for 800 meters (0.5 mile) in all directions. *On a small fire:* use dry chemical, CO_2, water spray or regular foam. *On a large fire:* use water spray, fog or regular foam. Do not scatter spilled material with high-pressure streams of water. Move containers from fire area if you can do it without risk. Dike fire-control water for later disposal. *Fire involving tanks:* from a secure, explosion-proof location, use water spray to cool exposed containers. If cooling streams are ineffective (venting sound increases in volume and pitch, tank discolors, or shows any signs of deforming), withdraw immediately to a secure position. Always stay away from tanks engulfed in fire. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode.

Disposal Method Suggested: Do not discharge into drains or sewers. Dispose of waste material as a hazardous waste in a landfill approved and licensed for the disposal of pesticides. Consult with environmental regulatory agencies for guidance on acceptable disposal practices. Incineration with effluent gas scrubbing is recommended. Containers must be disposed of properly by following package label directions or by contacting your local or federal environmental control agency, or by contacting your regional EPA office.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- USEPA, Office of Pesticide Programs, Pesticide Residue Limits, "Fomesafen sodium salt", 40 CFR 180.433. http://www.epa.gov/pesticides/food/viewtols.htm

Fonofos F:0400

Use Type: Insecticide

CAS Number: 944-22-9

Formula: $C_{10}H_{15}OPS_2$; $C_6H_5SPS(OC_2H_5)C_2H_5$

Synonyms: ENT 25,796; *O*-Ethyl-*S*-phenyl ethylphosphono dithioate; *O*-Ethyl-*S*-phenyl(RS)-ethylphosphonodithioate; *O*-Ethyl-*S*-phenyl ethyldithio phosphonate; Phosphonodithioic acid, ethyl-*O*-ethyl, *S*-phenyl ester

Trade Names: CAPFOS®; CUDGEL®; DIFONATE®; DYFONATE®[C]; DYPHONATE®; DOUBLE DOWN®; STAUFFER-2790

Chemical Class: Organophosphate
EPA/OPP PC Code: 041701
California DPR Chemical Code: 254
HSDB Number: 1717
UN/NA & ERG Number: UN3018 (liquid)/152; UN2783 (solid)/152
RTECS® Number: TA5950000
EC Number: 213-408-0 [*Annex I Index No.:* 015-091-00-2]

Uses: It is a soil organophosphate insecticide primarily used on corn. It was also used on maize, cereals, sorghum, fruit, olives, potatoes, sugar cane, peanuts, tobacco, turf, and some vegetable crops. It controls aphids, corn borer, corn rootworm, corn wireworm, cutworms, white grubs, symphylins, and other soil pests including some maggots. It was available in granular, microgranular, emusifiable concentrate, suspension concentrate, microcapsule suspension, and seed treatment. Not registered for use in the U.S. or in EU countries[115]. There are 16 global suppliers[97].

Human toxicity (long-term)[101]: Intermediate–10.00 ppb, Health Advisory

Fish toxicity (threshold)[101]: High–3.50002 ppb, MATC (Maximum Acceptable Toxicant Concentration)

Regulatory Authority and Advisory Information:
Carcinogenicity[83]: EPA Group E, evidence of non-carcinogenicity for humans
Health Advisory: Nerve Toxin, Mutagen
Acute Oral Category: 1, DANGER–POISON
Potential Ground Water Pollutant [California FAC Section 13145(d)/12811, inactive)
U.S. DOT 49CFR172.101, Inhalation Hazard Chemical as organophosphates

Superfund/EPCRA 302 Extremely Hazardous Substances: TPQ = 500 lb (227 kg)
Superfund/EPCRA 40CFR302.4 RQ: EHS, 1 lb (0.454 kg)
U.S. DOT Regulated Marine Pollutant (49CFR172.101, Appendix B), severe pollutant
European/International Regulations: Hazard Symbol: T+, N; risk phrases: R27/28; R50/53; safety phrases: S1/2; S28; S36/37; S45; S60; S61 (see Appendix 1)

Description: Fonofos is a pale yellow liquid. Pungent, mercaptan-like odor. Commercial forms also include granules and emulsifiable concentrates. Some liquid formulations may be flammable depending on the carrier solvent used. Molecular weight = 246.34; Specific gravity (H_2O:1) = 1.16 @ 25 °C; Boiling point = 130 °C @ 0.1 mm[83]; Freezing/Melting point = 30 °C; Vapor pressure = 3.38×10^{-4} mmHg @ 25 °C[83,USDA]; Flash point = 94 °C (cc). Hazard Identification (based on NFPA-704 M Rating System): Health 4, Flammability 1, Reactivity 0. Practically insoluble in water. Physical and toxicological properties may be affected by carrier solvents in commercial formulations.

Incompatibilities: In the presence of strong reducing agents such as hydrides, organophosphates form highly toxic and flammable phosphine gas. Contact with oxidizers can cause the release of toxic oxides of phosphorus. Contact with strong acids or alkalies causes chemical to be hydrolyzed. May react with strong oxidizers such as chlorates, peroxides, nitrates, etc. Corrosive to steels.

Permissible Exposure Limits in Air: OSHA PEL: None. However, the vacated 1989 OSHA PEL 0.1 mg/m^3 TWA [skin] is currently enforced in some states.
NIOSH REL: 0.1 mg/m^3 TWA [skin]
ACGIH TLV®[1]: 0.01 mg/m^3 TWA inhalable fraction and vapor [skin]; not classifiable as a human carcinogen; BEI$_A$ issued for Acetylcholinesterase inhibiting pesticides
Protective Action Criteria (PAC) Ver. 27[89]
PAC-1: 0.012 mg/m^3
PAC-2: 1.3 mg/m^3
PAC-3: 53 mg/m^3

Determination in Air: OSHA versatile sampler-2; Toluene/Acetone; Gas chromatography/Flame photometric detection for sulfur, nitrogen, or phosphorus; NIOSH IV Method #5600, Organophosphorus pesticides[18].

Permissible Concentration in Water: Federal Drinking Water Guidelines: EPA 10 μg/L; State Drinking Water Guidelines: Maine 14 μg/L; Florida 14 μg/L.

Determination in Water: NIOSH Method 1657. The determination of organophosphorus pesticides in municipal and industrial wastewater by gas chromatography. Detection limit = 6.0 *n*g/L. Log K_{ow} = >3.5. Values at or above 3.0 are likely to bioaccumulate in marine organisms.

Routes of Entry: Inhalation, skin absorption, ingestion, skin and/or eye contact

Harmful Effects and Symptoms: Organophosphates are highly toxic. Symptoms may develop rapidly, or there may be a delay of several hours following exposure before they become noticeable. The delay tends to be longer in the case of some compounds that dissolve fats, lipids, oils and non-polar solvents such as toluene. Symptoms may increase in severity for more than a single day and last for several days. In severe cases of organophosphate intoxication, respiratory failure may occur.

Short Term Exposure: Symptoms include nausea, vomiting, abdominal cramps, diarrhea, excessive salivation, headache, giddiness, vertigo, sensation of tightness in chest, blurring of vision, ocular pain, loss of muscle coordination, slurring in speech, muscle twitching, drowsiness, excessive secretion of respiratory tract mucous, and convulsions. This material is cholinesterase inhibitor. It can cause severe symptoms and death from respiratory arrest. Exposure above the airborne exposure limit may result in death. The effects may be delayed. Delayed pulmonary edema may occur after inhalation. Medical observation is recommended. LD_{50} (oral, rat) = 3–24.5 mg/kg. Extremely toxic; LD_{50} (dermal, rat) = 147 mg/kg.

Long Term Exposure: Cholinesterase inhibitor; cumulative effect is possible. Fonofos may damage the nervous system with repeated exposure, resulting in convulsions, respiratory failure. May cause liver damage and be neutoxic.

Points of Attack: Respiratory system, central nervous system, cardiovascular system, blood cholinesterase.

Medical Surveillance: Medical observation is recommended for 24 to 48 hours following breathing overexposure, as pulmonary edema may be delayed. Routine biological monitoring of pesticide applicators and field workers includes testing of plasma and red blood cell acetylcholinesterase levels (for enzyme poisoned by this chemical). These tests are normally accurate only if done within about two hours of exposure. If exposure stops, plasma levels return to normal in 1–2 weeks while red blood cell levels may be reduced for 1–3 months. When acetylcholinesterase enzyme levels are reduced by 25% or more below preemployment levels, risk of poisoning is increased, even if results are in lower ranges of "normal." Reassignment to work not involving organophosphate pesticides is recommended until enzyme levels recover. Do not drink any alcoholic beverages before or during use as it promotes absorption of organophosphates.

First Aid: **Treatment for organophosphate poisoning consists of thorough decontamination, cardiorespiratory support, and administration of the antidotes atropine and pralidoxime. In cases of severe poisoning, diazepam, an anticonvulsant, should also be administered. Antidotes should be administered as prevention even if the diagnosis is in doubt**. Speed in removing material from eyes and skin is of extreme importance. *Eyes:* Eye contact can cause dangerous amounts of these chemicals to be quickly absorbed through the mucous membrane into the bloodstream. Immediately and gently flush eyes with plenty of warm or cold water (NO hot water) for at least 15 minutes, occasionally lifting the upper and lower eyelids. Get medical aid immediately. *Skin:* Get medical aid. Dermal contact can cause dangerous amounts of these chemicals to be absorbed into the bloodstream. Wearing the appropriate PPE equipment and respirator for organophosphate pesticides, immediately flush skin with plenty of soap and water for at least 15 minutes while removing contaminated clothing and shoes. Shampoo hair promptly if contaminated. The removed, contaminated clothing and shoes should be double-bagged and left in Hot Zone for later disposal by hazardous materials experts. Skin may also be decontaminated with diluted hypochlorite solution. *Inhalation:* Get medical aid. Do not contaminate yourself. Wearing the appropriate PPE equipment and respirator for organophosphate pesticides, immediately remove the victim from the contaminated area to fresh air. If the victim is not breathing, administer artificial respiration. Do not use mouth-to-mouth method if victim ingested or inhaled the substance; give artificial respiration with the aid of a pocket mask equipped with a one-way valve or other proper respiratory medical device. If breathing is difficult, administer oxygen through bag/mask apparatus until medical help arrives. Do not leave victim unattended. *Ingestion:* Call poison control. Loosen all clothing. Never give anything by mouth to an unconscious person. If victim is *unconscious or having convulsions,* do nothing except keep victim warm. Get medical aid. Transfer promptly to a medical facility. In cases of ingestion, **do not induce vomiting**. If the victim is alert and asymptomatic, administer a slurry of activated charcoal at a dose of 1 g/kg (infant, child, and adult dose). A soda can and straw may be of assistance when offering charcoal to a child. *In some cases you may be specifically instructed by poison control to induce vomiting by way of 2 tablespoons of syrup of ipecac (adult) washed down with a cup of water*. Do NOT give activated charcoal before or with ipecac syrup. *Note to physician or authorized medical personnel:* Treat cases of respiratory compromise, coma, or excessive pulmonary secretions with respiratory support using protocols and techniques available and within the scope of training. Some cases may necessitate procedures such as endotracheal intubation or cricothyrotomy by properly trained and equipped personnel. When possible, atropine (see *Antidotes*, below) should be given under medical supervision. Patients who are comatose, hypotensive, or having seizures or cardiac arrhythmias should be treated according to advanced life support protocols. *Antidotes:* Two antidotes are administered to treat organophosphate poisoning. Atropine is a competitive antagonist of acetylcholine at muscarinic receptors and is used to control the excessive bronchial secretions which are often responsible for death. Pralidoxime relieves both the nicotinic and muscarine effects of organophosphate poisoning by regenerating acetylcholinesterase and can reduce both the bronchial secretions and the muscle weakness associated with poisoning. The initial intravenous dose of atropine in adults should be determined by the severity of symptoms: An initial adult dose of 1.0 to 2.0 mg or pediatric dose of 0.01 mg/kg (minimum 0.01 mg) should be administered intravenously. If intravenous access cannot be established, atropine may also be given intramuscularly, subcutaneously or via endotracheal tube. Doses should be repeated every 15 minutes until excessive secretions and sweating have been controlled. Once bronchial secretion has been controlled, atropine administration should be repeated whenever the secretions begin to recur. In seriously poisoned patients, very large doses may be required. Alterations of pulse rate and pupillary size should not be used as indicators of treatment adequacy. Pralidoxime should be administered as early in poisoning as possible as its efficacy may diminish when given more than 24 to 36 hours after exposure. Doses are as follows: adult 1.0 g; pediatric 25 to 50 mg/kg. The drug should be administered intravenously over 30 to 60 minutes, but in a life-threatening situation one-half of the total dose can be given per minute for a total administration time of 2 minutes. Treatment should begin to take effect within 40 minutes with a reduction in symptoms and the amount of atropine necessary to control bronchial secretion. The initial dose can be repeated in 1 hour and then every 8 to 12 hours until the patient is clinically well and no longer requires atropine. If intravenous access cannot be established, pralidoxime may also be given intramuscularly. Early administration of diazepam in addition to the combined atropine and pralidoxime treatment may help prevent the onset of seizures and potential brain and cardiac morphologic damage following high-level organophosphate poisoning.

Personal Protective Methods: Wear protective gloves and clothing to prevent any reasonable probability of dermal and/or eye contact. Safety equipment suppliers/manufacturers can provide recommendations on the most protective glove/clothing material for your operation. One recommendation is the use of DuPont™ Tychem® suit fabrics[88]. All protective clothing (suits, gloves, footwear, headgear) should be clean, available each day, and put on before work. Contact lenses should not be worn when working with this chemical. Wear splash-proof chemical goggles and face shield unless full facepiece respiratory protection is worn. Employees should wash immediately with soap when skin is wet or contaminated. Provide emergency showers and eyewash.

Respirator Selection: SCBA >0.012 mg/m^3. Engineering controls should be used wherever feasible to maintain airborne concentrations of this chemical below the prescribed exposure limit. Respirators and protective equipment are less effective than engineering controls, and should be used only in non-routine or emergency situations which may result in exposure concentrations in excess of the TWA environmental limit. *At any concentrations above the NIOSH REL, or where there is no REL, at any detectable concentration:* SCBAF: Pd,Pp (APF = 10,000) (any NIOSH/MSHA- or European Standard EN 149-approved self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode); or SaF: Pd,Pp: ASCBA (APF = 10,000) (any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary, self-contained breathing apparatus operated in a pressure-demand or other positive-pressure mode).

Storage: Color Code-Blue: Health Hazard/Poison. Store in a secure poison location. Prior to working with this chemical you should be trained on its proper handling and storage. Where possible, automatically transfer material from other storage containers to process containers. Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: Organophosphorus pesticides, solid or liquid (nonflammable), require a "poisonous materials" label. This chemical falls in Hazard Class 6.1.

Spill Handling: First remove all sources of ignition. Evacuate persons not wearing protective equipment from area of spill or leak until clean up is complete. Stay upwind; keep out of low areas. Ventilate area of spill or leak. Remove and isolate contaminated clothing at the site. Do not touch spilled material; stop leak if you can do so without risk. Use water spray to reduce vapors. *Small spills:* absorb with sand or other noncombustible absorbent material and place into containers for later disposal. *Large spills:* dike far ahead of spill for later disposal. Collect powdered material in the most convenient and safe manner and deposit in sealed containers. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable. Seek professional environmental engineering assistance from the U.S. EPA Environmental Response Team at (908) 548-8730 (24-hour response line).

Fire Extinguishing: Hazardous decomposition includes oxides of phosphorus, sulfur, and nitrogen. May contain phosphine gas. May be fatal if inhaled, ingested or absorbed through skin. Inhalation or contact with some of these materials will irritate or burn skin and eyes. Vapors may cause dizziness or suffocation. *Small fires:* dry chemical, carbon dioxide; water spray; or foam. *Large fires:* water spray, fog, or foam. Stay upwind; keep out of low areas. Ventilate closed spaces before entering them. Firefighting gear (including SCBA) may not provide adequate protection. If exposure occurs, remove and isolate gear immediately and thoroughly decontaminate personnel. Wear positive-pressure breathing apparatus and special protective clothing. Remove and isolate contaminated clothing at the site. Move container from fire area if you can do so without risk. Fight fire from maximum distance. Dike fire-control water for later disposal; do not scatter the material. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies. From a secure, explosion-proof location, use water spray to cool exposed containers. If cooling streams are ineffective (venting sound increases in volume and pitch, tank discolors, or shows any signs of deforming), withdraw immediately to a secure position. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode.

Disposal Method Suggested: This phosphono compound is reported to be satisfactorily decomposed by hypochlorite. In accordance with ***[40CFR165]***, follow recommendations for the disposal of pesticides and pesticide containers. Containers must be disposed of properly by following package label directions or by contacting your local or federal environmental control agency, or by contacting your regional EPA office.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- EXTOXNET, Extension Toxicology Network, "Pesticide Information Profile, Fonofos," Oregon State University, Corvallis, OR (June 1996). http://extoxnet.orst.edu/pips/fonofos.htm
- New Jersey Department of Health and Senior Services, "Hazardous Substance Fact Sheet: Fonofos," Trenton,

NJ (August 1985, rev. April 1999). http://www.state.nj.us/health/eoh/rtkweb/0945.pdf

- USEPA, "Chemical Profile: Fonofos," Washington DC, Chemical Emergency Preparedness Program (November 30, 1987)
- Agency for Toxic Substances and Disease Registry, U.S. Department of Health and Human Services, Public Health Service, "Managing Hazardous Materials Incidents," Atlanta, GA (June 2003)
- USEPA, "Health Advisory: Fonofos," Washington DC, Office of Drinking Water (August 1987)

Foramsulfuron F:0403

Use Type: Herbicide
CAS Number: 173159-57-4
Formula: $C_{17}H_{20}N_6O_7S$
Synonyms: 2-[[[[(4,6-Dimethoxy-2-pyrimidinyl)amino]carbonyl]amino]sulfonyl]-4-(formylamino)-*N,N*-dimethylbenzamide; 1-(4,6-Dimethoxypyrimidin-2-yl)-3-[2-(dimethylcarbamoyl)-5-formamidophenylsulfonyl]urea
Trade Names: Bayer AE-F130360®
Chemical Class: Sulfonylurea; Pyrimidiny sulfonylurea
EPA/OPP PC Code: 122020
California DPR Chemical Code: 5851
HSDB Number: 7894
UN/NA & ERG Number: UN3077(solid)/171
RTECS® Number: Not found or assigned
EC Number: None assigned
Uses: Used on athletic fields and recreational areas, including golf courses (for turf), lawns, etc. Used on corn. An acetolactate syntheses inhibitor.
U.S. Maximum Allowable Residue Levels for the pesticide foramsulfuron [40 CFR 180.1219]: is exempted from the requirement of a tolerance in corn, field, grain/corn, field, forage/ corn, field, stover/corn, pop, grain/corn, pop, forage/corn, pop, stover; corn, sweet, forage; corn, sweet, kernel plus cob with husks removed; corn, sweet, stover when applied as a herbicide in accordance with good agricultural practices.
Regulatory Authority and Advisory Information:
Carcinogenicity[83]: U.S. EPA considers the sulfonylureas not classifiable *with the exception of* sulfosulfuron (141776-32-1), a likely human carcinogen, and triflusulfuron-methyl (126535-15-7) a Possible human carcinogen[96].
Acute Oral Category: 4, Caution
European/International Regulations: Hazard Symbol: Xn, Xi, N; risk phrases: R38; R50/53; R65; safety phrases: S2; (see Appendix 1)
Description: Light beige, brownish-yellow solid. Weak, aromatic odor. Molecular weight = 452.44; Specific gravity (H_2O:1) = 1.44 @ 20°C; Boiling point = (decomposes); Freezing/Melting point = 199.6°C
Vapor pressure = 3 × 10^{-13} mmHg @ 20°C; Henry's Law constant = 5.68 0 10^{-17} atm-m^3/mol @ 25°C (est)[83].
Highly soluble in water.
Incompatibilities: Dust may form explosive mixture with air. May react with strong oxidizers such as chlorates, peroxides, nitrates, etc.
Permissible Concentration in Water: Runoff from spills or fire control may cause water pollution.
Determination in Water: Log K_{ow} = –0.78. Unlikely to bioaccumulate in marine organisms.
Routes of Entry: Inhalation of dust and dermal and/or eye contact.
Harmful Effects and Symptoms: Human health effects from the sulfonylurea herbicides at low environmental doses or at biomonitored levels from low environmental exposures are unknown. The sulfonylurea herbicides are generally of low toxicity in mammalian studies. Animal studies showed low acute toxicity and little chronic, reproductive, or developmental toxicity or teratogenic effects. Developmental or teratogenic effects tended only to occur at high or maternally toxic doses. At high sublethal, chronic oral doses, such nonspecific effects as weight loss and anemia were observed. Some chemical-specific effects were noted at high doses in animals[96].
Short Term Exposure: May cause irritation of the skin, eyes and respiratory tract. LD_{50} (oral, rat) = >5 g/kg; LD_{50} (dermal, rat) = >2 g/kg.
Long Term Exposure: Prolonged or frequently repeated skin contact may cause allergic reaction in some individuals.
Points of Attack: Skin.
Medical Surveillance: Evaluation by a qualified allergist, including exposure history and testing, may help diagnose allergy.
First Aid: If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least 15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately. If this chemical contacts the skin, remove contaminated clothing and wash immediately with soap and water. Seek medical attention immediately. If this chemical has been inhaled, remove from exposure, begin rescue breathing (using universal precautions) if breathing has stopped, and CPR if heart action has stopped. Transfer promptly to a medical facility. When this chemical has been swallowed, get medical attention. Give large quantities of water or milk and induce vomiting. Do not make an unconscious person vomit.
Personal Protective Methods: Applicators and other handlers must wear: Coveralls worn over long-sleeved shirt and long pants; Chemical-resistant gloves such as DuPont™ Tychem® suit fabrics, barrier laminate, or Viton®; Chemical-resistant footwear plus socks; Protective eye wear; Chemical-resistant headgear for overhead exposure; Chemical-resistant apron when cleaning equipment, mixing, or loading[83]. Agricultural Use/Engineering Controls: When handlers use closed systems, enclosed cabs, or aircraft in a manner that meets the requirements listed in the Worker Protection Standard (WPS) for agricultural pesticides, ***[40 CFR]*** 170.240(d)(4-6), the handler PPE requirements may be reduced or modified as specified in the Worker Protection Standard. Firefighters should wear NIOSH approved self-contained breathing apparatus and full protective clothing.

Respirator Selection: Specific respirator(s) have not been recommended by NIOSH. However, based on potential carcinogenicity, and where the potential exists for exposure, the following might be considered: *At any detectable concentration:* SCBAF: Pd,Pp (APF = 10,000) (any MSHA/NIOSH/MSHA- or European Standard EN 149-approved self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode); or SaF: Pd,Pp: ASCBA (APF = 10,000) (any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary, self-contained breathing apparatus operated in a pressure-demand or other positive-pressure mode). *Escape:* 100F (APF = 50) (any air-purifying, full facepiece respirator with an N100, R100, or P100 filter) or SCBAE (any appropriate escape-type, self-contained breathing apparatus).

Storage: Color Code-Blue: Health Hazard/Poison. Store in a secure poison location. Store in a refrigerator and protect from exposure to oxidizers or moisture[52]. A regulated, marked area should be established where this chemical is handled, used, or stored in compliance with OSHA Standard 1910.1045. Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: This material may be classified as Environmentally hazardous substances, solid, n. o. s. It usually falls in Hazard Class 9.

Spill Handling: Evacuate and restrict persons not wearing protective equipment from area of spill or leak until clean up is complete. Dampen spilled material with alcohol to avoid dust. Collect powdered material in the most convenient and safe manner and deposit in sealed containers. Ventilate area of spill or leak after clean up is complete. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable.

Fire Extinguishing: Hazardous decomposition includes oxides of nitrogen sulfur and carbon. As an immediate precautionary measure, isolate spill or leak area in all directions for at least 50 meters/150 feet for liquids and at least 25 meters/75 feet for solids. *Fire involving storage or vehicular tanks:* isolate for 800 meters/0.5 mile in all directions; also, consider initial evacuation for 800 meters/0.5 mile in all directions. *On a small fire:* use dry chemical, CO_2, water spray or regular foam. *On a large fire:* use water spray, fog or regular foam. Do not scatter spilled material with high-pressure streams of water. Move containers from fire area if you can do it without risk. Dike fire-control water for later disposal. *Fire involving tanks:* from a secure, explosion-proof location, use water spray to cool exposed containers. If cooling streams are ineffective (venting sound increases in volume and pitch, tank discolors, or shows any signs of deforming), withdraw immediately to a secure position. Always stay away from tanks engulfed in fire. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode.

Disposal Method Suggested: Do not discharge into drains or sewers. Dispose of waste material as hazardous waste using a licensed disposal contractor to an approved landfill. Consult with environmental regulatory agencies for guidance on acceptable disposal practices. Incineration would be an effective disposal procedure where permitted. If an efficient incinerator is not available, the product should be mixed with large amounts of combustible material and contact with the smoke should be avoided. In accordance with ***[40CFR165]***, follow recommendations for the disposal of pesticides and pesticide containers. Containers must be disposed of properly by following package label directions or by contacting your local or federal environmental control agency, or by contacting your regional EPA office.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- United States National Library of Medicine, *ChemIDplus Advanced*, Bethesda, MD. http://chem.sis.nlm.nih.gov/chemidplus/rn/173159-57-4

Forchlorfenuron F:0405

Use Type: Plant growth regulator

CAS Number: 68157-60-8

Formula: $C_{12}H_{10}ClN_3O$

Synonyms: *N*-(2-Chloro-4-pyridinyl)-*N*'-phenylurea; 1-(2-Chloro-4-pyridyl)-3-phenylurea; CPPU; *N*-Phenyl-*N*'-(2-chloro-4-pyridyl)urea; Urea, *N*-(2-chloro-4-pyridinyl)-*N*'-phenyl-

Trade Names: CN-11-3183; KT-30®; SKW 20010

Chemical Class: Phenylurea

EPA/OPP PC Code: 128819

California DPR Chemical Code: 5557

HSDB Number: 7983

UN/NA & ERG Number: UN2767 (Phenyl urea pesticides, solid, toxic)/151; UN3077(solid)/171

RTECS® Number: YS7182500

EC Number: [*Annex I Index No.:* 613-254-00-8]

Uses: Forchlorfenuron is as a plant growth regulator widely used in agriculture on fruits to increase their size, to promote cell division, and to improve the quality and the yield of fruits, especially table grapes, grape raisins, and kiwi fruit. In some parts of California, forchlorfenuron is said to double the size of Thompson seedless grapes and delay crop maturity up to several weeks.

U.S. Maximum Allowable Residue Levels for Forchlorfenuron [40 CFR 180.569 (a) (1)]: bushberry subgroup 13-07B, 0.01 ppm; grape 0.03 ppm; grape, raisin 0.06 ppm; kiwifruit 0.04 ppm. ***[40 CFR 180.569 (a) (2)]***: The following food commodities were cancelled or revoked on 12/31/2011: almond 0.01 ppm; almond, hulls 0.15 ppm; cherry, sweet 0.01 ppm; fig 0.01 ppm; pear 0.01 ppm; pistachio 0.01 ppm; plum, prune, fresh 0.01 ppm.

Regulatory Authority and Advisory Information:

Carcinogenicity: GHS Category 2: Suspected human carcinogen

EPA Acute reference dose (ARfD) = 0.1 mg/kg/day

European/International Regulations: Hazard Symbol: Xn, N; risk phrases: R40; R51/R53; safety phrases: S2; S36/37; S46; S61 (see Appendix 1)

WGK (German Aquatic Hazard Class): 3-Severe hazard to waters

Description: White to faint yellow crystalline powder. Molecular weight = 247.69; Specific gravity (H_2O:1) = 1.415 @ 25 °C; Freezing/Melting point = 170–172 °C; Vapor pressure = very low, 4×10^{-10} mmHg @ 25 °C; Flash point = >200 °C (cc). Low solubility in water.

Incompatibilities: May react with strong oxidizers such as chlorates, peroxides, nitrates, etc. Dust may form explosive mixture with air.

Determination in Water: Log K_{ow} = >3.0. Values above 3.0 are likely to bioaccumulate in aquatic organisms.

Routes of Entry: Inhalation, dermal contact, ingestion.

Harmful Effects and Symptoms

Short Term Exposure: Contact with eyes or skin may cause irritation or injury. Inhalation can cause irritation of the lungs and respiratory tract. May be harmful if swallowed. Dermal contact may cause severe irritation or burns. LD_{50} (oral, rat) = 4904 mg/kg[83]; LD_{50} (dermal, rat) = >2 g/kg.

Long Term Exposure: Fluorides may cause bone disease (pain and tenderness of the bones); mottled teeth in children. May cause emphysema, weight loss.

Points of Attack: Respiratory system, bones.

Medical Surveillance: This chemical is a suspected or known human carcinogen. Exposed persons should contact a physician for advice regarding the possible long term health effects and potential recommendation for medical monitoring. Recommendations from the physician may depend upon the specific compound, its chemical, physical and toxicity properties, the exposure level, length of exposure, and the route of exposure. Lung function tests.

First Aid: If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least 15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately. If this chemical contacts the skin, remove contaminated clothing and wash immediately with soap and water. Seek medical attention immediately. If this chemical has been inhaled, remove from exposure, begin rescue breathing (using universal precautions) if breathing has stopped, and CPR if heart action has stopped. Transfer promptly to a medical facility. When this chemical has been swallowed, get medical attention. Give large quantities of water. Do not induce vomiting when formulations containing petroleum solvents are ingested. Do not make an unconscious person vomit.

Personal Protective Methods: Safety equipment suppliers/manufacturers can provide recommendations on the most protective glove/clothing material for your operation. All protective clothing (suits, gloves, footwear, headgear) should be clean, available each day, and put on before work. Contact lenses should not be worn when working with this chemical. Wear dust-proof chemical goggles and face shield unless full facepiece respiratory protection is worn. Employees should wash immediately with soap when skin is wet or contaminated. Provide emergency showers and eyewash.

Respirator Selection: *At concentrations above the NIOSH REL, or where there is no REL, at any detectable concentration:* SCBAF:Pd,Pp (APF = 10,000): (any self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode); or SaF:Pd,Pp:ASCBA (APF = 10,000) (any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary self-contained positive-pressure breathing apparatus). *Escape*: GmFOv100 (APF = 50) [any air-purifying, full facepiece respirator (gas mask) with a chin-style, front- or back-mounted organic vapor canister having an N100, R100, or P100 filter]; or SCBAE (any appropriate escape-type, self-contained breathing apparatus).

Storage: Color Code-Blue: Health Hazard/Poison. Store in a secure poison location. Prior to working with this chemical you should be trained on its proper handling and storage. Store in a refrigerator or a cool, dry place and protect from exposure to ultraviolet light. Keep liquid away from oxidizers. Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: Phenyl urea pesticides, solid, toxic, require a label of "poisonous materials." Hazard Class 6.1.

Spill Handling: *Dry material:* First remove all sources of ignition. Evacuate persons not wearing protective equipment from area of spill or leak until clean up is complete. Dampen spilled material with 60–70% acetone and avoid airborne dust. Collect powdered material in the most convenient and safe manner and deposit in sealed containers. Ventilate area after clean up is complete. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA

1910.120(q) may be applicable. *Liquid:* Evacuate and restrict persons not wearing protective equipment from area of spill or leak until clean up is complete. Ventilate area of spill or leak. Absorb liquids in vermiculite, dry sand, earth, peat, carbon, or a similar material and deposit in sealed containers. Oil-skimming equipment may be used to remove slicks from water. Keep this chemical out of a confined space, such as a sewer, because of the possibility of an explosion, unless the sewer is designed to prevent the build-up of explosive concentrations. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable.

Fire Extinguishing: Hazardous decomposition includes hydrogen fluoride and nitrogen oxides. As an immediate precautionary measure, isolate spill or leak area in all directions for at least 50 meters/150 feet for liquids and at least 25 meters/75 feet for solids. *Fire involving storage or vehicular tanks:* isolate for 800 meters/0.5 mile in all directions; also, consider initial evacuation for 800 meters/0.5 mile in all directions. *On a small fire:* use dry chemical, CO_2, water spray or regular foam. *On a large fire:* use water spray, fog or regular foam. Do not scatter spilled material with high-pressure streams of water. Move containers from fire area if you can do it without risk. Dike fire-control water for later disposal. *Fire involving tanks:* from a secure, explosion-proof location, use water spray to cool exposed containers. If cooling streams are ineffective (venting sound increases in volume and pitch, tank discolors, or shows any signs of deforming), withdraw immediately to a secure position. Always stay away from tanks engulfed in fire. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode.

Disposal Method Suggested: Containers must be disposed of properly by following package label directions or by contacting your local or federal environmental control agency, or by contacting your regional EPA office. If this material cannot be disposed of according to label instructions, it may be dissolved or mixed with a combustible solvent and burned in a chemical incinerator equipped with an afterburner and scrubber. In accordance with ***[40CFR165]***, follow recommendations for the disposal of pesticides and pesticide containers.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- USEPA, Office of Pesticide Programs, Pesticide Residue Limits, "Forchlorfenuron", 40 CFR 180.569. http://www.epa.gov/pesticides/food/viewtols.htm

Formaldehyde F:0410

Use Type: Microbiocide, Fungicide, Bactericide; Soil sterilent

CAS Number: 50-00-0

Formula: CH_2O; HCHO

Synonyms: BFV; FA; Formaldehido (Spanish); Formalin; Formalin 40; Formalina (Spanish); Formalin-loesungen (German); Formic aldehyde; Methanal; Methyl aldehyde; Methylene glycol; Methylene oxide; NCI-C02799; Oxomethane; Oxymethylene; Polyoxymethylene glycols; Tetraoxymethylene; Trioxane

Trade Names: DYNOFORM®; FANNOFORM®; FORMALITH®; FORMOL®; FYDE®; HERCULES 37M6-8®; HOCH®; IVALON®; KARSAN®; LYSOFORM®; MAGNIFLOC 156C FLOCCULANT®; MORBICID®; STERIFORM®; SUPERLYSOFORM®

Chemical Class: Unclassified

EPA/OPP PC Code: 043001

California DPR Chemical Code: 295

HSDB Number: 164

UN/NA & ERG Number: UN1198 (flammable solutions)/132

RTECS® Number: LP8925000

EC Number: 200-001-8 [*Annex I Index No.:* 605-001-00-5]

Uses: Registered for use in the U.S. Not approved for use in EU countries[115]. Formaldehyde has found wide industrial usage as a fungicide, germicide and in disinfectants. It is used most often in an aqueous solution stabilized with methanol (formalin). It is also a pesticide intermediate.

U.S. Maximum Allowable Residue Levels for Formaldehyde [40 CFR 180.180.1001 (d)]: not more than 1% of pesticide formulation is exempted from the requirement of a tolerance when used as a preservative for formulation in accordance with good agricultural practice as inert (or occasionally active) ingredients in pesticide formulations applied to growing crops only.

Human toxicity (long-term)[101]: 26,923 ppb, CHCL (Chronic Human Carcinogen Level)

Fish toxicity (threshold)[101]: 184 ppb, MATC (Maximum Acceptable Toxicant Concentration).

Regulatory Authority and Advisory Information:

Carcinogenicity[83]: EPA Group B1, Probable carcinogen; NTP: 12th Report on Carcinogens, 2011: Known to be a human carcinogen; EU GHS Category 2: Suspected human carcinogen IARC: Group I, carcinogenic to humans; ACGIH A2 Suspected human carcinogen.

California Proposition 65 Chemical: Cancer (10/1/1993).

OSHA, 29CFR1910 Specifically Regulated Chemicals (See CFR 1910.1048)

Health Advisory: Tumorigen, Mutagen, Reproductive Toxin, Skin irritant/sensitizer

Clean Air Act: Hazardous Air Pollutants (Title I, Part A, Section 112); Accidental Release Prevention/Flammable substances, (Section 112[r], Table 3), TQ = 15,000 lb (6810 kg)

OSHA 29CFR1910.119, Appendix A. Process Safety List of Highly Hazardous Chemicals, TQ = 1000 lb (450 kg)

Clean Water Act: Section 311 Hazardous Substances/RQ 40CFR117.3 (same as CERCLA, see below); Section 313 Water Priority Chemicals (57FR41331, 9/9/92)

EPA Hazardous Waste Number (RCRA No.): U122

Superfund/EPCRA 302 Extremely Hazardous Substances: TPQ = 500 lb (227 kg)

Superfund/EPCRA 40CFR302.4 RQ: CERCLA, 100 lb (45.4 kg)

EPCRA Section 313 Form R *de minimus* concentration reporting level: 0.1%

European/International Regulations: Hazard Symbol: T; risk phrases: 23/24/25; R34; R40; R43; safety phrases: S1/2; S26; S36/37/39; S45; S51 (see Appendix 1)

WGK (German Aquatic Hazard Class): 2-Hazard to waters

Description: Formaldehyde is a colorless, pungent gas. The Odor Threshold is 0.8 ppm[41]. Formalin is an aqueous solution that is 37% formaldehyde by weight; inhibited solutions (added to prevent polymerization) usually contain 6–12% methyl alcohol. Molecular weight = 30.03; Specific gravity (H_2O:1) = 0.815 @ –20 °C; (formalin) 1.08 @ 25 °C; Boiling point (gas) = –19.1 °C; (commercial 37% solution) = 101 °C; Freezing /Melting point = –92.2 °C; –116.5 °C; Relative vapor density (air = 1) = 1.04; Vapor pressure = >1 atm; Flash point = Flammable gas; (formalin) 85 °C; (commercial 37% solution, 15% methanol) 50 °C; Autoignition temperature = 430 °C. Explosive limits (gas): LEL = 7.0% (20,950 ppm); UEL = 73.0%. NFPA 704 M Hazard Identification (gas): Health 3, Flammability 4, Reactivity 0; (37% solution, 15% methanol): Health 3, Flammability 2, Reactivity 2. Good solubility in water.

Incompatibilities: Pure formaldehyde may polymerize unless properly inhibited (usually with methanol). Forms explosive mixture with air. Incompatible with strong acids, amines, strong oxidizers, alkaline materials, nitrogen dioxide, performic acid, phenols,urea. Reaction with hydrochloric acid forms bis-chloromethyl ether, a carcinogen. Formalin is incompatible with strong oxidizers, alkalis, acids, phenols, urea, oxides, isocyanates, caustics, anhydrides. Liquid formaldehyde is corrosive to some steels.

Permissible Exposure Limits in Air: NIOSH(2) IDLH level = [Ca] 20 ppm. For sensitized persons, odor is not an adequate indicator of formaldehyde's presence and may not provide reliable warning of hazardous concentrations. (Nitriles) 2 ppm, Ceiling Concentration, not to be exceeded in any 15-minute work period.

AIHA WEEL: Worker exposure by all routes should be minimalized to the fullest extent possible

Protective Action Criteria (PAC) Ver. 27[89]

PAC-1: **0.9** ppm
PAC-2: **14** ppm
PAC-3: **56** ppm

*AEGLs (Acute Emergency Guideline Levels) and ERPGs (Emergency Response Planning Guideline) are in **bold face**.

DFG MAK:[skin] Carcinogen Category 2

Determination in Air: Collection with Si gel cartridge coated with DNPH; Workup with acetonitrile; analysis with high-pressure liquid chromatography/ultraviolet detection; NIOSH IV, Method #2016[18]. See also Method(s) #2541, #3500. See NIOSH Criteria Document 78-212 NITRILES.[18].

Permissible Concentration in Water: Federal Drinking Water Guidelines: 100 ppb[93]; EPA Health Advisory: 1000 μg/L; State Drinking Water Guidelines: California 100 μg/L; Maine 140 μg/L; Florida 600 μg/L; Minnesota 1000 μg/L; New Hampshire 100 μg/L; New Jersey 100 μg/L

Determination in Water: Log K_{ow} = <1.0. Unlikely to bioaccumulate in marine organisms.

Routes of Entry: Inhalation, ingestion, skin and/or eye contact.

Harmful Effects and Symptoms

Short Term Exposure: Formaldehyde is a highly toxic systemic poison that is absorbed well by inhalation. The vapor is a severe respiratory tract and skin irritant and may cause dizziness or suffocation. Contact with formaldehyde solution may cause severe burns to the eyes and skin. Inhalation of vapors can produce narrowing of the bronchi (tracheobronchitis) and possible spasms with an accumulation of fluid in the lungs. This can cause death. Children may be more susceptible than adults to the respiratory effects of formaldehyde. Formaldehyde solution (formalin) causes corrosive injury to the gastrointestinal tract, especially the pharynx, epiglottis, esophagus, and stomach. The systemic effects of formaldehyde are due primarily to its metabolic conversion to formate, and may include metabolic acidosis, circulatory shock, respiratory insufficiency, and acute renal failure. Formaldehyde is a potent sensitizer and a probable human carcinogen. Acute exposure to formaldehyde may result in burns to the skin, eyes, and mucous membranes; lacrimation (tearing); nausea; vomiting (may be bloody); abdominal pain; and diarrhea. Difficulty in breathing, cough, pneumonia, and pulmonary edema may occur. Sensitized people may experience asthmatic reactions, even when exposed briefly. Hypotension (low blood pressure) and hypothermia (reduced body temperature) may precede cardiovascular collapse. Lethargy, dizziness, convulsions, and coma may be noted. Nephritis (inflammation of the kidneys), hematuria (bloody urine), and liver toxicity have been reported. Exposure at concentrations well above the PEL may cause death. The effects may be delayed

Note: There is considerable individual variation in sensitivity to formaldehyde. *Inhalation:* Irritation of the nose and throat can occur after an exposure of 0.25 ppm to 0.45 ppm. Levels between 0.4 ppm and 0.8 ppm can give rise to coughing and wheezing, tightness of the chest and shortness of breath. Sudden exposures to concentrations of 4 ppm may lead to irritation of lung and throat severe enough to give rise to bronchitis and laryngitis. Breathing may be impaired at levels above 100 ppm and serious lung damage may occur at 50 ppm. *Skin:* Direct contact with the liquid can lead to irritation, itching, burning and drying. It is also possible to develop an allergic reaction to the compound following exposure by any route. *Eyes:* Exposure to airborne levels of formaldehyde of 0.4 ppm have brought on tearing and irritation. Small amounts of liquid splashed in the eye can cause damage to the cornea. Eye irritation was reported at levels between 0.05 and 2.0 ppm. *Ingestion:* As little as 1 liquid ounce has resulted in death to humans. Smaller amounts can damage the throat, stomach and intestine, resulting in nausea, vomiting, abdominal pain and diarrhea. Accidental exposure may also cause loss of consciousness, lowered blood pressure, kidney damage and, if the person is pregnant, the possibility of the fetus being aborted. LD_{50} (oral, rat) = 500–800 mg/kg; LD_{50} (dermal, rat) = 270 mg/kg.

Long Term Exposure: The major concerns of repeated formaldehyde exposure are sensitization and cancer. In sensitized persons, formaldehyde can cause asthma and contact dermatitis. In persons who are not sensitized, prolonged inhalation of formaldehyde at low levels is unlikely to result in chronic pulmonary injury. Adverse effects on the central nervous system such as increased prevalence of headache, depression, mood changes, insomnia, irritability, attention deficit, and impairment of dexterity, memory, and equilibrium have been reported to result from long-term exposure. Inhalation can result in respiratory congestion with associated coughing and shortness of breath. Repeated dermal contact can lead to drying and scaling. Some individuals may experience allergic reactions after initial contact with the chemical. Subsequent contact may cause skin rashes and asthma and reactions may become more severe if exposure persists. Chronic exposure may be more serious for children because of their potential longer latency period. *Carcinogenicity[83]:* The Department of Health and Human Services has determined that formaldehyde may reasonably be anticipated to be a carcinogen. In humans, formaldehyde exposure has been weakly associated with increased risk of nasal cancer and nasal tumors were observed in rats chronically inhaling formaldehyde. *Reproductive and developmental effects:* There is limited evidence that formaldehyde causes adverse reproductive effects. The TERIS database states that the risk of developmental defects to the exposed fetus ranges from none to minimal. There have been reports of menstrual disorders in women occupationally exposed to formaldehyde, but they are controversial. Studies in experimental animals have reported some effects on spermatogenesis. Formaldehyde has not been proven to be teratogenic in animals and is probably not a human teratogen at occupationally permissible levels. Formaldehyde has been shown to have genotoxic properties in human and laboratory animal studies producing sister chromatid exchange and chromosomal aberrations. Special consideration regarding the exposure of pregnant women is warranted, since formaldehyde has been shown to be a genotoxin; thus, medical counseling is recommended for the acutely exposed pregnant woman. Genetic damage from exposure has been shown in bacteria and some insects. May cause skin sensitization.

Points of Attack: Skin, eyes and respiratory system. Cancer site: nasal cancer.

Medical Surveillance: This chemical is a suspected or known human carcinogen. Exposed persons should contact a physician for advice regarding the possible long term health effects and advice for medical monitoring. Routine laboratory studies for all exposed patients include CBC, glucose, and electrolyte determinations. Additional studies for patients exposed to formaldehyde include urinalysis (protein, casts, and red blood cells may be present), methanol level, osmolal gap, and ABG measurements (to monitor acidosis in severe toxicity). Chest radiography and pulse oximetry may be helpful in cases of inhalation exposure. Plasma formaldehyde levels are not useful. Evaluation by a qualified allergist, including exposure history and testing, may help diagnose allergy.

First Aid: Flush liquid-exposed skin and hair with plain water for 3 to 5 minutes. Wash area thoroughly with soap and water when possible. Use caution to avoid hypothermia when decontaminating children or the elderly. Use blankets or warmers when appropriate. Irrigate exposed or irritated eyes with plain water or saline for 15 minutes. Remove contact lenses if easily removable without additional trauma to the eye. If pain or injury is evident, continue eye irrigation while transferring the victim to the Support Zone. Victims who are conscious and able to swallow should be given 4 to 8 ounces of water or milk. Gastric lavage with a small-bore nasogastric (NG) tube should be considered if it can be performed within 1 hour after ingestion. The effectiveness of activated charcoal administration is unknown, but it is suggested following lavage (administer activated charcoal at 1 gm/kg, usual adult dose 60–90 g, child dose 25–50 g). A soda can and straw may be of assistance when offering charcoal to a child. *Note to physician or authorized medical personnel:* There is no antidote for formaldehyde. Treat patients who have metabolic acidosis with sodium bicarbonate (adult dose = 1 ampule; pediatric dose = 1 Eq/kg). Further correction of acidosis should be guided by ABG measurements. Hemodialysis is effective in removing formic acid (formate) and methanol and in correcting severe metabolic acidosis. If methanol poisoning from ingestion of formalin is suspected, as indicated by a serum methanol level of greater than 20 mg/dL or elevated osmolal gap, start ethanol infusion. With 10% ethanol, the loading dose is 7.5 mL/kg body weight; maintenance dose is 1.0 to 1.5 mL/kg/hour; and maintenance dose during hemodialysis is 1.5 to 2.5 mL/kg/hour. In this setting, the target blood level of ethanol is 0.1 mg/dL. Evaluation by a qualified allergist, including exposure history and testing, may help diagnose allergy.

Personal Protective Methods: Prevention of intoxication may be easily accomplished by supplying adequate ventilation and protective clothing. Barrier creams may also be helpful. Wear protective gloves and clothing to prevent any reasonable probability of dermal and/or eye contact. Formalin (as formaldehyde): Prevent dermal and/or eye contact. **8 hr:** butyl rubber (gloves, suits, boots), nitrile rubber (gloves, suits, boots), Viton™ (gloves, suits), Saranex™ coated suits, Barricade™ coated suits; CPF3™ suits; **4 hr:** Teflon™ (gloves, suits, boots), 4H™ and Silver Shield™ gloves, Responder™ suits. Safety equipment suppliers/manufacturers can provide recommendations on the most protective glove/clothing material for your operation. All protective clothing (suits, gloves, footwear, headgear) should be clean, available each day, and put on before work. Contact lenses should not be worn when working with this chemical. Wear splash-proof chemical goggles and face shield unless full facepiece respiratory protection is worn. Employees should wash immediately with soap when skin is wet or contaminated. Provide emergency showers and eyewash.

Respirator Selection: SCBA >**0.9** ppm (60 min. AEGL) *Formaldehyde (1910.1048)*: *<or = 7.5 ppm (10×PEL)*: Full facepiece respirator with cartridges or canisters specifically approved for protection against formaldehyde. A half-mask respirator with cartridges specifically approved for protection against formaldehyde can be substituted for the full facepiece respirator providing that effective gas-proof goggles are provided and used in combination with the half-mask respirator. *<or = 75 ppm (100×PEL)* (1) Full face-mask respirator with chin-style or chest- or back-mounted type with industrial-size canister specifically approved for protection against formaldehyde; or (2) Type C supplied-air respirator, demand type or continuous-flow type, with full facepiece, hood, or helmet. *>75 ppm (100×PEL)* or unknown concentrations (emergencies): (1) Self-contained breathing apparatus with positive-pressure full facepiece; or (2) Combination supplied-air, full facepiece positive-pressure respirator with auxiliary self-contained air supply.

Storage: Color Code-Red: Flammability Hazard: Store in a flammable liquid storage area or approved cabinet away from ignition sources and corrosive and reactive materials. Prior to working with this chemical you should be trained on its proper handling and storage. Before entering confined space where this chemical may be present, check to make sure that an explosive concentration does not exist. Formaldehyde must be stored to avoid contact with oxidizers (such as permanganates, nitrates, peroxides, chlorates and perchlorates), and alkaline materials, since violent reactions occur. Store in tightly closed containers in a cool, well-ventilated area away from heat, sparks or flames. If this material contains a flammable carrier, sources of ignition, such as smoking and open flames, are prohibited where formaldehyde is used, handled, or stored in a manner that could create a potential fire or explosion hazard. Procedures for the handling, use and storage of cylinders should be in compliance with OSHA 1910.101 and 1910.169, as with the recommendations of the Compressed Gas Association. A regulated, marked area should be established where this chemical is handled, used, or stored in compliance with OSHA Standard 1910.1045.

Shipping: Formaldehyde, solutions, with not <25% formaldehyde require a label of "CORROSIVE." Formaldehyde, solutions, flammable, require a label of "CORROSIVE, FLAMMABLE LIQUID." Nonflammable solutions are in Hazard Class 8 and flammable solutions are in Hazard Class 3; both are in Packing Group III.

Spill Handling: Issue poison warning.
First: isolate in all directions (feet/meters) 100/30
Then: Protect persons downwind (miles/kilometers)
Day 0.1/0.2
Night 0.1/0.2
Large spills (from a large package or from many small packages)
First: isolate in all directions (feet/meters) 200/60
Then: Protect persons downwind (miles/kilometers)
Day 0.3/0.5
Night 0.5/0.8

Shut off ignition sources; no flares, smoking or flames in hazard area. Do not touch spilled material; stop leak if you can do so without risk. Use water spray to reduce vapors; do not get water inside container. *Small spills:* absorb with sand or other noncombustible absorbent material and place into containers for later disposal. *Large spills:* dike far ahead of spill for later disposal. Use fluorocarbon water spray, cellosize, and hycar to diminish vapors. Use sodium carbonate, ammonium hydroxide or sodium sulfite to neutralize spill. Use universal gel, fly ash, universal sorbent material, or cement powder to absorb the spill. Keep formaldehyde out of a confined space, such as a sewer, because of the possibility of an explosion, unless the sewer is designed to prevent the build-up of explosive concentrations. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable.

Fire Extinguishing: This chemical is a flammable gas or a combustible liquid. Hazardous decomposition includes oxides of carbon. As an immediate precautionary measure, isolate spill or leak area in all directions for at least 50 meters/150 feet for liquids and at least 25 meters/75 feet for solids. *If tank, rail car or tank truck is involved in a fire*, *isolate* for 800 meters/0.5 mile in all directions; also, consider initial evacuation for 800 meters /0.5 mile) in all directions. *On a small fire:* use dry chemical, CO_2, water spray or alcohol-resistant foam. Vapors are heavier than air and will collect in low areas. Vapors in confined areas may explode when exposed to fire. *On a large fire:* use water spray, fog or regular foam. Do not scatter spilled material with high-pressure streams of water. Move containers from fire area if you can do it without risk. Dike fire-control water for later disposal. *Fire involving tanks:* from a secure, explosion-proof location, use water spray to cool exposed containers. If cooling streams are ineffective (venting sound increases in volume and pitch, tank discolors, or shows any signs of deforming), withdraw immediately to a secure position. Always stay away from tanks engulfed in fire. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode.

Disposal Method Suggested: Incineration in solution of combustible solvent. Consult with environmental regulatory agencies for guidance on acceptable disposal practices. Generators of waste containing this contaminant (≥100 kg/mo) must conform with EPA regulations governing storage, transportation, treatment, and waste disposal.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- USEPA, Office of Pesticide Programs, Pesticide Residue Limits, “Formaldehyde,” 40 CFR 180.920 and 180.1024. http://www.epa.gov/pesticides/food/viewtols.htm
- U.S. Department of Health and Human Services, Agency for Toxic Substances and Disease Registry, “ToxFAQs for Formaldehyde,” (July 1999). http://www.atsdr.cdc.gov/tfacts111.html
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- USEPA, “Chemical Profile: Formaldehyde,” Washington DC, Chemical Emergency Preparedness Program (November 30, 1987)
- Agency for Toxic Substances and Disease Registry, U.S. Department of Health and Human Services, Public Health Service, “Managing Hazardous Materials Incidents,” Atlanta, GA (June 2003)
- New York State Department of Health, “Chemical Fact Sheet: Formaldehyde,” Albany, NY, Bureau of Toxic Substance Assessment (March 1986)

Formetanate hydrochloride

F:0440

Use Type: Insecticide, Acaricide

CAS Number: 23422-53-9

Formula: $C_{11}H_{16}ClN_3O_2$

Synonyms: Carbamic acid, methyl-, ester with *N′*-(*m*-hydroxyphenyl)-*N,N*-dimethylformamidine, hydrochloride; *m*-[((Di-methylamino)methylene)amino] phenylcarbamate,hydrochloride;3-Dimethylaminomethylene aminophenyl-*N*-methylcarbamate,hydrochloride; *N,N*-Dimethyl-*N′*-[((methylamino)carbonyl)oxy] phenylmethanimideamidemonohydrochloride

Trade Names: CARZOL®; CARZOL® SP; DICARZOL®; ENT 27566®; EP-332®; MORTON® EP332; NOR-AM® EP 332; SCHERING® 36056; SN 36056®

Chemical Class: Formamidine; Carbamate (N-methyl)

EPA/OPP PC Code: 097301

California DPR Chemical Code: 111

HSDB Number: 2619

UN/NA & ERG Number: UN2757 (solid)/151

RTECS® Number: FC2800000

EC Number: 245-656-0 [*Annex I Index No.:* 006-052-00-0]

Uses: Registered for use in the U.S. Not listed for use in EU countries[115]. An insecticide used for thrips and true bug control on fruit crops.

U.S. Maximum Allowable Residue Levels for Formetanate Hydrochloride [40 CFR 180.276]: in or on raw agricultural commodities as follows: 5 ppm in or on peaches; 4 ppm in or on grapefruit, lemons, limes, nectarines, oranges, and tangerines; 3 ppm in or on apples and pears; 2 ppm in or on plums (fresh prunes). ***[40 CFR 185.3450]***: in dried prunes when present therein as a result of the application of the insecticide to growing plums (fresh prunes). ***[40 CFR 186.3450]***: in citrus molasses resulting from the application of the insecticide to the growing raw agricultural commodities grapefruit, lemons, limes, oranges, and tangerines.

Human toxicity (long-term)[101]: Intermediate–14.00 ppb, Health Advisory

Fish toxicity (threshold)[101]: Very low–627.37903 ppb, MATC (Maximum Acceptable Toxicant Concentration)

Regulatory Authority and Advisory Information: Carcinogenicity[83]: EPA Carcinogens: Group E, evidence of non-carcinogenicity for humans.
Acute Oral Category: 1, DANGER–POISON
Health Advisory: Nerve Toxin
RCRA Universal Treatment Standards: Wastewater (mg/L), 0.056; Non-wastewater (mg/kg), 1.4
EPA Hazardous Waste Number (RCRA No.): P198
EPCRA Section 302 Extremely Hazardous Substances: TPQ = 500/10,000 lb (227/4,540 kg)
EPCRA Section 304 RQ: EHS, 1 lb (0.454 kg)
Marine pollutant (49CFR, Subchapter 172.101, Appendix B), severe pollutant as formetanate
European/International Regulations: Hazard Symbol: T+, N; risk phrases: R 26/28; R 43; R 50/53; safety phrases S:1/2; S24; S28; S37/39; S45; S60; S61 (see Appendix 1)
WGK (German Aquatic Hazard Class): 3-Severe hazard to waters

Description: White to yellow, crystalline solid or powder. Faint odor. Molecular weight = 257.8; Freezing/Melting point = 191.2 °C; Vapor pressure = practically zero @ 25 °C. Highly soluble in water.

Incompatibilities: Carbamates are incompatible with reducing agents, strong acids, oxidizing acids, peroxides, and bases. Contact with active metals or nitrides causes the release of flammable, and potentially explosive, hydrogen gas. When heated to decomposition or on contact with acids or acid fumes, may produce highly toxic chloride fumes; deadly phosgene gas may be formed. May cause pitting of some metals.

Permissible Concentration in Water: Runoff from spills or fire control may cause water pollution.

Determination in Water: Log K_{ow} = <–3. Unlikely to bioaccumulate in marine organisms.

Routes of Entry: Skin absorption, ingestion and inhalation

Harmful Effects and Symptoms

Short Term Exposure: Eye pupils are small; blurred vision; eye watering; runny nose; cough; shortness of breath; salivation; nausea, stomach cramps, diarrhea, and vomiting; increased blood pressure; profuse sweating; hypermotility, hallucinations; agitation; tingling of the skin; slow heartbeat; convulsions; fluid in lungs; loss of consciousness; incontinence; breathing stops; death. Carbamates inhibit the acetylcholinesterase enzymes and alter the way in which nervous impulses are transmitted. However, within several hours carbamates spontaneously detach from the enzymes. Extremely toxic. LD_{50} (oral, rat) = 15–20 mg/kg.

Long Term Exposure: A potent acetylcholinesterase (AChE) inhibitor; cumulative effect is possible. Nerve toxin; this chemical may damage the nervous system with repeated exposure, resulting in convulsions, respiratory failure. May cause liver damage.

Points of Attack: A potent acetylcholinesterase (AChE) inhibitor; cumulative effect is possible. This chemical may damage the nervous system with repeated exposure, resulting in convulsions, respiratory failure. May cause liver damage.

Medical Surveillance: Medical observation is recommended for 24 to 48 hours following breathing overexposure, as pulmonary edema may be delayed. Cigarette smoking may exacerbate pulmonary injury and should be discouraged for at least 72 hours following exposure. Routine biological monitoring of pesticide applicators and field workers includes testing of plasma and red blood cell acetylcholinesterase levels (for enzyme poisoned by this chemical). These tests are normally accurate only if done within about two hours of exposure. If exposure stops, plasma levels return to normal in 1–2 weeks while red blood cell levels may be reduced for 1–3 months. When acetylcholinesterase enzyme levels are reduced by 25% or more below preemployment levels, risk of poisoning is increased, even if results are in lower ranges of "normal." Reassignment to work not involving organophosphate pesticides is recommended until enzyme levels recover. Do not drink any alcoholic beverages before or during use as it promotes absorption of organophosphates. Also consider complete blood count and chest x-ray following acute overexposure

First Aid: Speed in removing material from eyes and skin is of extreme importance. *Eyes:* Eye contact can cause dangerous amounts of these chemicals to be quickly absorbed through the mucous membrane into the bloodstream. Immediately and gently flush eyes with plenty of warm or cold water (NO hot water) for at least 15 minutes, occasionally lifting the upper and lower eyelids. Get medical aid immediately. *Skin:* Get medical aid. Dermal contact can cause dangerous amounts of these chemicals to be absorbed into the bloodstream. Wearing the appropriate PPE equipment and respirator for carbamate pesticides, immediately flush skin with plenty of soap and water for at least 15 minutes while removing contaminated clothing and shoes. Shampoo hair promptly if contaminated; protect eyes. *Ingestion:* Call poison control. Loosen all clothing. Never give anything by mouth to an unconscious person. Get medical aid. Do NOT induce vomiting. If conscious, alert, and able to swallow, rinse mouth and have victim drink 4 to 8 ounces of water. Check to see if poison control instructs you to use ipecac syrup, otherwise administer slurry of activated charcoal (2 oz in 8 oz of water). If victim is *UNCONSCIOUS OR HAVING CONVULSIONS,* do nothing except keep victim warm. *In some cases you may be specifically instructed by poison control to induce vomiting by way of 2 tablespoons of syrup of ipecac (adult) washed down with a cup of water*. Do NOT give activated charcoal before or with ipecac syrup. *Inhalation:* Get medical aid. Do not contaminate yourself. Wearing the appropriate PPE equipment and respirator for carbamate pesticides, immediately remove the victim from the contaminated area to fresh air. If the victim is not breathing, administer artificial respiration. Do not use mouth-to-mouth method if victim ingested or inhaled the substance; give artificial respiration with the aid of a pocket mask equipped with a one-way valve or other proper respiratory medical device. If breathing is difficult, administer oxygen through bag/mask apparatus until medical help arrives. Do not leave victim unattended. *Note to physician or authorized medical personnel.* Administer atropine, 2 mg (1/30 gr) intramuscularly or intravenously as soon as any local or systemic signs or symptoms of an intoxication are noted; repeat the administration of atropine every 3 to 8 minutes until signs of atropinization (mydriasis, dry mouth, rapid pulse, hot and dry skin) occur; initiate treatment in children with 0.05 mg mg/kg of atropine; repeat at 5 to 10 minute intervals. Watch respiration, and remove bronchial secretions if they appear to be obstructing the airway; intubate if necessary. *Medical note:* 2-PAMCI may be contraindicated in the case of some carbamate poisonings. As first aid for pulmonary edema, a doctor or authorized paramedic might consider administering a corticosteroid spray.

Personal Protective Methods: Wear protective gloves and clothing to prevent any reasonable probability of dermal and/or eye contact. Safety equipment suppliers/manufacturers can provide recommendations on the most protective glove/clothing material for your operation. DuPont™ Tychem® suit fabrics[88]. All protective clothing (suits, gloves, footwear, headgear) should be clean, available each day, and put on before work. Contact lenses should not be worn when working with this chemical. Wear dust-proof chemical goggles and face shield unless full facepiece respiratory protection is worn. Employees should wash immediately with soap when skin is wet or contaminated. Provide emergency showers and eyewash.

Respirator Selection: *At concentrations above the NIOSH REL, or where there is no REL, at any detectable concentration:* SCBAF:Pd,Pp (APF = 10,000): (any self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode); or SaF:Pd,Pp:ASCBA (APF = 10,000) (any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary self-contained positive-pressure breathing apparatus). *Escape*: GmFOv100 (APF = 50) [any air-purifying, full facepiece respirator (gas mask) with a chin-style, front- or back-mounted organic vapor canister having an N100, R100, or P100 filter]; or SCBAE (any appropriate escape-type, self-contained breathing apparatus).

Storage: Color Code-Blue: Health Hazard/Poison. Store in a secure poison location. Prior to working with this chemical you should be trained on its proper handling and storage. Store in tightly closed containers in a cool, well-ventilated area away from strong alkalis (such as sodium hydroxide, sodium bicarbonate, etc.). Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: This is a solid toxic carbamate and should be labeled "poisonous materials." It falls into Hazard Class 6.1.

Spill Handling: For solids, isolate spill or leak area in all directions for at least 25 meters/75 feet. Increase, in the downwind direction, as necessary. Do not touch damaged containers or spilled material unless wearing appropriate protective clothing. Stop leak if you can do it without risk. Prevent entry into waterways, sewers, basements or confined areas. Cover with plastic sheet to prevent spreading. Absorb or cover with dry earth, sand or other non-combustible material and transfer to containers. Do not allow water to get inside containers.

Fire Extinguishing: *On small fire:* use dry chemical powder, carbon dioxide or water spray. *On a large fire*: use water spray, fog or alcohol-resistant foam. Move containers from fire area if you can do it without risk. Dike fire-control water for later disposal. Use water spray or fog; do not scatter material using straight water jet streams. *Fire involving storage or vehicular tanks:* isolate for 800 meters/0.5 mile in all directions; also, consider initial evacuation for 800 meters/0.5 mile in all directions. Fight fire from maximum distance or use unmanned hose holders or monitor nozzles. Do not allow water to get inside containers. Cool containers with flooding quantities of water until well after fire is out. Withdraw immediately in the case of rising sound from venting safety devices or discoloration of tank. *Always* stay away from tanks engulfed in fire. For massive fire, use unmanned hose holders or monitor nozzles; if this is impossible, withdraw from area and let fire burn.

Disposal Method Suggested: Do not discharge into drains or sewers. Dispose of waste material as hazardous waste using a licensed disposal contractor to an approved landfill. Consult with environmental regulatory agencies for guidance on acceptable disposal practices. Generators of waste containing this contaminant (≥100 kg/mo) must conform with EPA regulations governing storage, transportation, treatment, and waste disposal. Incineration with effluent gas scrubbing is recommended. Containers must be disposed of properly by following package label directions or by contacting your local or federal environmental control agency, or by contacting your regional EPA office.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- USEPA, Office of Pesticide Programs, Pesticide Residue Limits, "Formetanate Hydrochloride", 40 CFR 180.276. http://www.epa.gov/pesticides/food/viewtols.htm

Formothion F:0460

Use Type: Insecticide, Acaricide

CAS Number: 2540-82-1

Formula: $C_6H_{12}NO_4PS_2$; $(CH_3O)_2PSSCH_2CON(CH_3)CHO$

Synonyms: *O,O*-Dimethyl-*S*-(*N*-formyl-*N*- methylcarbamoylmethyl)phosphorodithioate; Carbamoylmethyl phosphorodithioate; *O,O*-Dimethyldithiophosphorylacetic acid-*N*-methyl-*N*-formylamide; *O* *O,O*-Dimethyl-*S*-(*N*-methyl-*N*-formyl-carbamoylmethyl)-dithiophosphate; *O,O*-Dimethyl-*S*-(*N*-methyl-*N*-formyl-carbamoylmethyl)-phosphorodithioate; *O,O*-Dimethylphosphorodithioate *N*-formyl-2-mercapto-*N*-methylacetamide-*S*-ester; ENT

27,257; Formotion (Spanish); *S*-(2-(Formylmethylamino)2-oxoethyl)-*O,O*-dimethylphosphorodithioate; *N*-Formyl-*N*-methylcarbamoylmethyl-*O,O*-dimethylphosphorodithioate; *S*-(*N*-Formyl-*N*-methylcarbamoylmethyl)-*O,O*-dimethylphosphorodithioate; *S*-(*N*- formyl-*N*-methylcarbamoylmethyl)dimethylphosphorodithiolothionate

Trade Names: AFLIX®; ANTHIO®; ANTIO®; CP 53926®; S 6900®; SAN 244 I®; SAN 6913 I®; SAN 71071®; SPENCER S-6900®; VEL 4284®

Chemical Class: Organophosphate

EPA/OPP PC Code: 366400

HSDB Number: 1587

UN/NA & ERG Number: UN3018 (liquid)/152
UN2783 (solid)/152

RTECS® Number: TE1050000

EC Number: 219-818-6 [*Annex I Index No.:* 015-057-00-7]

Uses: Formothion is a systemic and contact insecticide used to control spider mites, aphids, psyllids, mealy bugs, whiteflies, jassids, leaf miners, ermine moths, and fruit flies. It is used on tree fruits, vines, olives, hops, cereals, sugar cane, rice. Formothion is available as an emulsifiable concentrate and an ultra-low-volume spray. A U.S. EPA restricted Use Pesticide (RUP). Not approved for use in EU countries[115].

Regulatory Authority and Advisory Information: Health Advisory: Nerve Toxin, Mutagen
Acute Oral Category: 2, WARNING
U.S. DOT 49CFR172.101, Inhalation Hazard Chemical as organophosphates

Superfund/EPCRA 302 Extremely Hazardous Substances: TPQ = 100 lb (45.4 kg)
Superfund/EPCRA 40CFR302.4 RQ: EHS, 1 lb (0.454 kg)
European/International Regulations: Hazard Symbol: Xn; risk phrases: R21/22; safety phrases: S2; S36/37 (see Appendix 1)

Description: Formothion is a yellowish viscous oil or oily crystalline mass. Odorless. Molecular weight = 257.27; Specific gravity (H_2O:1) = 1.361 @ 20 °C; Freezing/Melting point = 25.5 °C; Vapor pressure = 85×10^{-6}; mmHg @ 25 °C. Hazard Identification (based on NFPA-704 M Rating System): Health 2, Flammability 1, Reactivity 0. High solubility in water.

Incompatibilities: Alkaline materials. May react with strong oxidizers such as chlorates, peroxides, nitrates, etc. In the presence of strong reducing agents such as hydrides, organophosphates form highly toxic and flammable phosphine gas. Contact with oxidizers can cause the release of toxic oxides of phosphorus.

Permissible Exposure Limits in Air: Protective Action Criteria (PAC) Ver. 27[89]
PAC-1: 0.025 mg/m^3
PAC-2: 0.27 mg/m^3
PAC-3: 140 mg/m^3

Determination in Air: OSHA versatile sampler-2; Toluene/Acetone; Gas chromatography/Flame photometric detection for sulfur, nitrogen, or phosphorus; NIOSH Method IV Method #5600, Organophosphorus pesticides[18].

Determination in Water: NIOSH Method 1657. The determination of organophosphorus pesticides in municipal and industrial wastewater by gas chromatography. Detection limit = 6.0 ng/L. Log K_{ow} = <1.5. Unlikely to bioaccumulate in marine organisms.

Routes of Entry: Inhalation, dermal absorption.

Harmful Effects and Symptoms: Organophosphates are highly toxic. Symptoms may develop rapidly, or there may be a delay of several hours following exposure before they become noticeable. The delay tends to be longer in the case of some compounds that dissolve fats, lipids, oils and non-polar solvents such as toluene. Symptoms may increase in severity for more than a single day and last for several days. In severe cases of organophosphate intoxication, respiratory failure may occur.

Short Term Exposure: Early symptoms of poisoning include: headache, blurred vision, dizziness, weakness, perspiring, nausea,muscle spasms, vomiting, and sensation of tightness in chest; loss of coordination. Chronic low doses may produce symptoms similar to influenza. Formothion is one of the least toxic systemic organophosphates. Formothion is a compound of low to moderate toxicity. It causes the depression of cholinesterase, leading to accumulation of acetylcholine in the nervous system, which is believed to be responsible for the symptoms. Organic phosphorus insecticides are absorbed by the skin, as well as by the respiratory and gastrointestinal tracts. They are cholinesterase inhibitors. Symptoms of exposure include headache, giddiness, blurred vision, nervousness, profound weakness, nausea, cramps, diarrhea, and discomfort in the chest. Signs include sweating, tearing, salivation, vomiting, cyanosis, convulsions, coma, loss of reflexes and loss of sphincter control. Delayed pulmonary edema may occur after inhalation. LD_{50} (oral, rat) = 365 mg/kg. Moderately toxic; LD_{50} (dermal, rat) = 353 mg/kg.

Long Term Exposure: Cholinesterase inhibitor; cumulative effect is possible. This chemical may damage the nervous system with repeated exposure, resulting in convulsions, respiratory failure. May cause liver damage.

Points of Attack: Respiratory system, lungs, central nervous system, cardiovascular system, skin, eyes, plasma and red blood cell cholinesterase. Repeated exposure may cause changes in personality and exhibit depression, anxiety or irritability.

Medical Surveillance: Medical observation is recommended for 24 to 48 hours following breathing overexposure, as pulmonary edema may be delayed. Routine biological monitoring of pesticide applicators and field workers includes testing of plasma and red blood cell acetylcholinesterase levels (for enzyme poisoned by this chemical). These tests are normally accurate only if done within about two hours of exposure. If exposure stops, plasma levels return to normal in 1–2 weeks while red blood cell levels may be reduced for 1–3 months. When acetylcholinesterase enzyme levels are reduced by 25% or more below preemployment levels, risk of poisoning is increased, even if results are in lower ranges of "normal." Reassignment to work not involving organophosphate pesticides is recommended until enzyme levels recover. Do not drink any alcoholic beverages before or during use as it promotes absorption of organophosphates. Also consider complete blood count and chest x-ray following acute overexposure.

First Aid: **Treatment for organophosphate poisoning consists of thorough decontamination, cardiorespiratory support, and administration of the antidotes atropine and pralidoxime. In cases of severe poisoning, diazepam, an anticonvulsant, should also be administered. Antidotes should be administered as prevention even if the diagnosis is in doubt**. Speed in removing material from eyes and skin is of extreme importance. *Eyes:* Eye contact can cause dangerous amounts of these chemicals to be quickly absorbed through the mucous membrane into the bloodstream. Immediately and gently flush eyes with plenty of warm or cold water (NO hot water) for at least 15 minutes, occasionally lifting the upper and lower eyelids. Get medical aid immediately. *Skin:* Get medical aid. Dermal contact can cause dangerous amounts of these chemicals to be absorbed into the bloodstream. Wearing the appropriate PPE equipment and respirator for organophosphate pesticides, immediately flush skin with plenty of soap and water for at least 15 minutes while removing contaminated clothing and shoes. Shampoo hair promptly if contaminated. The removed, contaminated clothing and shoes should be double-bagged and left in Hot Zone for later disposal by hazardous materials experts. Skin may also be decontaminated with diluted hypochlorite solution. *Inhalation:* Get medical aid. Do not contaminate yourself. Wearing the appropriate PPE equipment and respirator for organophosphate pesticides, immediately remove the victim from the contaminated area to fresh air. If the victim is not breathing, administer artificial respiration. Do not use mouth-to-mouth method if victim ingested or inhaled the substance; give artificial respiration with the aid of a pocket mask equipped with a one-way valve or other proper respiratory medical device. If breathing is difficult, administer oxygen through bag/mask apparatus until medical help arrives. Do not leave victim unattended. *Ingestion:* Call poison control. Loosen all clothing. Never give anything by mouth to an unconscious person. If victim is *unconscious or having convulsions,* do nothing except keep victim warm. Get medical aid. Transfer promptly to a medical facility. In cases of ingestion, **do not induce vomiting**. If the victim is alert and asymptomatic, administer a slurry of activated charcoal at a dose of 1 g/kg (infant, child, and adult dose). A soda can and straw may be of assistance when offering charcoal to a child. *In some cases you may be specifically instructed by poison control to induce vomiting by way of 2 tablespoons of syrup of ipecac (adult) washed down with a cup of water*. Do NOT give activated charcoal before or with ipecac syrup.

Note to physician or authorized medical personnel: Treat cases of respiratory compromise, coma, or excessive pulmonary secretions with respiratory support using protocols and techniques available and within the scope of training. Some cases may necessitate procedures such as endotracheal intubation or cricothyrotomy by properly trained and equipped personnel. When possible, atropine (see *Antidotes*, below) should be given under medical supervision. Patients who are comatose, hypotensive, or having seizures or cardiac arrhythmias should be treated according to advanced life support protocols. *Antidotes:* Two antidotes are administered to treat organophosphate poisoning. Atropine is a competitive antagonist of acetylcholine at muscarinic receptors and is used to control the excessive bronchial secretions which are often responsible for death. Pralidoxime relieves both the nicotinic and muscarine effects of organophosphate poisoning by regenerating acetylcholinesterase and can reduce both the bronchial secretions and the muscle weakness associated with poisoning. The initial intravenous dose of atropine in adults should be determined by the severity of symptoms: An initial adult dose of 1.0 to 2.0 mg or pediatric dose of 0.01 mg/kg (minimum 0.01 mg) should be administered intravenously. If intravenous access cannot be established, atropine may also be given intramuscularly, subcutaneously or via endotracheal tube. Doses should be repeated every 15 minutes until excessive secretions and sweating have been controlled. Once bronchial secretion has been controlled, atropine administration should be repeated whenever the secretions begin to recur. In seriously poisoned patients, very large doses may be required. Alterations of pulse rate and pupillary size should not be used as indicators of treatment adequacy. Pralidoxime should be administered as early in poisoning as possible as its efficacy may diminish when given more than 24 to 36 hours after exposure. Doses are as follows: adult 1.0 g; pediatric 25 to 50 mg/kg. The drug should be administered intravenously over 30 to 60 minutes, but in a life-threatening situation one-half of the total dose can be given per minute for a total administration time of 2 minutes. Treatment should begin to take effect within 40 minutes with a reduction in symptoms and the amount of atropine necessary to control bronchial secretion. The initial dose can be repeated in 1 hour and then every 8 to 12 hours until the patient is clinically well and no longer requires atropine. If intravenous access cannot be established, pralidoxime may also be given intramuscularly. Early administration of diazepam in addition to the combined atropine and pralidoxime treatment may help prevent the onset of seizures and potential brain and cardiac morphologic damage following high-level organophosphate poisoning.

Personal Protective Methods: Wear protective gloves and clothing to prevent any reasonable probability of dermal and/or eye contact. Safety equipment suppliers/manufacturers can provide recommendations on the most protective glove/clothing material for your operation. One recommendation is the use of DuPont™ Tychem® suit fabrics[88]. All protective clothing (suits, gloves, footwear, headgear) should be clean, available each day, and put on before work. Contact lenses should not be worn when working with this chemical. Wear splash-proof chemical goggles and face shield unless full facepiece respiratory protection is worn. Employees should wash immediately with soap when skin is wet or contaminated. Provide emergency showers and eyewash.

Respirator Selection: SCBA >0.025 mg/m^3 Engineering controls should be used wherever feasible to maintain airborne concentrations of this chemical below the prescribed exposure limit. Respirators and protective equipment are less effective than engineering controls, and should be used only in non-routine or emergency situations which may result in exposure concentrations in excess of the TWA environmental limit. *At any concentrations above the NIOSH REL, or where there is no REL, at any detectable concentration:* SCBAF: Pd,Pp (APF = 10,000) (any NIOSH/MSHA- or European Standard EN 149-approved self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode); or SaF: Pd,Pp: ASCBA (APF = 10,000) (any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary, self-contained breathing apparatus operated in a pressure-demand or other positive-pressure mode).

Storage: Color Code-Blue: Health Hazard/Poison. Store in a secure poison location. Prior to working with this chemical you should be trained on its proper handling and storage. Where possible, automatically transfer material from other storage containers to process containers. Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: Organophosphorus pesticides, solid or liquid (nonflammable), require a "poisonous materials" label. This chemical falls in Hazard Class 6.1.

Spill Handling: First remove all sources of ignition. Evacuate persons not wearing protective equipment from area of spill or leak until clean up is complete. Stay upwind; keep out of low areas. Ventilate area of spill or leak. Remove and isolate contaminated clothing at the site. Do not touch spilled material; stop leak if you can do so without risk. Use water spray to reduce vapors. *Small spills:* absorb with sand or other noncombustible absorbent material and place into containers for later disposal. *Large spills:* dike far ahead of spill for later disposal. Collect powdered material in the most convenient and safe manner and deposit in sealed containers. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable. Seek professional environmental engineering assistance from the U.S. EPA Environmental Response Team at (908) 548-8730 (24-hour response line).

Fire Extinguishing: Hazardous decomposition includes oxides of phosphorus, sulfur, and nitrogen. May be fatal if inhaled, ingested or absorbed through skin. Inhalation or contact with some of these materials will irritate or burn skin and eyes. Vapors may cause dizziness or suffocation. *Small fires:* dry chemical, carbon dioxide; water spray; or foam. *Large fires:* water spray, fog, or foam. Stay upwind; keep out of low areas. Ventilate closed spaces before entering them. Firefighting gear (including SCBA) may not provide adequate protection. If exposure occurs, remove and isolate gear immediately and thoroughly decontaminate personnel. Wear positive-pressure breathing apparatus and special protective clothing. Remove and isolate contaminated clothing at the site. Move container from fire area if you can do so without risk. Fight fire from maximum distance. Dike fire-control water for later disposal; do not scatter the material. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies. From a secure, explosion-proof location, use water spray to cool exposed containers. If cooling streams are ineffective (venting sound increases in volume and pitch, tank discolors, or shows any signs of deforming), withdraw immediately to a secure position. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode.

Disposal Method Suggested: Destruction by alkali hydrolysis or incineration. Containers must be disposed of properly by following package label directions or by contacting your local or federal environmental control agency, or by contacting your regional EPA office.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- EXTOXNET, Extension Toxicology Network, "Pesticide Information Profile, Formothion," Oregon State University, Corvallis, OR (September 1995). http://extoxnet.orst.edu/pips/formothi.htm
- New Jersey Department of Health and Senior Services, "Hazardous Substance Fact Sheet, Formothion," Trenton, NJ (September 2000). http://www.state.nj.us/health/eoh/rtkweb/2439.pdf
- USEPA, "Chemical Profile: Formothion," Washington DC, Chemical Emergency Preparedness Program (November 30, 1987)
- Agency for Toxic Substances and Disease Registry, U.S. Department of Health and Human Services, Public Health Service, "Managing Hazardous Materials Incidents," Atlanta, GA (June 2003)

Fosetyl-Al F:0468

Use Type: Fungicide

CAS Number: 39148-24-8

Formula: $C_6H_{18}AlO_9P_3$

Synonyms: Aluminum tris(*O*-ethylphosphonate); Aluminum phosethyl; Aluminium triethyl triphosphonate;

Fosetyl aluminum; Phosethyl aluminum; Phosphonic acid, monoethyl ester, aluminum salt (3:1); Phosethyl-Al

Trade Names: 32545 R®; ALIETTE®; ALIETTE® 80 WG; CHIPCO® ALIETTE WDG; EFOSITE-AL®; EFOSITE ALUMINUM®; EPAL®; LS-74783®; MIKAL®

Chemical Class: Organophosphate

EPA/OPP PC Code: 123301

California DPR Chemical Code: 2210

HSDB Number: 6856

UN/NA & ERG Number: UN2783 (solid)/152; UN3018 (liquid

RTECS® Number: SZ9640000

EC Number: 254-320-2 [*Annex I Index No.:* 006-095-00-5]

Uses: Used on fruits, vegetables and nut crops; also on ornamentals and greenhouse products.

U.S. Maximum Allowable Residue Levels for Fosetyl-al [40 CFR 180.415 (a)]: avocado 25 ppm; banana 3.0 ppm; bushberry subgroup 13B, 40 ppm; caneberries 0.1 ppm; cranberry 0.5 ppm; fruit, citrus, group 10, 5.0 ppm; fruit, pome 10 ppm; ginseng, root 0.1 ppm; hop, dried cone 45 ppm; juneberry 40 ppm; leafy vegetables (except brassica vegetables) 100 ppm; lingonberry 40 ppm; nut, macadamia 0.20 ppm; onion, green 10.0 ppm; pea, succulent 0.3 ppm; pineapple 0.1 ppm; pineapple, fodder 0.1 ppm; pineapple, forage 0.1 ppm; onion, dry bulb 0.5 ppm; salal 40 ppm; strawberry 75 ppm; tomato 3 ppm; turnip, greens 40 ppm; turnip, roots 15 ppm; vegetable, brassica, leafy, group 5, 60 ppm; and vegetable, cucurbit, group 9, 15 ppm. *Regional registration, as defined in section 180.1(n)* ***[40 CFR 180.415(c)]:*** in or on the following raw agricultural commodities: asparagus 0.1 ppm; grape 10 ppm.

Regulatory Authority and Advisory Information:

Carcinogenicity[83]: EPA, Not likely to be a human carcinogen

Acute Oral Category: 3, CAUTION

Health Advisory: Nerve Toxin, Skin irritant/sensitizer

Potential Ground Water Pollutant [California FAC Section 13145(d)/12811, active]

DOT Inhalation Hazard Chemicals as organophosphates

European/International Regulations: Hazard Symbol: Xi; risk phrases: R41; safety phrases: S2; S26; S39; S46 (see Appendix 1)

Description: White, crystalline solid or powder. Odorless. Molecular weight = 354.101; Specific gravity (H_2O:1) = 1.55; Boiling point = (decomposes); Freezing/Melting point = 214 °C; Vapor pressure = 1×10^{-7} mmHg @ 20 °C. Henry's Law constant = 3.2×10^{-15} atm-m^3/mol @ 25 °C (est)[83]. Highly soluble in water; solubility = 120 g/L.

Incompatibilities: In the presence of strong reducing agents such as hydrides, organophosphates form highly toxic and flammable phosphine gas. Contact with oxidizers can cause the release of toxic oxides of phosphorus. Decomposes in temperatures above 260 °C.

Permissible Exposure Limits in Air:

Determination in Air: OSHA versatile sampler-2; Toluene/Acetone; Gas chromatography/Flame ionization detection; NIOSH IV[18], Method #5600, Organophosphorus Pesticides

Permissible Concentration in Water: Federal Drinking Water Guidelines: EPA 50-200[Al]μg/L; State Drinking Water Standards: California 1000[Al]μg/L; State Drinking Water Guidelines: Arizona 73 [Al]μg/L; Maine 1430 [Al]μg/L; California 200 [Al]μg/L.

Determination in Water: Log K_{ow} = –3. Unlikely to bioaccumulate in marine organisms.

Routes of Entry: Inhalation; dermal and eye contact.

Harmful Effects and Symptoms

Short Term Exposure: A severe eye irritant. Eye pupils are small; blurred vision; eye watering; runny nose; cough; shortness of breath; salivation; dizziness; nausea, stomach cramps, diarrhea, and vomiting; increased blood pressure; profuse sweating; hypermotility, hallucinations; irritability; tingling of the skin; drowsiness; slow heartbeat; convulsions; fluid in lungs; loss of consciousness; incontinence; breathing stops; death. Organophosphates inhibit the action of acetylcholinesterase enzymes, and alter the way in which nervous impulses are transmitted. The effects can last for hours, days, or much longer. The action of the enzymes is reestablished after new enzymes are formed. LD_{50} (oral, rat) = >5 g/kg[83]; LD_{50} (dermal, rat) = 600 mg/kg.

Long Term Exposure: Cholinesterase inhibitor; cumulative effect is possible. Organophosphates may damage the nervous system with repeated exposure, resulting in convulsions, respiratory failure. May cause liver damage.

Points of Attack: Respiratory system, central nervous system, cardiovascular system, blood cholinesterase.

Medical Surveillance: Medical observation is recommended for 24 to 48 hours following breathing overexposure, as pulmonary edema may be delayed. Cigarette smoking may exacerbate pulmonary injury and should be discouraged for at least 72 hours following exposure

First Aid: Speed in removing material from eyes and skin is of extreme importance. *Eyes:* Eye contact can cause dangerous amounts of these chemicals to be quickly absorbed through the mucous membrane into the bloodstream. Immediately and gently flush eyes with plenty of warm or cold water (NO hot water) for at least 15 minutes, occasionally lifting the upper and lower eyelids. Get medical aid immediately. *Skin:* Get medical aid. Dermal contact can cause dangerous amounts of these chemicals to be absorbed into the bloodstream. Wearing the appropriate PPE equipment and respirator for organophosphate pesticides, immediately flush skin with plenty of soap and water for at least 15 minutes while removing contaminated clothing and shoes. Shampoo hair promptly if contaminated. *Ingestion:* Call poison control. Loosen all clothing. Never give anything by mouth to an unconscious person. Get medical aid. Do NOT induce vomiting. If conscious, alert, and able to swallow, rinse mouth and have victim drink 4 to 8 ounces of water do NOT induce vomiting but immediately administer slurry of activated charcoal (2 oz in 8 oz of water). If victim is *UNCONSCIOUS OR HAVING CONVULSIONS,* do nothing except keep victim warm. *In some cases you may be specifically instructed by poison control to induce vomiting by way of 2 tablespoons of syrup of ipecac* *(adult) washed down with a cup of water*. Do NOT give activated charcoal before or with ipecac syrup. *Inhalation:* Get medical aid. Do not contaminate yourself. Wearing the appropriate PPE equipment and respirator for organophosphate pesticides, immediately remove the victim from the contaminated area to fresh air. If the victim is not breathing, administer artificial respiration. Do not use mouth-to-mouth method if victim ingested or inhaled the substance; give artificial respiration with the aid of a pocket mask equipped with a one-way valve or other proper respiratory medical device. If breathing is difficult, administer oxygen through bag/mask apparatus until medical help arrives. Do not leave victim unattended. *Note to physician or authorized medical personnel.* Administer atropine, 2 mg (1/30 gr) intramuscularly or intravenously as soon as any local or systemic signs or symptoms of an intoxication are noted; repeat the administration of atropine every 3 to 8 minutes until signs of atropinization (mydriasis, dry mouth, rapid pulse, hot and dry skin) occur; initiate treatment in children with 0.05 mg mg/kg of atropine; repeat at 5 to 10 minute intervals. Watch respiration, and remove bronchial secretions if they appear to be obstructing the airway; intubate if necessary. *Note to physician or authorized medical personnel*: *N*-methylpyridinium-2-aldoxime (2-PAMCI) when used in conjunction with atropine reacts with the phosphorylated cholinesterase, thereby restoring normal activity to by removing the phosphorylating group. The combination of these two chemicals is synergistic and must be administered within minutes to a few hours following exposure (depending on the specific agent) to be effective. Give 2-PAMCI (Pralidoxime; Protopam), 2.5 gm in 100 ml of sterile water or in 5% dextrose and water, intravenously, slowly, in 15–30 minutes; if sufficient fluid is not available, give 1 g of 2-PAMCI in 3 ml of distilled water by deep intramuscular injection; repeat this every half hour if respiration weakens or if muscle fasciculation or convulsions recur. Also diazepam, an anticonvulsant, might be considered. As first aid for pulmonary edema, a doctor or authorized paramedic might consider administering a corticosteroid spray.

Respirator Selection: Wherever and whenever workplace conditions warrant respirator use, a respiratory protection program must be followed that meets one or more of the following government standards: OSHA's 29 CFR 1910.134, ANSI Z88.2, or European Standard EN 149.

Storage: Color Code-Blue: Health Hazard/Poison. Store in a secure poison location. Prior to working with this chemical, you should be trained on its proper handling and storage. Store in tightly closed containers in a cool, well-ventilated area away from strong bases. Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: Organophosphorus pesticides, solid or liquid (nonflammable), require a "poisonous materials" label. This chemical falls in Hazard Class 6.1.

Spill Handling: First remove all sources of ignition. Evacuate persons not wearing protective equipment from area of spill or leak until clean up is complete. Stay upwind; keep out of low areas. Ventilate area of spill or leak. Remove and isolate contaminated clothing at the site. Do not touch spilled material; stop leak if you can do so without risk. Use water spray to reduce vapors. *Small spills:* absorb with sand or other noncombustible absorbent material and place into containers for later disposal. *Large spills:* dike far ahead of spill for later disposal. Collect powdered material in the most convenient and safe manner and deposit in sealed containers. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable. Seek professional environmental engineering assistance from the U.S. EPA Environmental Response Team at (908) 548-8730 (24-hour response line).

Fire Extinguishing: Decomposes in temperatures above 260 °C. Hazardous decomposition includes oxides of aluminum, phosphorus, sulfur, and nitrogen. May be fatal if inhaled, ingested or absorbed through skin. Inhalation or contact with some of these materials will irritate or burn skin and eyes. Vapors may cause dizziness or suffocation. *Small fires:* dry chemical, carbon dioxide; water spray; or foam. *Large fires:* water spray, fog, or foam. Stay upwind; keep out of low areas. Ventilate closed spaces before entering them. Firefighting gear (including SCBA) may not provide adequate protection. If exposure occurs, remove and isolate gear immediately and thoroughly decontaminate personnel. Wear positive-pressure breathing apparatus and special protective clothing. Remove and isolate contaminated clothing at the site. Move container from fire area if you can do so without risk. Fight fire from maximum distance. Dike fire control water for later disposal; do not scatter the material. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies. From a secure, explosion-proof location, use water spray to cool exposed containers. If cooling streams are ineffective (venting sound increases in volume and pitch, tank discolors, or shows any signs of deforming), withdraw immediately to a secure position. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode.

Disposal Method Suggested: Destruction by alkali hydrolysis or incineration. Containers must be disposed of properly by following package label directions or by contacting your local or federal environmental control agency, or by contacting your regional EPA office.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank

(HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov

- USEPA, Office of Pesticide Programs, Pesticide Residue Limits, "Fosetyl-al", 40 CFR 180.415. http://www.epa.gov/pesticides/food/viewtols.htm
- Pesticide Management Education Program, "Fosetyl-al (Aliette) Chemical Fact Sheet 10/83," Cornell University, Ithaca, NY (October 1983). http://pmep.cce.cornell.edu/profiles/fung-nemat/febuconazole-sulfur/fosetyl-al/fung-prof-fosetylal.html

Fosthiazate F:0479

Use Type: Insecticide, Nematicide
CAS Number: 98886-44-3
Formula: $C_9H_{18}NO_3PS_2$
Synonyms: ACS 66824; (*RS*)-*S*-sec-Butyl-*O*-ethyl-2-oxo-1,3-thiazolidin-3-ylphosphonothioate; *S*-sec-Butyl O-ethyl (2-oxo-1,3-thiazolidine-3-yl)phosphonothioate; *S-sec*-Butyl-*O*-ethyl(2-oxo-3-thiazolidinyl)phosphonothioate; O-Ethyl S-(1-methylpropyl) (2-oxo-3-thiazolidinyl)phosphonothioate; (2-Oxo-3-thiazolidinyl)phosphonothioic acid O-ethyl S-(1-methylpropyl) ester
Trade names: CGA 41065®; IKI 1145®; NEMATHORIN®; PREMEIR®; PRIME®
Chemical Class: Organophosphate
EPA/OPP PC Code: 129022
California DPR Chemical Code:
HSDB Number: 7961
UN/NA & ERG Number: UN3018 (liquid
RTECS® Number: TB1707000
EC Number: [*Annex I Index No.* 015-168-00-0]
Uses: Systemic pesticide applied to the soil.
U.S. Maximum Allowable Residue Levels for residues of the insecticide fosthiazate, including its metabolites and degradates, in or on the commodity in this paragraph. Compliance with the tolerance level specified in this paragraph is to be determined by measuring only the sum of fosthiazate, O-ethyl S-(1-methylpropyl)(2-oxo-3-thiazolidinyl)phosphonothioate, and its metabolite, O-ethyl S-(1-methylpropyl)(2-(methylsulfonyl)ethyl)phosphoramidothioate, calculated as the stoichiometric equivalent of fosthiazate [40 CFR 18.596 (A)]: in or on the commodity: tomato 0.02 ppm.
Regulatory Authority and Advisory Information: Acute Oral Category: 2, WARNING
Health Advisory: Nerve Toxin
Air Pollutant Standard Set. US DOT 49CFR172.101, Inhalation Hazardous Chemical as organophosphates
European/International Regulations: Hazard Symbol: T, Xn, Xi, N; risk phrases: R21; R23/25; R39; R41; R43; R50/53; safety phrases: S1/2; S25; S26; S39; S45; S53; S60; S61 (see Appendix 1)
Description: Pale yellow liquid. Molecular weight = 283.37; Specific gravity (H_2O:1) = 1.23 @ 20 °C; Boiling point = 197.8 °C; Vapor pressure = 4×10^{-6} mmHg @ 25 °C. Soluble in water.
Incompatibilities: May react violently with antimony(V) pentafluoride. Incompatible with lead diacetate, magnesium, silver nitrate. In the presence of strong reducing agents such as hydrides, organophosphates form highly toxic and flammable phosphine gas. Contact with oxidizers can cause the release of toxic oxides of phosphorus.
Determination in Air: OSHA versatile sampler-2; Toluene/Acetone; Gas chromatography/Flame photometric detection for sulfur, nitrogen, or phosphorus; NIOSH IV Method #5600[18], Organophosphorus pesticides. See also OSHA Method #62(58)
Permissible Concentration in Water: Runoff from spills or fire control may cause water pollution.
Determination in Water: Log K_{ow} = <2.0. Unlikely to bioaccumulate in marine organisms. The determination of organophosphorus pesticides in municipal and industrial wastewater by gas chromatography. Detection limit = 6.0 ng/L.
Routes of Entry: Inhalation, dermal and/or eye contact.
Harmful Effects and Symptoms
Short Term Exposure: An eye irritant. Eye pupils are small; blurred vision; eye watering; runny nose; cough; shortness of breath; salivation; dizziness; nausea, stomach cramps, diarrhea, and vomiting; increased blood pressure; profuse sweating; hypermotility, hallucinations; irritability; tingling of the skin; drowsiness; slow heartbeat; convulsions; fluid in lungs; loss of consciousness; incontinence; breathing stops; death. Organophosphates inhibit the action of acetylcholinesterase enzymes, and alter the way in which nervous impulses are transmitted. The effects can last for hours, days, or much longer. The action of the enzymes is reestablished after new enzymes are formed.
LD_{50} (oral, rat) = 57 mg/kg; LD_{50} (dermal, rat) = 861 mg/kg.
Long Term Exposure: Cholinesterase inhibitor; cumulative effect is possible. Organophosphates may damage the nervous system with repeated exposure, resulting in convulsions, respiratory failure. May cause liver damage. Skin sensitizer.
Points of Attack: Respiratory system, central nervous system, cardiovascular system, blood cholinesterase. May be neurotoxic. Skin.
Medical Surveillance: Medical observation is recommended for 24 to 48 hours following breathing overexposure, as pulmonary edema may be delayed. Routine biological monitoring of pesticide applicators and field workers includes testing of plasma and red blood cell acetylcholinesterase levels (for enzyme poisoned by this chemical). These tests are normally accurate only if done within about two hours of exposure. If exposure stops, plasma levels return to normal in 1–2 weeks while red blood cell levels may be reduced for 1–3 months. When acetylcholinesterase enzyme levels are reduced by 25% or more below preemployment levels, risk of poisoning is increased, even if results are in lower ranges of "normal." Reassignment to work not involving organophosphate pesticides is recommended until enzyme levels recover. Do not drink any alcoholic beverages before or during use as it promotes absorption of organophosphates. Complete blood count. Evaluation by a qualified

allergist, including exposure history and testing, may help diagnose allergy.

First Aid: **Treatment for organophosphate poisoning consists of thorough decontamination, cardiorespiratory support, and administration of the antidotes atropine and pralidoxime. In cases of severe poisoning, diazepam, an anticonvulsant, should also be administered. Antidotes should be administered as prevention even if the diagnosis is in doubt**. Speed in removing material from eyes and skin is of extreme importance. *Eyes:* Eye contact can cause dangerous amounts of these chemicals to be quickly absorbed through the mucous membrane into the bloodstream. Immediately and gently flush eyes with plenty of warm or cold water (NO hot water) for at least 15 minutes, occasionally lifting the upper and lower eyelids. Get medical aid immediately. *Skin:* Get medical aid. Dermal contact can cause dangerous amounts of these chemicals to be absorbed into the bloodstream. Wearing the appropriate PPE equipment and respirator for organophosphate/carbamate pesticides, immediately flush skin with plenty of soap and water for at least 15 minutes while removing contaminated clothing and shoes. Shampoo hair promptly if contaminated. The removed, contaminated clothing and shoes should be double-bagged and left in Hot Zone for later disposal by hazardous materials experts. Skin may also be decontaminated with diluted hypochlorite solution. *Inhalation:* Get medical aid. Do not contaminate yourself. Wearing the appropriate PPE equipment and respirator for organophosphate pesticides, immediately remove the victim from the contaminated area to fresh air. If the victim is not breathing, administer artificial respiration. Do not use mouth-to-mouth method if victim ingested or inhaled the substance; give artificial respiration with the aid of a pocket mask equipped with a one-way valve or other proper respiratory medical device. If breathing is difficult, administer oxygen through bag/mask apparatus until medical help arrives. Do not leave victim unattended. *Ingestion:* Call poison control. Loosen all clothing. Never give anything by mouth to an unconscious person. If victim is *unconscious or having convulsions,* do nothing except keep victim warm. Get medical aid. Transfer promptly to a medical facility. In cases of ingestion, **do not induce vomiting**. If the victim is alert and asymptomatic, administer a slurry of activated charcoal at a dose of 1 g/kg (infant, child, and adult dose). A soda can and straw may be of assistance when offering charcoal to a child. *In some cases you may be specifically instructed by poison control to induce vomiting by way of 2 tablespoons of syrup of ipecac (adult) washed down with a cup of water*. Do NOT give activated charcoal before or with ipecac syrup. *Note to physician or authorized medical personnel:* Treat cases of respiratory compromise, coma, or excessive pulmonary secretions with respiratory support using protocols and techniques available and within the scope of training. Some cases may necessitate procedures such as endotracheal intubation or cricothyrotomy by properly trained and equipped personnel. When possible, atropine (see *Antidotes*, below) should be given under medical supervision. Patients who are comatose, hypotensive, or having seizures or cardiac arrhythmias should be treated according to advanced life support protocols. *Antidotes:* Two antidotes are administered to treat organophosphate poisoning. Atropine is a competitive antagonist of acetylcholine at muscarinic receptors and is used to control the excessive bronchial secretions which are often responsible for death. Pralidoxime relieves both the nicotinic and muscarine effects of organophosphate poisoning by regenerating acetylcholinesterase and can reduce both the bronchial secretions and the muscle weakness associated with poisoning. The initial intravenous dose of atropine in adults should be determined by the severity of symptoms: An initial adult dose of 1.0 to 2.0 mg or pediatric dose of 0.01 mg/kg (minimum 0.01 mg) should be administered intravenously. If intravenous access cannot be established, atropine may also be given intramuscularly, subcutaneously or via endotracheal tube. Doses should be repeated every 15 minutes until excessive secretions and sweating have been controlled. Once bronchial secretion has been controlled, atropine administration should be repeated whenever the secretions begin to recur. In seriously poisoned patients, very large doses may be required. Alterations of pulse rate and pupillary size should not be used as indicators of treatment adequacy. Pralidoxime should be administered as early in poisoning as possible as its efficacy may diminish when given more than 24 to 36 hours after exposure. Doses are as follows: adult 1.0 g; pediatric 25 to 50 mg/kg. The drug should be administered intravenously over 30 to 60 minutes, but in a life-threatening situation one-half of the total dose can be given per minute for a total administration time of 2 minutes. Treatment should begin to take effect within 40 minutes with a reduction in symptoms and the amount of atropine necessary to control bronchial secretion. The initial dose can be repeated in 1 hour and then every 8 to 12 hours until the patient is clinically well and no longer requires atropine. If intravenous access cannot be established, pralidoxime may also be given intramuscularly. Early administration of diazepam in addition to the combined atropine and pralidoxime treatment may help prevent the onset of seizures and potential brain and cardiac morphologic damage following high-level organophosphate poisoning.

Personal Protective Methods: Wear protective gloves and clothing to prevent any reasonable probability of dermal and/or eye contact. Safety equipment suppliers/manufacturers can provide recommendations on the most protective glove/clothing material for your operation. One recommendation is the use of DuPont™ Tychem® suit fabrics[88]. All protective clothing (suits, gloves, footwear, headgear) should be clean, available each day, and put on before work. Contact lenses should not be worn when working with this chemical. Wear splash-proof chemical goggles and face shield unless full facepiece respiratory protection is worn. Employees should wash immediately with soap when skin is wet or contaminated. Provide emergency showers and eyewash.

Respirator Selection: Engineering controls should be used wherever feasible to maintain airborne concentrations of this chemical below the prescribed exposure limit. Respirators and protective equipment are less effective than engineering controls, and should be used only in non-routine or emergency situations which may result in exposure concentrations in excess of the TWA environmental limit. *At any concentrations above the NIOSH REL, or where there is no REL, at any detectable concentration:* SCBAF: Pd,Pp (APF = 10,000) (any NIOSH/MSHA- or European Standard EN 149-approved self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode); or SaF: Pd,Pp: ASCBA (APF = 10,000) (any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary, self-contained breathing apparatus operated in a pressure-demand or other positive-pressure mode).

Storage: Color Code-Blue: Health Hazard/Poison. Store in a secure poison location. Prior to working with this chemical you should be trained on its proper handling and storage. Where possible, automatically transfer material from other storage containers to process containers. Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: Organophosphorus pesticides, solid or liquid (nonflammable), require a "poisonous materials" label. This chemical falls in Hazard Class 6.1.

Spill Handling: First remove all sources of ignition. Evacuate persons not wearing protective equipment from area of spill or leak until clean up is complete. Stay upwind; keep out of low areas. Ventilate area of spill or leak. Remove and isolate contaminated clothing at the site. Do not touch spilled material; stop leak if you can do so without risk. Use water spray to reduce vapors. *Small spills:* absorb with sand or other noncombustible absorbent material and place into containers for later disposal. *Large spills:* dike far ahead of spill for later disposal. Collect powdered material in the most convenient and safe manner and deposit in sealed containers. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable. Seek professional environmental engineering assistance from the U.S. EPA Environmental Response Team at (908) 548-8730 (24-hour response line).

Fire Extinguishing: Hazardous decomposition includes oxides of phosphorus, sulfur, and nitrogen. May be fatal if inhaled, ingested or absorbed through skin. Inhalation or contact with some of this material will irritate or burn skin and eyes. Vapors may cause dizziness or suffocation. As an immediate precautionary measure, isolate spill or leak area in all directions for at least 50 meters/150 feet for liquids and at least 25 meters/75 feet for solids. *Fire involving storage or vehicular tanks:* isolate for 800 meters/0.5 mile in all directions; also, consider initial evacuation for 800 meters/0.5 mile in all directions. *On a small fire:* use dry chemical, CO_2, water spray or regular foam. *On a large fire:* use water spray, fog or regular foam. Do not scatter spilled material with high-pressure streams of water. Move containers from fire area if you can do it without risk. Dike fire-control water for later disposal. *Fire involving tanks:* from a secure, explosion-proof location, use water spray to cool exposed containers. If cooling streams are ineffective (venting sound increases in volume and pitch, tank discolors, or shows any signs of deforming), withdraw immediately to a secure position. Always stay away from tanks engulfed in fire. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode.

Disposal Method Suggested: Destruction by alkali hydrolysis or incineration. Containers must be disposed of properly by following package label directions or by contacting your local or federal environmental control agency, or by contacting your regional EPA office.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- United States National Library of Medicine, *ChemIDplus Advanced*, Bethesda, MD. http://chem.sis.nlm.nih.gov/chemidplus/rn/98886-44-3

Fuberidazole F:0480

Use Type: Fungicide, Seed treatment

CAS Number: 3878-19-1

Formula: $C_{11}H_8N_2O$

Synonyms: Fuberidatol; Fuberisazol; Fubridazole; 2-(2-Furanyl)-1H-benzimidazole; 2-(2-Furyl)benzimidazole; Furidazol; Furidazole; 2-(2'-furyl)-benzimidazole

Trade Names: BAYCOR®; BAYER 33172®; BAYTAN®; BAYTAN® FS; ICI BAYTAN®; NEOVORONIT®; SIBUTOL®; SIBUTROL®; VORONIT®; VORONITE®; W VII/117®

Chemical Class: Benzimidazole

EPA/OPP PC Code: 466200

UN/NA & ERG Number: UN2811/154

RTECS® Number: DD9010000

EC Number: 223-404-0 [*Annex I Index No.:* 613-016-00-3]

Uses: Uses include cereal seed dressing; and fungicidal non-mercurial seed dressing with special action against fusarium. Not registered as a pesticide for use in the U.S. Registered for use in EU countries[115].

Regulatory Authority and Advisory Information: Health Advisory: Mutagen

Acute Oral Category: 2, WARNING

Superfund/EPCRA 302 Extremely Hazardous Substances: TPQ = 100/10,000 lb (45.4/4,540 kg)

Superfund/EPCRA 40CFR302.4 RQ: EHS, 1 lb (0.454 kg)

European/International Regulations: Hazard Symbol: Xn, N; risk phrases: R22; R50/53; safety phrases: S2; S22; S60; S61 (see Appendix 1)

Description: Fuberidazole is a tan crystalline powder. The commercial may be available as an emulsifiable concentrate. Molecular weight = 184.21; Boiling point = (decomposes); Freezing/Melting point = 286 °C (decomposition); Vapor pressure = 10^{-5} mmHg @ 25 °C; LEL = 17,000 ppm. Hazard Identification (based on NFPA-704 M Rating System): Health 2, Flammability 1, Reactivity 0. Soluble in water; solubility = 0.05 g/L. Physical and toxicological properties may be affected by carrier solvents in commercial formulations.

Incompatibilities: Incompatible with oxidizers, isocyanates, halogenated organics, acidic phenols, epoxides, anhydrides, and acid halides. Decomposes above 286 °C.

Permissible Exposure Limits in Air: Protective Action Criteria (PAC) Ver. 27[89]

PAC-1: 0.3 mg/m^3

PAC-2: 3.3 mg/m^3

PAC-3: 15 mg/m^3

Permissible Concentration in Water: Runoff from spills or fire control may cause water pollution.

Determination in Water: Log K_{ow} = >2.5–<3.0. Values above 3.0 are likely to bioaccumulate in aquatic organisms.

Routes of Entry: Inhalation, ingestion, dermal and/or eye contact.

Harmful Effects and Symptoms

Short Term Exposure: Fuberidazole is classified as moderately toxic. Gastrointestinal tract acute effects. LD_{50} (oral, rat) = 300–500 mg/kg(9); LD_{50} (dermal, rat) = 500 mg/kg.

Long Term Exposure: May be a skin sensitizer. May cause reproductive and fetal effects.

Points of Attack: Skin. Reproductive system.

Medical Surveillance: If skin sensitization is suspected, an evaluation by a qualified allergist, including exposure history and testing, may help diagnose allergy. In addition to comprehensive initial medical and work histories emphasizing reproductive experience and menstrual history, patient should have physical examination and testing of genito-urinary tract, sperm count, motility and morphology. If required, other tests, such as serum testosterone, serum follicle stimulating hormone (FSH), and serum lutenizing hormone (LH), may be indicated.

First Aid: Give artificial respiration if victim is not breathing. *Do not* use mouth-to-mouth method if victim ingested or inhaled the substance; give artificial respiration with the aid of a pocket mask equipped with a one-way valve or other proper respiratory medical device. Administer oxygen if breathing is difficult. Remove and isolate contaminated clothing and shoes. In cases of contact with substance, immediately flush skin or eyes with running water for at least 20 minutes. For minor skin contact, avoid spreading material on unaffected skin. Keep victim warm and quiet. Effects of exposure (inhalation, ingestion or skin contact) to substance may be delayed. Ensure that medical personnel are aware of the material(s) involved and take precautions to protect themselves.

Personal Protective Methods: Wear protective gloves and clothing to prevent any reasonable probability of dermal and/or eye contact. Safety equipment suppliers/manufacturers can provide recommendations on the most protective glove/clothing material for your operation. All protective clothing (suits, gloves, footwear, headgear) should be clean, available each day, and put on before work. Contact lenses should not be worn when working with this chemical. Wear dust-proof chemical goggles and face shield unless full facepiece respiratory protection is worn. Employees should wash immediately with soap when skin is wet or contaminated. Provide emergency showers and eyewash. For emergency situations, wear a positive-pressure, pressure-demand, full facepiece self-contained breathing apparatus (SCBA); or pressure-demand supplied-air respirator with escape SCBA and a fully encapsulating, chemical-resistant suit.

Respirator Selection: SCBA >0.3 mg/m^3. Follow regulations in OSHA 29CFR1910.134 or European Standard EN149. Use a NIOSH/MSHA- or European Standard EN149-approved respirator; or use an approved supplied-air respirator with a full facepiece operated in the positive-pressure mode, or with a full facepiece, hood, or helmet in the continuous-flow mode; or use a NIOSH/MSHA- or European Standard EN149-approved self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive-pressure mode.

Storage: Color Code-Blue: Health Hazard/Poison: Store in a secure poison location. Prior to working with this chemical you should be trained on its proper handling and storage. Store in tightly closed containers in a cool, well-ventilated area. Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: Pesticides, solid, toxic, n.o.s. require a label of "poisonous materials." It falls into Hazard Class 6.1.

Spill Handling: First remove all sources of ignition. Evacuate persons not wearing protective equipment from area of spill or leak until clean up is complete. Do not touch spilled material; stop leak if you can do so without risk. Use water spray to reduce vapors. *Small spills*: absorb with sand or other noncombustible absorbent material and place into containers for later disposal. *Small dry spills*: with clean shovel place material into clean, dry container and cover; move containers from spill area. *Large spills*: dike far ahead of spill for later disposal. Ventilate area after clean up is complete. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable.

Fire Extinguishing: When heated to decomposition, above 286 °C, it releases oxides of nitrogen and carbon. This material is a combustible solid. *Fire involving storage or vehicular tanks:* isolate for 800 meters/0.5 mile in all directions; also, consider initial evacuation for 800 meters/0.5 mile in all directions. *Small fire:* dry chemical, carbon dioxide or water spray. *Large fire:* dry chemical, carbon dioxide, alcohol-resistant foam or water spray. Move containers from fire area if you can do it without risk. Dike fire-control water for later disposal; do not scatter the material. *Fire involving tanks or car/trailer loads:* fight fire from maximum distance or use unmanned hose holders or monitor nozzles. Do not get water inside containers. Cool containers with flooding quantities of water until well after fire is out. Withdraw immediately in the case of rising sound from venting safety devices or discoloration of tank. Always stay away from tanks engulfed in fire. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode.

Disposal Method Suggested: In accordance with 40CFR 165 recommendations for the disposal of pesticides and pesticide containers. Containers must be disposed of properly by following package label directions or by contacting your local or federal environmental control agency, or by contacting your regional EPA office.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- USEPA, “Chemical Profile: Fuberidazole,” Washington DC, Chemical Emergency Preparedness Program (November 30, 1987)

G

Gibberellic acid G:0121

Use Type: Plant growth hormone, Plant regulator

CAS Number: 77-06-5; 125-67-7 (monopotassium salt)

Formula: $C_{19}H_{22}O_6$; $C_{20}H_{24}O_6$ (methyl ester); $C_{19}H_{21}KO_6$ (potassium salt)

Synonyms: Gibb-3-ene-1,10-dicarboxylic acid, 2,4a,7- trihydroxy-1-methyl-8-methylene-, 1,4a-lactone, (1α,2β,4aα, 4bβ,10β)-; Gibberellins; NCI-C55823; 2,4a,7-Trihydroxy-1-methyl-8-methylenegibb-3-ene-1,10-dicarboxylic acid, 1,4a-lactone; GA; GA_3

monopotassium salt: Potassium gibberellate

Trade Names: ACTIVOL®; BERELEX®; BRELLIN®; BOLL-SET®; CEKUGIB®; CROP BOOSTER®; CYTOPLEX HMS®, DYNOGEN®; FALGRO®; FLORALTONE® (with 2,3,5-triiodobenzoic acid); FLORGIB®; FOLI-ZYME®; GIBBEX®; GIBBERELLIN A_3®; GIBBERELLIN X®; GIBBREL®; GIBGRO®; GIB-SOL®; GIB-TABS®; GIBRESCOL®; GROCEL®; KALGIBB®; MAXON®; N-LARGE®; NOVAGIB®; PGR-IV®; PRO-GIBB®; REGULEX®; RELEASE®; RELAX®; RYZUP®; STIMULATE®; VIGOR®

Chemical class: Tetracyclic dihydroxylactonic acid; Diterpenoid acid

EPA/OPP PC Code: 043801; 043802 (potassium salt)

California DPR Chemical Code: 310; 771 (potassium salt)

HSDB Number: 712

UN/NA & ERG Number: None[88] Not regulated.

RTECS® Number: LY8990000

Uses: Gibberellic acids (Gibberellins) are naturally occurring plant hormones that are used as plant growth regulators to stimulate both cell division and elongation that affects leaves and stems. Applications of this hormone also hastens plant maturation and seed germination. Delayed harvesting of fruits, allowing them to grow larger. Gibberellic acids are applied to growing field crops, small fruits, grapes, vines and tree fruit, and ornamentals, shrubs and vines.

U.S. Maximum Allowable Residue Levels for Gibberellic Acid (40 CFR 180.1098): in or on all food commodities when used as plant regulators on plants, seeds, or cuttings and on all food commodities after harvest in accordance with good agricultural practices. *Note:* The U.S. EPA has generally exempted from tolerances many or most of the biochemical plant growth regulators.

Regulatory Authority and Advisory Information:

Health Advisory: Mutagen

Description: White, crystalline solid or powder. Odorless. Molecular weight = 346.39; Freezing/Melting point = 235 °C (decomposition); Vapor pressure = 1.3×10^{-13} mmHg @ 25 °C (est)[83]. Hazard Identification (based on NFPA-704 M Rating System): Health 2, Flammability 0, Reactivity 0. Soluble in water.

Incompatibilities: May react violently with strong oxidizers, bromine, 90% hydrogen peroxide, chlorine solutions, phosphorus trichloride, silver powders or dust. Incompatible with acidic or alkaline materials. Contact with some silver compounds may form explosive salts of silver oxalate.

Determination in Water: Log K_{ow} = <0.5. Unlikely to bioaccumulate in marine organisms.

Routes of Entry: Eyes, skin, inhalation.

Harmful Effects and Symptoms

Short Term Exposure: Contact with eyes or skin may cause irritation or injury. Inhalation should be avoided; use NIOSH- or CEN (UK)-approved air purifying respirators for pesticides. May be harmful if swallowed. LD_{50} (oral, rat) = 6300 mg/kg; LD_{50} (dermal, rabbit) = >2 g/kg.

Long Term Exposure: May cause tumors. May cause reproductive and fetal effects.

Points of Attack: Reproductive system.

Medical Surveillance: In addition to comprehensive initial medical and work histories emphasizing reproductive experience and menstrual history, patient should have physical examination and testing of genito-urinary tract, sperm count, motility and morphology. If required, other tests, such as serum testosterone, serum follicle stimulating hormone (FSH), and serum lutenizing hormone (LH), may be indicated.

First Aid: If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least 15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately. If this chemical contacts the skin, remove contaminated clothing and wash immediately with soap and water. Seek medical attention immediately. If this chemical has been inhaled, remove from exposure, begin rescue breathing (using universal precautions) if breathing has stopped, and CPR if heart action has stopped. Transfer promptly to a medical facility. When this chemical has been swallowed, get medical attention. If victim is conscious and able to swallow, have victim drink 4 to 8 ounces of water. Do not induce vomiting. *Note to physician or authorized medical personnel*: Medical observation is recommended for 24 to 48 hours following breathing overexposure, as pulmonary edema may be delayed. As first aid for pulmonary edema, a doctor or authorized paramedic might consider administering a corticosteroid spray. Cigarette smoking may exacerbate pulmonary injury and should be discouraged for at least 72 hours following exposure

Respirator Selection: Wherever and whenever workplace conditions warrant respirator use, a respiratory protection program must be followed that meets one or more of the following government standards: OSHA's 29 CFR 1910.134, ANSI Z88.2, or European Standard EN 149.

Storage: Color Code-Blue: Health Hazard/Poison: Store in a secure poison location. Prior to working with this chemical you should be trained on its proper handling and storage. Store in tightly closed containers in a cool, well-ventilated area. Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.
Shipping: No shipping information available.
Spill Handling: If a spill occurs, clean it up promptly. Don't wash it away. Instead, sprinkle the spill with sawdust, vermiculite, or kitty litter. Sweep it into a plastic garbage bag, and dispose of it as directed on the pesticide product label[83]. Wash all contaminated surfaces with a soap and water solution.
Fire Extinguishing: *on a small fire:* use dry chemical, carbon dioxide or water spray. *On a small fire:* use water spray, fog or regular foam. Move containers from fire area if you can do it without risk. Dike fire-control water for later disposal. Use water spray or fog; do not scatter material using straight water jet streams. *Fire involving storage or vehicular tanks:* isolate for 800 meters/0.5 mile in all directions; also, consider initial evacuation for 800 meters/0.5 mile in all directions. fight fire from maximum distance or use unmanned hose holders or monitor nozzles. Do not allow water to get inside containers. Cool containers with flooding quantities of water until well after fire is out. Withdraw immediately in the case of rising sound from venting safety devices or discoloration of tank. *Always* stay away from tanks engulfed in fire. For massive fire, use unmanned hose holders or monitor nozzles; if this is impossible, withdraw from area and let fire burn.
Disposal Method Suggested: Recycle any unused portion of the material for its approved use or return it to the manufacturer or supplier. Ultimate disposal of the chemical must consider: the material's impact on air quality; potential migration in soil or water; effects on animal, aquatic, and plant life; and conformance with environmental and public health regulations[83]. Burial or incineration (where permitted) would be effective disposal procedures.
References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- USEPA, "Reregistration Eligibility Decision (RED), Gibberellic Acid" Office of Prevention, Pesticides and Toxic Substances, Washington DC (December 1995). http://www.epa.gov/REDs/4110.pdf
- Registry of Toxic Effects of Chemical Substances, "Gibberellic Acid," National Institute for Occupational Safety and Health (NIOSH), (October 2002). http://www.cdc.gov/NIOSH/ly892d30.html#L
- USEPA, Office of Pesticide Programs, Pesticide Residue Limits, "Gibberellic Acid," 40 CFR 180.1098. http://www.epa.gov/pesticides/food/viewtols.htm

Glufosinate-ammonium G:0135

Use Type: Herbicide
CAS Number: 77182-82-2
Formula: $C_5H_{15}N_2O_4P$
Synonyms: 2-Amino-4-(hydroxymethylphosphinyl)butanoic acid monoammonium salt; Ammonium (3-amino-3-carboxypropyl)methylphosphinate; Ammonium 2-amino-4-(hydroxymethylphosphinyl)butanoate; Ammonium-*dl*-homoalanin-4-yl (methyl) phosphinate; Ammonium (*dl*-homoalanine-4-yl)methylphosphinate; Butanoic acid, 2-amino-4-(hydroxymethylphosphinyl)-, monoammonium salt; Butanoic acid, 2-amino-4-(hydroxymethylphosphinyl)-, monoammonium salt; Monoammonium 2-amino-4-(hydroxymethylphosphinyl) butanoate; Phosphinothricin monoammonium salt
Trade Names: BASTA®; DERRINGER®; FINALE®; HOE 00661®; HOE 03986®; HOE 39866®; IGNITE®; LIBERTY®; RELY®; REMOVE®; RUBOUT®; TOTAL®
Chemical class: Organophosphate
EPA/OPP PC Code: 128850
California DPR Chemical Code: 3946
HSDB Number: 6666
UN/NA & ERG Number: UN2783 (solid)/152
RTECS® Number: EK7713600
EC Number: 278-636-5 [*Annex I Index No.:* 015-155-00-X]
Uses: Glufosinate-ammonium is a naturally occurring broad-spectrum contact herbicide that is used to control a wide range of weeds after the crop emerges or for total vegetation control on non-crop lands. It is used on crops that have been genetically engineered. Glufosinate herbicides are also used to desiccate crops before harvest.
U.S. Maximum Allowable Residue Levels for Glufosinate Ammonium and its metabolite, 3-methylphosphinico-propionic acid, expressed as 2-amino-4-(hydroxmethyl-phosphinyl)butanoic acidequivalents. [40 CFR 180.473(a)(1)]: in or on the following food commodities: almond, hulls 0.50 ppm; apple 0.05 ppm; banana 0.03 ppm; banana, pulp 0.20 ppm; cattle, fat 0.05 ppm; cattle, meat 0.05 ppm; cattle, meat byproducts 0.10 ppm; egg 0.05 ppm; goat, fat 0.05 ppm; goat, meat 0.05 ppm; goat, meat byproducts 0.10 ppm; grape 0.05 ppm; hog, fat 0.05 ppm; hog, meat 0.05 ppm; hog, meat byproducts 0.10 ppm; horse, fat 0.05 ppm; horse, meat 0.05 ppm; horse, meat byproducts 0.10 ppm; milk 0.02 ppm; nut, tree group 0.10 ppm; potato 0.80 ppm; potato chips 1.60 ppm; potato granules and flakes 2.00 ppm; poultry, fat 0.05 ppm; poultry, meat 0.05 ppm; poultry, meat byproducts 0.10 ppm; sheep, fat 0.05 ppm; sheep, meat 0.05 ppm; and sheep, meat byproducts 0.10 ppm. ***For glufosinate and its metabolites, 2-acetamido-4methylphosphinico-butanoic acid and 3-methylphosphinico-propionic acid, expressed as 2-amino-4-(hydroxymethylphosphinyl)butanoic acidequivalents. [40 CFR 180.473(a)(2)]:*** in or on the following food commodities derived from transgenic canola, transgenic field corn, transgenic soybeans and transgenic sugar beets that are tolerant to the herbicide glufosinate ammonium as follows: aspirated grain fractions 25.0 ppm; beet,

sugar, molasses 5.0 ppm; beet, sugar, roots 0.9 ppm; beet, sugar, tops (leaves) 1.5 ppm; canola, meal 1.1 ppm; canola, seed 0.4 ppm; corn, field, forage 4.0 ppm; corn, field, grain 0.2 ppm; corn, field, stover 6.0 ppm; soybean, hulls 5.0 ppm; and soybean 2.0 ppm.

Human toxicity (long-term [101]: Very low–140.00 ppb, Health Advisory

Fish toxicity (threshold)[101]: Very low–1984.85607 ppb, MATC (Maximum Acceptable Toxicant Concentration)

Regulatory Authority and Advisory Information:

Carcinogenicity[83]: EPA, Not likely to be carcinogenic to humans

Acute Oral Category: 3, CAUTION

Health Advisory: Nerve Toxin

DOT Inhalation Hazard Chemicals as organophosphates

European/International Regulations: Hazard Symbol: T; risk phrases: R20/21/22; R48/20/33; R60; R63; safety phrases: S2; S45; S53 (see Appendix 1)

WGK (German Aquatic Hazard Class): 1-Low hazard to waters

Description: White to yellowish crystalline solid or powder. Slight, pungent odor. Molecular weight = 198.19; Specific gravity (H_2O:1) = 1.32; 1.4; Boiling point = (decomposes); Freezing/Melting point = 215–217 °C. Highly soluble in water; solubility = 2×10^5 ppm @ 20 °C.

Incompatibilities: Decomposes in temperatures above 240 °C. May react violently with antimony(V) pentafluoride. Incompatible with lead diacetate, magnesium, silver nitrate. In the presence of strong reducing agents such as hydrides, organophosphates form highly toxic and flammable phosphine gas. Contact with oxidizers can cause the release of toxic oxides of phosphorus.

Permissible Exposure Limits in Air: OSHA versatile sampler-2; Toluene/Acetone; Gas chromatography/Flame ionization detection; NIOSH IV, Method #5600, Organophosphorus Pesticides[18].

Determination in Water: Aqueous hydrolysis rate = <0.0023/day @ 25 °C, pH 5,7,9[83,USDA]. Log K_{ow} = <–3. Unlikely to bioaccumulate in marine organisms.

Routes of Entry: Inhalation, ingestion, dermal and/or eye contact.

Harmful Effects and Symptoms

Short Term Exposure: Eye pupils are small; blurred vision; eye watering; runny nose; cough; shortness of breath; salivation; dizziness; nausea, stomach cramps, diarrhea, and vomiting; increased blood pressure; profuse sweating; hypermotility, hallucinations; irritability; tingling of the skin; drowsiness; slow heartbeat; convulsions; fluid in lungs; loss of consciousness; incontinence; breathing stops; death. Organophosphates inhibit the action of acetylcholinesterase enzymes, and alter the way in which nervous impulses are transmitted. The effects can last for hours, days, or much longer. The action of the enzymes is reestablished after new enzymes are formed. LD_{50} (oral, rat) = 1620 mg/kg; LD_{50} (dermal, rat) = >2 g/kg.

Long Term Exposure: Cholinesterase inhibitor; cumulative effect is possible. Organophosphates may damage the nervous system with repeated exposure, resulting in convulsions, respiratory failure. May cause liver damage. Possible reproduction hazard. A neurotoxin.

Points of Attack: Respiratory system, central nervous system, cardiovascular system, blood cholinesterase. May target liver, kidneys, bladder, blood, and lungs. A neurotoxin.

Medical Surveillance: Preliminary medical exam to detect chronic diseases of central nervous system, liver, heart, kidneys, lung and skin, as well as endocrinological or immunological disturbances, should protect susceptible individuals. Periodical medical exams of internal organs, skin and eyes are important to avoid chronic occupational intoxications. They should include lab and patch tests when necessary[83]. Medical observation is recommended for 24 to 48 hours following breathing overexposure, as pulmonary edema may be delayed. Cigarette smoking may exacerbate pulmonary injury and should be discouraged for at least 72 hours following exposure

First Aid: Speed in removing material from eyes and skin is of extreme importance. *Eyes:* Eye contact can cause dangerous amounts of these chemicals to be quickly absorbed through the mucous membrane into the bloodstream. Immediately and gently flush eyes with plenty of warm or cold water (NO hot water) for at least 15 minutes, occasionally lifting the upper and lower eyelids. Get medical aid immediately. *Skin:* Get medical aid. Dermal contact can cause dangerous amounts of these chemicals to be absorbed into the bloodstream. Wearing the appropriate PPE equipment and respirator for organophosphate pesticides, immediately flush skin with plenty of soap and water for at least 15 minutes while removing contaminated clothing and shoes. Shampoo hair promptly if contaminated. *Ingestion:* Call poison control. Loosen all clothing. Never give anything by mouth to an unconscious person. Get medical aid. Do NOT induce vomiting. * If conscious, alert, and able to swallow, rinse mouth and have victim drink 4 to 8 ounces of water do NOT induce vomiting but immediately administer slurry of activated charcoal (2 oz in 8 oz of water). If victim is *unconscious or having convulsions,* do nothing except keep victim warm. **In some cases you may be specifically instructed by poison control to induce vomiting by way of 2 tablespoons of syrup of ipecac (adult) washed down with a cup of water*. Do NOT give activated charcoal before or with ipecac syrup. *Inhalation:* Get medical aid. Do not contaminate yourself. Wearing the appropriate PPE equipment and respirator for organophosphate pesticides, immediately remove the victim from the contaminated area to fresh air. If the victim is not breathing, administer artificial respiration. Do not use mouth-to-mouth method if victim ingested or inhaled the substance; give artificial respiration with the aid of a pocket mask equipped with a one-way valve or other proper respiratory medical device. If breathing is difficult, administer oxygen through bag/mask apparatus until medical help arrives. Do not leave victim unattended. *Note to physician or authorized medical personnel.* Administer atropine, 2 mg (1/30 gr) intramuscularly or intravenously as soon as any local or systemic signs or symptoms of an intoxication are noted; repeat the administration of atropine every

3 to 8 minutes until signs of atropinization (mydriasis, dry mouth, rapid pulse, hot and dry skin) occur; initiate treatment in children with 0.05 mg mg/kg of atropine; repeat at 5 to 10 minute intervals. Watch respiration, and remove bronchial secretions if they appear to be obstructing the airway; intubate if necessary. *Notes to physician or authorized medical personnel*: *N*-methylpyridinium-2-aldoxime (2-PAMCI) when used in conjunction with atropine reacts with the phosphorylated cholinesterase, thereby restoring normal activity by removing the phosphorylating group. The combination of these two chemicals is synergistic and must be administered within minutes to a few hours following exposure (depending on the specific agent) to be effective. Give 2-PAMCI (Pralidoxime; Protopam), 2.5 gm in 100 ml of sterile water or in 5% dextrose and water, intravenously, slowly, in 15–30 minutes; if sufficient fluid is not available, give 1 g of 2-PAMCI in 3 ml of distilled water by deep intramuscular injection; repeat this every half hour if respiration weakens or if muscle fasciculation or convulsions recur. Also diazepam, an anticonvulsant, might be considered. As first aid for pulmonary edema, a doctor or authorized paramedic might consider administering a corticosteroid spray.

Respirator Selection: Wherever and whenever workplace conditions warrant respirator use, a respiratory protection program must be followed that meets one or more of the following government standards: OSHA's 29 CFR 1910.134, ANSI Z88.2, or European Standard EN 149.

Storage: Color Code-Blue: Health Hazard/Poison. Store in a secure poison location. Prior to working with this chemical, you should be trained on its proper handling and storage. Store in tightly closed containers in a cool, well-ventilated area away from strong bases. Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: Organophosphorus pesticides, solid or liquid (nonflammable), require a label of "poisonous materials." This chemical falls in Hazard Class 6.1.

Spill Handling: First remove all sources of ignition. Evacuate persons not wearing protective equipment from area of spill or leak until clean up is complete. Stay upwind; keep out of low areas. Ventilate area of spill or leak. Remove and isolate contaminated clothing at the site. Do not touch spilled material; stop leak if you can do so without risk. Use water spray to reduce vapors. *Small spills:* absorb with sand or other noncombustible absorbent material and place into containers for later disposal. *Large spills:* dike far ahead of spill for later disposal. Collect powdered material in the most convenient and safe manner and deposit in sealed containers. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable. Seek professional environmental engineering assistance from the U.S. EPA Environmental Response Team at (908) 548-8730 (24-hour response line).

Fire Extinguishing: Hazardous decomposition includes oxides of phosphorus, sulfur, and nitrogen. May be fatal if inhaled, ingested or absorbed through skin. Inhalation or contact with some of these materials will irritate or burn skin and eyes. Vapors may cause dizziness or suffocation. *Small fires:* dry chemical, carbon dioxide; water spray; or foam. *Large fires:* water spray, fog, or foam. Stay upwind; keep out of low areas. Ventilate closed spaces before entering them. Firefighting gear (including SCBA) may not provide adequate protection. If exposure occurs, remove and isolate gear immediately and thoroughly decontaminate personnel. Wear positive-pressure breathing apparatus and special protective clothing. Remove and isolate contaminated clothing at the site. Move container from fire area if you can do so without risk. fight fire from maximum distance. Dike fire-control water for later disposal; do not scatter the material. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies. From a secure, explosion-proof location, use water spray to cool exposed containers. If cooling streams are ineffective (venting sound increases in volume and pitch, tank discolors, or shows any signs of deforming), withdraw immediately to a secure position. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode.

Disposal Method Suggested: Destruction by alkali hydrolysis or incineration. Containers must be disposed of properly by following package label directions or by contacting your local or federal environmental control agency, or by contacting your regional EPA office.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- USEPA, Office of Pesticide Programs, Pesticide Residue Limits, "Glufosinate Ammonium," 40 CFR 180.473. http://www.epa.gov/fedrgstr/EPA-PEST/2003/September/Day-29/p24565.htm

Glutaraldehyde G:0140

Use Type: Fungicide, Biocide

CAS Number: 111-30-8

Formula: $C_5H_8O_2$; $HCO(CH_2)_3CHO$

Synonyms: 1,3-Diformal propane; Glutamic dialdehyde; Glutaral; Glutard dialdehyde; Glutaric acid dialdehyse; Glutaric dialdehyde; NCI-C55425; Pentanedial;

1,5-Pentanedial; 1,5-Pentanedione; Potentiated acid glutaraldehyde

Trade Names: AQUCAR®; CIDEX® (component of this product); CUDEX; ODIX (component of this product); COLDCIDE-25® microbiocide concentrate; GKN-O® microbiocide concentrate (glutaraldehyde + alkyl dimethyl benzyl ammonium chloride + alkyl dimethyl ethylbenzyl ammonium chloride); HOSPEX®; SONACIDE®

Chemical class: Aldehyde

EPA/OPP PC Code: 043901

California DPR Chemical Code: 139

HSDB Number: 949

UN/NA & ERG Number: UN2810/Guide 153

RTECS® Number: MA2450000

EC Number: 203-856-5 [*Annex I Index No.:* 605-022-00-X]

Uses: Used to control pollutants in water treatment plants and towers. Glutaraldehyde is also used as a cross-linking agent for protein and polyhydroxy materials. It has been used in tanning and as a fixative for tissues. It is also used as an intermediate. Buffered solutions are used as antimicrobial agents in hospitals. Registered for use in the U.S. and other countries. Not approved for use in most EU countries[115].

Regulatory Authority and Advisory Information:

Carcinogenicity[83]: ACGIH A4, not classified as a human carcinogen.

Health Advisory: Mutagen, Developmental/Reproductive Toxin, Skin irritant/sensitizer

European/International Regulations: Hazard Symbol: T, N; risk phrases: R23/25; R34; R42/43; R50; safety phrases: S1/2; S26; S36/37/39; S45; S61 (see Appendix 1)

WGK (German Aquatic Hazard Class): 3-Severe hazard to waters

Description: Glutaraldehyde is a colorless liquid, which readily changes to a glossy polymer. Pungent odor. The Odor Threshold is 0.04 ppm[NY]; 0.2 ppm[NJ]. Molecular weight = 100.13; Specific gravity (H_2O:1) = 1.057; Boiling point = 100 °C; also 187–189 °C (decomposes); Freezing/Melting point = –13.8 °C; also–5.7 °C; Vapor pressure = 17 mmHg. Hazard Identification (based on NFPA-704 M Rating System): Health 2, Flammability 0, Reactivity 0. Highly soluble in water.

Incompatibilities: May react violently with bromine, ketones. Incompatible with strong acids, azo dyes, caustics, ammonia, amines, boranes, hydrazines, strong oxidizers.

Permissible Exposure Limits in Air: Conversion factor: 1 ppm = 4.09 mg/m^3 @ 25 °C & 1 atm

OSHA PEL: None

NIOSH REL: 0.2 ppm/0.8 mg/m^3 Ceiling Concentration.

Note: NIOSH recommends that careful consideration should be given to reducing exposures to this aldehyde. Further information can be found in the *NIOSH Current Intelligence Bulletin 55: Carcinogenicity of Acetaldehyde and Malonaldehyde, and Mutagenicity of Related Low-Molecular-Weight Aldehydes* [DHHS (NIOSH), Publication No. 91-112]; See *NIOSH Pocket Guide*, Appendix C

ACGIH TLV®[1]: 0.05 ppm/0.2 mg/m^3 Ceiling Concentration, sensitizer, not classifiable as a human carcinogen

Protective Action Criteria (PAC) Ver. 27[89]

PAC-1: **0.2** ppm

PAC-2: **1** ppm

PAC-3: **5** ppm

*AEGLs (Acute Emergency Guideline Levels) and ERPGs (Emergency Response Planning Guideline) are in **bold face**.

DFG MAK: 0.05 ppm/0.21 mg/m^3 TWA; Peak Limitation Category I(2) a momentary value of 0.2 ml/m^3/0.83 mg/m^3 should not be exceeded; danger of skin and airway sensitization; Carcinogen Category 4; Pregnancy Risk Group C

Determination in Air: Si gel; Acetonitrile; High-pressure liquid chromatography/Ultraviolet; NIOSH IV, Method #2532; OSHA Analytical Method #ID-64

Determination in Water: Log K_{ow} = –0.19. Unlikely to bioaccumulate in marine organisms.

Routes of Entry: Inhalation, skin absorption, ingestion, skin and/or eye contact. Can be absorbed through the skin

Harmful Effects and Symptoms

Short Term Exposure: Irritates the eyes, skin, and respiratory tract. *Inhalation:* 0.3 ppm can cause nose and throat irritation; 0.4 ppm has caused headaches; 0.5 ppm has been described as intolerably irritating. *Skin:* Can cause irritation. Contact with a 5% solution can sensitize the skin and cause an allergic response to subsequent contact of much lower concentrations. *Eyes*: Vapors of a 2% solution (0.4 ppm) have produced irritation; high levels may cause irreversible eye damage. *Ingestion:* Can cause irritation of the mouth and stomach. LD_{50} (oral, rat) = 134–246[OEC] mg/kg. Moderately toxic.

LD_{50} (oral, rat) = 134 mg/kg; LD_{50} (dermal, rat) = >2.5 g/kg.

Long Term Exposure: May cause tumors. Repeated or prolonged contact with skin may cause chemical sensitization, skin allergy and asthma. Exposure may cause liver and nervous system damage. Glutaraldehyde may cause mutations, handle with extreme caution. May cause asthmatic signs and symptoms in hyper-reactive individuals.

Points of Attack: Eyes, skin, respiratory system, liver, central nervous system.

Medical Surveillance: If symptoms develop or overexposure has occurred, the following may be useful: Liver function tests. Evaluation by a qualified allergist, including exposure history and testing, may help diagnose allergy.

Note: Testing by NIOSH has not been completed to determine the carcinogenicity of glutaraldehyde and related low-molecular-weight-aldehydes. However, the limited studies to date indicate that these substances have chemical reactivity and mutagenicity similar to acetaldehyde and malonaldehyde. NIOSH recommends that acetaldehyde and malonaldehyde be considered potential occupational carcinogens in conformance with the OSHA carcinogen policy. Therefore, NIOSH recommends that careful consideration should be given to reducing exposures to related aldehydes such as gluteraldehyde. Exposure to acetaldehyde has produced nasal tumors in rats and laryngeal tumors in hamsters, and exposure to malonaldehyde has produced thyroid gland and pancreatic islet cell tumors in rats. Further information can be found in the

"NIOSH Current Intelligence Bulletin 55: Carcinogenicity of Acetaldehyde and Malonaldehyde, and Mutagenicity of Related Low-Molecular-Weight Aldehydes" [NIOSH Publication No. 91-112.] NIOSH Current Intelligence Bulletin #55, September 1991.

First Aid: If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least 15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately. If this chemical contacts the skin, remove contaminated clothing and wash immediately with soap and water. Seek medical attention immediately. If this chemical has been inhaled, remove from exposure, begin rescue breathing (using universal precautions) if breathing has stopped, and CPR if heart action has stopped. Transfer promptly to a medical facility. When this chemical has been swallowed, get medical attention. Give large quantities of water and induce vomiting. Do not make an unconscious person vomit. Do not induce vomiting when formulations containing petroleum solvents are ingested

Personal Protective Methods: Wear protective gloves and clothing to prevent any reasonable probability of dermal contact: **8 hr:** butyl rubber gloves, suits, boots; Viton™ gloves, suits; **4 hr**: natural rubber gloves; Neoprene™ rubber gloves, suits, boots; nitrile rubber gloves, suits, boots; polyvinyl chloride gloves, suits, boots. Safety equipment suppliers/manufacturers can provide recommendations on the most protective glove/clothing material for your operation. All protective clothing (suits, gloves, footwear, headgear) should be clean, available each day, and put on before work. Contact lenses should not be worn when working with this chemical. Wear splash-proof chemical goggles and face shield unless full facepiece respiratory protection is worn. Employees should wash immediately with soap when skin is wet or contaminated. Provide emergency showers and eyewash.

Respirator Selection: SCBA >**0.2** ppm AEGL (Acute Emergency Guideline Levels). NIOSH: Where potential exists for exposures *over 0.2 ppm*, use an NIOSH/MSHA- or European Standard EN 149-approved respirator with an organic vapor cartridge/canister and a dust/mist/fume prefilter. More protection is provided by a full facepiece respirator than by a half-mask respirator, and even greater protection is provided by a powered-air purifying respirator. *Where potential for high exposures exists*, use an NIOSH/MSHA- or European Standard EN 149-approved supplied-air respirator with a full facepiece operated in the positive-pressure mode, or with a full facepiece, hood, or helmet in the continuous-flow mode; or use an NIOSH/MSHA- or European Standard EN 149-approved self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive-pressure mode.

Storage: (1) Color Code-Yellow Stripe (*strong reducing agent*): Reactivity Hazard; Store separately in a area isolated from flammables, combustibles, or other yellow coded materials. (2) Color Code-Blue: Health Hazard/Poison: Store in a secure poison location. Prior to working with this chemical you should be trained on its proper handling and storage. Store in tightly closed containers in a cool, well-ventilated area away from strong acids, caustics, ammonia, amines, oxidizers. Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: Glutaraldehyde fits the shipping name of Toxic, liquids, organic, n.o.s. It requires a shipping label of "poisonous materials." It falls into Hazard Class 6.1.

Spill Handling: Evacuate and restrict persons not wearing protective equipment from area of spill or leak until clean up is complete. Ventilate area of spill or leak. Absorb liquids in vermiculite, dry sand, earth, peat, carbon, or a similar material and deposit in sealed containers. Keep this chemical out of a confined space, such as a sewer, because of the possibility of an explosion, unless the sewer is designed to prevent the build-up of explosive concentrations. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable.

Fire Extinguishing: Hazardous decomposition includes oxides of carbon. Extinguish fire using an agent suitable for type of surrounding fire. Glutaraldehyde itself does not burn. Use dry chemical, carbon dioxide; or alcohol foam extinguishers. Vapors are heavier than air and will collect in low areas. Vapors may travel long distances to ignition sources and flashback. Vapors in confined areas may explode when exposed to fire. Containers may explode in fire. Storage containers and parts of containers may rocket great distances, in many directions. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies. From a secure, explosion-proof location, use water spray to cool exposed containers. If cooling streams are ineffective (venting sound increases in volume and pitch, tank discolors, or shows any signs of deforming), withdraw immediately to a secure position. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode.

Disposal Method Suggested: Dissolve or mix the material with a combustible solvent and burn in a chemical incinerator equipped with an afterburner and scrubber. Do not discharge effluent containing this product into lakes, streams, ponds, estuaries, oceans, or other waters unless in accordance with the requirements of a National Pollution Discharge Elimination System (NPDES) permit and the permitting authority has been notified in writing prior to discharge. Do not discharge effluent containing this product to sewer systems without previously notifying the local sewage treatment plant authority. For guidance contact your State Water Board or Regional Office of the EPA. All federal, state, and local environmental regulations must be observed.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- New York State Department of Health, "Chemical Fact Sheet; Glutaraldehyde," Albany, NY, Bureau of Toxic Substance Assessment (April 1986)
- New Jersey Department of Health and Senior Services, "Hazardous Substance Fact Sheet: Glutaraldehyde," Trenton, NJ (February, 1989, rev. April 1994, January 2000). http://www.state.nj.us/health/eoh/rtkweb/0960.pdf
- Sax, N. I., Ed., "Dangerous Properties of Industrial Materials Report," 1, No. 7, 2-4 (1981)

Glyphosate G:0180

Use Type: Herbicide

CAS Number: 1071-83-6

Formula: $C_3H_8NO_5P$; $HOCOCH_2NHCH_2PO(OH)_2$

Synonyms: Glifosato (Spanish); Glycine, *N*-(phosphonomethyl)-; Phosphonomethyliminoacetic acid; *N*-Phosphonomethyl glycine; *N*-(Phosphonomethyl)-glycine

Trade Names: ACCORD®; AQUANEAT®; CAMPAIGN®; COSMIC®; FALLOW MASTER®; FIELD MASTER®; FIRE POWER®; FLAME PLUS®, Agrochemicals del Ecuador (AGROCHEM) (Ecuador); FONT 360®, Agrochemicals del Ecuador (AGROCHEM) (Ecuador); FOZZATE®; GALLUP®; GLAND-UP®; GLIFONOX®; GLION®; GLYCEL®; GLY-FLO®; GLYFOCAL®; GLYFOS®; GLYPRO®; GLYTEX®; GLYWEED®; GROUND-UP®; KEN-ROUND EXTRA®; KEN-STAR PLUS®; KLEERAWAY®; LANDMASTER®; LIDER®; MON 0573®; MON 2139®; OXALIS®; PONDMASTER®; RANGER®; RAZOR®; READY MASTER®; RODEO®; ROPHOSATE®; ROUNDUP®; SANOS®; STANDOUT®; SWEEP®; TOUCHDOWN®; TREVISSIMO®; TROP®; ZPP 1560 AS HERBICIDE®

Chemical class: Phosphonoglycine Herbicide; Phosphinic acid

EPA/OPP PC Code: 417300; 471300 use code No. 417300

California DPR Chemical Code: 2997

HSDB Number: 3432

UN/NA & ERG Number: UN3077(solid)/171; UN3082 (liquid)/171

RTECS® Number: MC1075000

EC Number: 213-997-4 [*Annex I Index No.:* 607-315-00-8]

Uses: A General Use Pesticide (GUP). Glyphosate is a broad-spectrum, nonselective systemic herbicide used for control of annual and perennial plants including grasses, sedges, broad-leaved weeds, fruit orchards, vineyards, and woody plants. Frequently used on plantation crops such as tea, bananas, coffee, coconut, cocoa, mangoes and palms. As a pre-crop emergence control, it is used on vegetables, beet, okra, soya beans, lucerne, figs, kiwi, olives cereals, cotton, etc.) It can be used on non-cropland, aquatic weed control, and pre-harvest desiccation of cotton, cereals, peas and beans. It controls suckers on fruit trees. Glyphosate itself is an acid, but it is commonly used in salt form, most commonly the isopropylamine salt. It may also be available in acidic or trimethylsulfonium salt forms. It is generally distributed as water-soluble concentrates and powders. The world's largest selling herbicide.

U.S. Maximum Allowable Residue Levels for Glyphosate (40 CFR 180.364): Acerola 0.2 ppm; alfalfa, forage 175 ppm; alfalfa, hay 400 ppm; almond, hulls 25 ppm; aloe vera 0.5 ppm; ambarella 0.2 ppm; animal Feed, nongrass, group 18, 400 ppm; artichoke, Jerusalem 0.2 ppm; asparagus 0.5 ppm; atemoya 0.2 ppm; avocado 0.2 ppm; bamboo, shoots 0.2 ppm; banana 0.2 ppm; barley, bran 30 ppm; barley, grain 20 ppm; beet, sugar, dried pulp 25 ppm; beet, sugar, roots 10 ppm; beet, sugar, tops 10 ppm; berry group 13, 0.2 ppm; betelnut 1 ppm; biriba 0.2 ppm; borage, seed 0.1 ppm; breadfruit 0.2 ppm; cacao bean 0.2 ppm; cactus, fruit 0.5 ppm; cactus, pads 0.5 ppm; canistel 0.2 ppm; canola, meal 15 ppm; canola, seed 10 ppm; cattle, liver 0.5 ppm; chaya, leaves 1 ppm; cherimoya 0.2 ppm; citrus, dried pulp 1.5 ppm; coconut 0.1 ppm; coffee, bean 1 ppm; corn, field, forage 6 ppm; corn, field, grain 1 ppm; cotton, gin byproducts 100 ppm; cotton, undelinted seed 15 ppm; crambe, seed 0.1 ppm; cranberry 0.2 ppm; custard apple 0.2 ppm; date, dried fruit 0.2 ppm; dokudami, leaves 2 ppm; durian 0.2 ppm; egg 0.05 ppm; epazote, leaves 1.3 ppm; feijoa 0.2 ppm; fig 0.2 ppm; fish 0.25 ppm; flax, meal 8 ppm; flax, seed 4 ppm; fruit, citrus, group 10, 0.5 ppm; fruit, pome, group 11, 0.2 ppm; fruit, stone, group 12, 0.2 ppm; galangal, roots 0.2 ppm; ginger, white, flower 0.2 ppm; goat, liver 0.5 ppm; gourd, buffalo, seed 0.1 ppm; governor's plum 0.2 ppm; gow kee, leaves 0.2 ppm; grain, aspirated fractions 100 ppm; grain, cereal, except barley, field corn, grain sorghum, oats and wheat 0.1 ppm; grain, cereal, forage, fodder and straw, group 16, 100 ppm; grain, crops, except wheat, oats, grain sorghum, barley, 0.1 ppm; grape 0.2 ppm; grass, forage, fodder and hay, group 17, 300 ppm; guava 0.2 ppm; herb and spice group 19, 0.2 ppm; herb and spice group 19, 7 ppm; hog, kidney 4 ppm; hog, liver 0.5 ppm; hop, dried cones 7 ppm; horse, liver 0.5 ppm; ilama 0.2 ppm; imbe 0.2 ppm; imbu 0.2 ppm; jaboticaba 0.2 ppm; jackfruit 0.2 ppm; jojoba, seed 0.1 ppm; juneberry 0.2 ppm; kava, roots 0.2 ppm; kenaf, forage 200 ppm; kiwifruit 0.2 ppm; lesquerella, seed 0.1 ppm; leucaena, forage 200 ppm; lingonberry 0.2 ppm; longan 0.2 ppm; lychee 0.2 ppm; mamey apple 0.2 ppm; mango 0.2 ppm; mangosteen 0.2 ppm; marmaladebox 0.2 ppm; meadowfoam, seed 0.1 ppm; mioga, flower 0.2 ppm; mustard, seed 0.1 ppm; nut, pine 1 ppm; nut, tree, group 14, 1 ppm; oat, grain 20 ppm; okra 0.5 ppm; olive 0.2 ppm; oregano, Mexican, leaves 2 ppm; palm heart, leaves 0.2 ppm; palm, oil 0.1 ppm; papaya 0.2 ppm; papaya, mountain 0.2 ppm; passionfruit 0.2 ppm; pawpaw

0.2 ppm; peanut 0.1 ppm; peanut, forage 0.5 ppm; peanut, hay 0.5 ppm; pepper leaf, fresh leaves 0.2 ppm; peppermint, tops 200 ppm; perilla, tops 1.8 ppm; persimmon 0.2 ppm; pineapple 0.1 ppm; pistachio 1 ppm; pomegranate 0.2 ppm; poultry, meat 0.1 ppm; poultry, meat byproducts 1 ppm; pulasan 0.2 ppm; quinoa, grain 5 ppm; rambutan 0.2 ppm; rapeseed, meal 15 ppm; rapeseed, seed 10 ppm; rose apple 0.2 ppm; safflower, seed 0.1 ppm; salal 0.2 ppm; sapodilla 0.2 ppm; sapote, black 0.2 ppm; sapote, mamey 0.2 ppm; sapote, white 0.2 ppm; sesame, seed 0.1 ppm; sheep, liver 0.5 ppm; shellfish 3 ppm; sorghum, grain, grain 15 ppm; soursop 0.2 ppm; soybean, forage 100 ppm; soybean, hay 200 ppm; soybean, hulls 100 ppm; soybean, seed 20 ppm; Spanish lime 0.2 ppm; spearmint, tops 200 ppm; star apple 0.2 ppm; starfruit 0.2 ppm; stevia, dried leaves 1 ppm; strawberry 0.2 ppm; sugar apple 0.2 ppm; sugarcane, cane 2 ppm; sugarcane, molasses 30 ppm; sunflower, seed 0.1 ppm; Surinam cherry 0.2 ppm; tamarind 0.2 ppm; tea, dried 1 ppm; tea, instant 7 ppm; teff, grain 5 ppm; ti, leaves 0.2 ppm; ti, roots 0.2 ppm; ugli fruit 0.5 ppm; vegetable, brassica, leafy, group 5, 0.2 ppm; vegetable, bulb, group 3, 0.2 ppm; vegetable, cucurbit, group 9, 0.5 ppm; vegetable, foliage of legume, except soybean, subgroup 7a, 0.2 ppm; vegetable, fruiting, group 8, 0.1 ppm; vegetable, legume, group 6, 5 ppm; vegetable, root, except sugarbeet, ppm; subgroup 1b, 0.2 ppm; wasabi, roots 0.2 ppm; water spinach, tops 0.2 ppm; watercress, upland 0.2 ppm; wax jambu 0.2 ppm; wheat, grain 5 ppm; wheat, milled fractions, except flour 20 ppm; yacon, tuber 0.2 ppm.

Note: June 2013 EPA raised the allowable concentrations of glyphosate as follows: forage and hay teff, up to 100 ppm; oilseed crops, up to 40 ppm; root crops, 6000 ppb; fruits, 200 ppb–500 ppb.

Human toxicity (long-term)[101]: Very low–700.00 ppb, MCL (Maximum Contaminant Level)

Fish toxicity (threshold)[101]: Very low–26000.00 ppb, MATC (Maximum Acceptable Toxicant Concentration)

Regulatory Authority and Advisory Information:

Carcinogenicity[83]: EPA Group E, evidence of non-carcinogenicity for humans.

Note: Human skin cell studies conducted at the Indian Institute of Toxicology Research in Pradesh, India, reported in a 2013 study that glyphosate "has cancer-promoting properties."

Acute Oral Category: 3, CAUTION

Health Advisory: Mutagen

NTP: Toxicity studies, Report #TOX-16, October 2000

US DOT 49CFR172.101, Inhalation Hazard Chemical as organophosphates

European/International Regulations: Hazard Symbol: Xi, N; risk phrases: R41; R51/53; safety phrases: S2; S26; S39; S61 (see Appendix 1)

WGK (German Aquatic Hazard Class): 2-Hazard to waters

Description: Glyphosate is a colorless crystalline powder. Odorless. Hazard Identification (based on NFPA-704 M Rating System): Health 3, Flammability 2, Reactivity 0. Often used as a liquid in a carrier solvent which may change physical and toxicological properties. Molecular weight = 169.09; Specific gravity (H_2O:1) = 1.71; Boiling point = (decomposes); Freezing/Melting point = (decomposes) 230 °C; 190 °C; Vapor pressure = 1.97×10^{-7} mmHg @ 45 °C. Flash point: flammable in solution. Hazard Identification (based on NFPA-704 M Rating System): Health 2, Flammability 0, Reactivity 0. Highly soluble in water; solubility = 5–10 mg/L @ 25 °C.

Incompatibilities: Decomposes in temperatures above 215 °C. pH = 2.5 (1% solution). Solutions are corrosive to iron, unlined steel, and galvanized steel, forming a highly combustible or explosive gas mixture. Do not store glyphosate in containers made from these materials.

Permissible Exposure Limits in Air: No OELs have been established in the U.S. for this chemical.

Permissible Concentration in Water: Federal Drinking Water Guidelines: 700 ppb[93]

Determination in Water: Analysis of glyphosate is by a high-performance liquid chromatographic (HPLC) method. Log K_{ow} = Negative. Unlikely to bioaccumulate in marine organisms.

Routes of Entry: Inhalation, ingestion, through the skin.

Harmful Effects and Symptoms: Some glyphosate end-use products (some in Toxicity Categories I or II) cause primary eye irritation or skin irritation. In California, glyphosate ranks high among pesticides causing illness or injury to workers, who report numerous incidents of eye and skin irritation from splashes during mixing and loading[83].

Short Term Exposure: Irritates the eyes, skin, and respiratory tract. Exposure to high levels can cause nausea, vomiting, diarrhea, decreased blood pressure, and convulsions. High exposures can cause arrhythmia and possible death. LD_{50} (oral, rat) = 4873 mg/kg; LD_{50} (dermal, rabbit) = >7500 mg/kg.

Long Term Exposure: May cause tumors. May cause liver and kidney damage. Long term exposure to glyphosate above the MCL (0.7 mg/L/700 ppm) may cause lung congestion, kidney damage and reproductive effects[14]. Reproductive cells. May cause skin sensitization.

Points of Attack: Respiratory system, lungs, central nervous system, cardiovascular system, skin, eyes, plasma and red blood cell cholinesterase, liver, kidney, heart.

Medical Surveillance: Preliminary medical exam to detect chronic diseases of central nervous system, liver, heart, kidneys, lung and skin, as well as endocrinological or immunological disturbances, should protect susceptible individuals. Periodical medical exams of internal organs, skin and eyes are important to avoid chronic occupational intoxications. They should include lab and patch tests when necessary[83]. If symptoms develop or overexposure is suspected, the following may be useful: Liver and kidney function tests. Exam of the nervous system. In addition to comprehensive initial medical and work histories emphasizing reproductive experience and menstrual history, patient should have physical examination and testing of genito-urinary tract, sperm count, motility and morphology. If required, other tests, such as serum testosterone, serum follicle stimulating hormone (FSH), and serum lutenizing hormone (LH), may be indicated. Evaluation by a qualified allergist, including exposure history and testing, may help diagnose allergy.

First Aid: If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least 15 minutes, occasionally lifting upper and lower lids. If this chemical contacts the skin, remove contaminated clothing and wash immediately with soap and water. When this chemical has been swallowed, get medical attention. Give large quantities of water and induce vomiting. Do not make an unconscious person vomit. If this chemical has been inhaled, remove from exposure and transfer promptly to a medical facility

Personal Protective Methods: Wear protective gloves and clothing to prevent any reasonable probability of dermal and/or eye contact. Safety equipment suppliers/manufacturers can provide recommendations on the most protective glove/clothing material for your operation. All protective clothing (suits, gloves, footwear, headgear) should be clean, available each day, and put on before work. Contact lenses should not be worn when working with this chemical. Wear splash-proof chemical goggles and face shield unless full facepiece respiratory protection is worn. Employees should wash immediately with soap when skin is wet or contaminated. Provide emergency showers and eyewash.

Respirator Selection: Follow regulations in OSHA 29CFR1910.134 or European Standard EN149. Use a NIOSH/MSHA- or European Standard EN149-approved respirator; or use an approved supplied-air respirator with a full facepiece operated in the positive-pressure mode, or with a full facepiece, hood, or helmet in the continuous-flow mode; or use a NIOSH/MSHA- or European Standard EN149-approved self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive-pressure mode.

Storage: Color Code-Blue: Health Hazard/Poison: Store in a secure poison location. Prior to working with this chemical you should be trained on its proper handling and storage. Store in tightly closed containers in a cool, well-ventilated area away from oxidizers. Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: This material may be classified as Environmentally hazardous substances, liquid or solid, n.o.s. It usually falls in Hazard Class 9.

Spill Handling: Evacuate and restrict persons not wearing protective equipment from area of spill or leak until clean up is complete. Ventilate area of spill or leak. Absorb liquids in vermiculite, dry sand, earth, peat, carbon, or a similar material and deposit in sealed containers. Collect powdered material in the most convenient and safe manner and deposit in sealed containers for later disposal. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable.

Fire Extinguishing: Hazardous decomposition includes oxides of nitrogen, carbon and phosphorus. Solid glyphosate may burn, but does not readily ignite. As an immediate precautionary measure, isolate spill or leak area in all directions for at least 50 meters/150 feet for liquids and at least 25 meters/75 feet for solids. *Fire involving storage or vehicular tanks:* isolate for 800 meters/0.5 mile in all directions; also, consider initial evacuation for 800 meters/0.5 mile in all directions. *On a small fire:* use dry chemical, CO_2, water spray or regular foam. *On a large fire:* use water spray, fog or regular foam. Do not scatter spilled material with high-pressure streams of water. Move containers from fire area if you can do it without risk. Dike fire-control water for later disposal. *Fire involving tanks:* from a secure, explosion-proof location, use water spray to cool exposed containers. If cooling streams are ineffective (venting sound increases in volume and pitch, tank discolors, or shows any signs of deforming), withdraw immediately to a secure position. Always stay away from tanks engulfed in fire. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode.

Disposal Method Suggested: Do not discharge into drains or sewers. Dispose of waste material as hazardous waste using a licensed disposal contractor to an approved landfill. Consult with environmental regulatory agencies for guidance on acceptable disposal practices. The best way to dispose of small amounts of excess pesticides is to use them – apply them – according to the directions on the label. If you cannot use them, ask your neighbors whether they have a similar pest control problem and can use them. If all of the remaining pesticide cannot be properly used, check with your local solid waste management authority, environmental agency, or health department to find out whether your community has a household hazardous waste collection program or a similar program for getting rid of unwanted, leftover pesticides. These authorities can also inform you of any local requirements for pesticide waste disposal. Safe Disposal of Pesticides. An empty pesticide container can be as hazardous as a full one because of residues left inside. Never reuse such a container. When empty, a pesticide container should be rinsed carefully three times and the rinse water thoroughly drained back onto the sprayer or the container previously used to mix the pesticide. Use the rinsewater as a pesticide, following label directions. Replace the cap or closure securely. Dispose of the container according to label instructions. Do not puncture or burn a pressurized container like an aerosol – it could explode. Do cut or puncture other empty pesticide containers made of metal or plastic to prevent someone from reusing them. Wrap the empty container and put it in the trash after you have rinsed it[83].

References:

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- EXTOXNET, Extension Toxicology Network, "Pesticide Information Profile, Glyphosate," Oregon State University, Corvallis, OR (June 1996). http://extoxnet.orst.edu/pips/glyphosa.htm
- USEPA, Office of Pesticide Programs, Pesticide Residue Limits, "Glyphosate," 40 CFR 180.364. http://www.epa.gov/pesticides/food/viewtols.htm
- USEPA, "Health Advisory: Glyphosate," Washington DC, Office of Drinking Water (August 1987)
- New Jersey Department of Health and Senior Services, "Hazardous Substance Fact Sheet, Glyphosate," Trenton, NJ (June 1999). http://www.state.nj.us/health/eoh/rtkweb/3139.pdf
- USEPA, Technical Fact Sheet, Glyphosate (no date). http://www.epa.gov/safewater/pdfs/factsheets/soc/tech/glyphosa.pdf
- Indian Agrarian Crisis, *Reseach Article: How Roundup weedkiller can promote cancer, new study from India reveals.* http://agrariancrisis.in/2013/11/15/how-roundup-weedkiller-can-promote-cancer-new-study-from-india-reveals
- Henderson, A. M.; Gervais, J. A.; Luukinen, B.; Buhl, K.; Stone, D., *Glyphosate Technical Fact Sheet*; National Pesticide Information Center, Oregon State University Extension Services, Corvallis, OR (2010)

Glyphosate isopropylamine

G:0180

Use Type: Herbicide

CAS Number: 38641-94-0

Formula: $C_6H_{17}N_2O_5P$

Synonyms: Glifosato estrella; Glyphosate-isopropyl ammonium; Isopropylamine glyphosate; Mono(isopropylammonium) salt of glyphosate

Trade names: MON 39; MON 139; GILFONOX; GLYCEL; NITOSORG; RATTLER; RODEO; RONDO; ROUNDUP; UTAL

Chemical Class: Phosphonoglycine Herbicide

EPA/OPP PC Code: 103601

California DPR Chemical Code: 1855

HSDB Number: 3433

UN/NA & ERG Number: UN3077(solid)/171; UN3082 (liquid)/171

RTECS® Number: MC1080000

EC Number: 254-056-8

Uses: As a herbicide to control broadleaf weeds and grasses in many food and non-food crops and a variety of other sites including ornamentals, lawns and turf, residential areas, greenhouses, forest plantings and industrial rights-of-way. It is formulated as a liquid, solid or pellet/tablet, and is applied using ground or aerial equipment[83]. Registered for use in the U.S. and other countries. Registered for use in some (Germany, Finland) EU countries[115].

U.S. Maximum Allowable Residue Levels for Glyphosate isopropylamine salt (40 CFR 180.364): in or on the following food commodities: acerola 0.2 ppm; alfalfa, forage 175 ppm; alfalfa, hay 400 ppm; alfalfa, seed 0.5 ppm; almond, hulls 25 ppm; animal feed, nongrass, group 18 400 ppm; aloe vera 0.5 ppm; ambarella 0.2 ppm; artichoke, globe 0.2 ppm; asparagus 0.5 ppm; atemoya 0.2 ppm; avocado 0.2 ppm; bamboo, shoots 0.2 ppm; banana 0.2 ppm; barley, bran 30 ppm; barley, grain 20 ppm; beet, sugar, dried pulp 25 ppm; beet, sugar, roots 10 ppm; beet, sugar, tops 10 ppm; berry, group 13, 0.2 ppm; betelnut 1.0 ppm; biriba 0.2 ppm; blimbe 0.2 ppm; borage, seed 0.1 ppm; breadfruit 0.2 ppm; cactus, fruit 0.5 ppm; cactus, pads 0.5 ppm; canistel 0.2 ppm; canola, meal 15 ppm; canola, seed 10 ppm; cattle, kidney 4.0 ppm; cattle liver 0.5 ppm; chaya 1.0 ppm; cherimoya 0.2 ppm; citrus, dried pulp 1.5 ppm; cacao bean 0.2 ppm; coconut 0.1 ppm; coffee, bean 1.0 ppm; corn, field, forage 6.0 ppm; corn, field, grain 1.0 ppm; cotton, gin byproducts 175 ppm; cotton, undelinted seed 35 ppm; cranberry 0.2 ppm; crambe, seed 0.1 ppm; custard apple 0.2 ppm; date 0.2 ppm; dokudami 2.0 ppm; durian 0.2 ppm; egg 0.05 ppm; epazote 1.3 ppm; feijoa 0.2 ppm; fig 0.2 ppm; fish 0.25 ppm; flax, meal 8.0 ppm; flax, seed 4.0 ppm; fruit, citrus, group 10, 0.5 ppm; fruit, pome, group 11, 0.2 ppm; fruit, stone, group 12, 0.2 ppm; galangal, root 0.2 ppm; ginger, white, flower 0.2 ppm; goat, kidney 4.0 ppm; goat, liver 0.5 ppm; gourd, buffalo, seed 0.1 ppm; governor's plum 0.2 ppm; gow kee, leaves 0.2 ppm; grain, aspirated fractions 100.0 ppm; grain, cereal, group 15, except barley, field corn, grain sorghum, oat and wheat 0.1 ppm; grain, cereal, stover and straw, group 100 ppm; grape 0.2 ppm; grass, forage, fodder and hay, group 17, 300 ppm; guava 0.2 ppm; herb subgroup 19A, 0.2 ppm; hog, kidney 4.0 ppm; hog, liver 0.5 ppm; hop, dried cone 7.0 ppm; horse, kidney 4.0 ppm; horse, liver 0.5 ppm; ilama 0.2 ppm; imbe 0.2 ppm; imbu 0.2 ppm; jaboticaba 0.2 ppm; jackfruit 0.2 ppm; jojoba, seed 0.1 ppm; juneberry 0.2 ppm; kava, roots 0.2 ppm; kenaf, forage 200 ppm; kiwifruit 0.2 ppm; lesquerella, seed 0.1 ppm; leucaena, forage 200 ppm; lingonberry 0.2 ppm; longan 0.2 ppm; lychee 0.2 ppm; mamey apple 0.2 ppm; mango 0.2 ppm; mangosteen 0.2 ppm; marmaladebox 0.2 ppm; meadowfoam, seed 0.1 ppm; mioga, flower 0.2 ppm; mustard, seed 0.1 ppm; nut, pine 1.0 ppm; nut, tree, group 14, 1.0 ppm; oat, grain 20 ppm; okra 0.5 ppm; olive 0.2 ppm; oregano, Mexican, leaves 2.0 ppm; palm heart 0.2 ppm; palm heart, leaves 0.2 ppm; palm, oil 0.1 ppm; papaya 0.2 ppm; papaya, mountain 0.2 ppm; passionfruit 0.2 ppm; pawpaw 0.2 ppm; peanut 0.1 ppm; peanut, forage 0.5 ppm; peanut, hay 0.5 ppm; pepper leaf, fresh leaves 0.2 ppm; peppermint, tops 200 ppm; perilla, tops 1.8 ppm; persimmon 0.2 ppm; pineapple 0.1 ppm; pistachio 1.0 ppm; pomegranate 0.2 ppm; poultry, meat 0.1 ppm; poultry, meat byproducts 1.0 ppm; pulasan 0.2 ppm; quinoa, grain 5.0 ppm; rambutan 0.2 ppm; rapeseed, meal 15 ppm; rapeseed, seed 10 ppm; rose apple

0.2 ppm; safflower, seed 0.1 ppm; salal 0.2 ppm; sapodilla 0.2 ppm; sapote, black 0.2 ppm; sapote, mamey 0.2 ppm; sapote, white 0.2 ppm; sesame, seed 0.1 ppm; sheep, kidney 4.0 ppm; sheep, liver 0.5 ppm; shellfish 3.0 ppm; sorghum, grain, grain 15 ppm; soursop 0.2 ppm; soybean, seed 20 ppm; soybean, forage 100 ppm; soybean, hay 200 ppm; soybean, hulls 100 ppm; Spanish lime 0.2 ppm; spearmint, tops 200 ppm; spice subgroup 19B, 7.0 ppm; star apple 0.2 ppm; starfruit 0.2 ppm; stevia, dried leaves 1.0 ppm; strawberry 0.2 ppm; sugar apple 0.2 ppm; sugarcane, cane 2.0 ppm; sugarcane, molasses 30 ppm; sunflower, seed 0.1 ppm; Surinam cherry 0.2 ppm; tamarind 0.2 ppm; tea, dried 1.0 ppm; tea, instant 7.0 ppm; teff, grain 5.0 ppm; ti, leaves 0.2 ppm; ti, roots 0.2 ppm; ugli fruit 0.5 ppm; vegetable, brassica, leafy, group 5, 0.2 ppm; vegetable, bulb, group, 0.2 ppm; vegetable, cucurbit, group 9, 0.5, ppm; vegetable, foliage of legume except soybean, subgroup 7A, 0.2 ppm; vegetable, fruiting, group 0.1 ppm; vegetable, leafy, group, 0.2 ppm; vegetable, leaves of root and tuber, group (except sugar beet tops), 0.2 ppm; vegetable, legume, group 6 except soybean, 5.0 ppm; vegetable, root and tuber, group 1, except sugar beet, 0.2 ppm; wasabi, roots 0.2 ppm; water spinach, tops 0.2 ppm; watercress, upland 0.2 ppm; wax jambu 0.2 ppm; wheat, grain 5.0 ppm; wheat, milling fractions (except flour) 20 ppm; and yacon, tuber 0.2 ppm.

Regulatory Authority and Advisory Information:
Health Advisory: Mutagen

Description: White powder or a clear, amber liquid. However, there is a wide range of products available on the market. Slight amine odor. Molecular weight = 228.22; Specific gravity (H_2O:1) = 1.167 @ 20 °C; Boiling point = (decomposes); Freezing/Melting point = 198 °C; Vapor pressure = 2×10^{-8} mmHg @ 25 °C; Flash point = >200 °C. High solubility in water. Physical and toxicological properties may be affected by carrier solvents in commercial formulations.

Incompatibilities: May react with strong oxidizers such as chlorates, peroxides, nitrates, etc.

Permissible Concentration in Water: Runoff from spills or fire control may cause water pollution.

Determination in Water: Log K_{ow} = >5.0. Values above 3.0 are likely to bioaccumulate in aquatic organisms.

Routes of Entry: Inhalation, ingestion, through the skin

Harmful Effects and Symptoms

Short Term Exposure: Irritation may occur from skin or eye contact. May cause respiratory tract irritation. Signs of exposure, including ingestion, may include nausea and vomiting; diarrhea, erythema of mucous membranes; epigastric pain. Life-threatening effects from inhalation include pulmonary edema and aspiration pneumonitis. High exposures may cause arrhythmia, decreased blood pressure, convulsions and possible death. Intoxication or overexposure may cause mental problems. LD_{50} (oral, rat) = >10 g/kg; LD_{50} (dermal, rat) = >7.5 g/kg.

Long Term Exposure: Mutagenic. May cause reproductive and fetal effects. Some commercial glyphosate formulations have caused erythema, “goose bumps” (piloerection), and contact dermatitis.

Points of Attack: Reproductive cells.

Medical Surveillance: In addition to comprehensive initial medical and work histories emphasizing reproductive experience and menstrual history, patient should have physical examination and testing of genito-urinary tract, sperm count, motility and morphology. If required, other tests, such as serum testosterone, serum follicle stimulating hormone (FSH), and serum lutenizing hormone (LH), may be indicated.

First Aid: If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least 15 minutes, occasionally lifting upper and lower lids. If this chemical contacts the skin, remove contaminated clothing and wash immediately with soap and water. When this chemical has been swallowed, get medical attention. Give large quantities of water and induce vomiting. Do not make an unconscious person vomit. If this chemical has been inhaled, remove from exposure and transfer promptly to a medical facility

Personal Protective Methods: Wear protective gloves and clothing to prevent any reasonable probability of dermal and/or eye contact. Safety equipment suppliers/manufacturers can provide recommendations on the most protective glove/clothing material for your operation. All protective clothing (suits, gloves, footwear, headgear) should be clean, available each day, and put on before work. Contact lenses should not be worn when working with this chemical. Wear splash-proof chemical goggles and face shield unless full facepiece respiratory protection is worn. Employees should wash immediately with soap when skin is wet or contaminated. Provide emergency showers and eyewash.

Respirator Selection: Follow regulations in OSHA 29CFR1910.134 or European Standard EN149. Use a NIOSH/MSHA- or European Standard EN149-approved respirator; or use an approved supplied-air respirator with a full facepiece operated in the positive-pressure mode, or with a full facepiece, hood, or helmet in the continuous-flow mode; or use a NIOSH/MSHA- or European Standard EN149-approved self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive-pressure mode.

Storage: Color Code-Blue: Health Hazard/Poison: Store in a secure poison location. Prior to working with this chemical you should be trained on its proper handling and storage. Store in tightly closed containers in a cool, well-ventilated area away from oxidizers. Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: This material may be classified as Environmentally hazardous substances, liquid or solid, n.o.s. It usually falls in Hazard Class 9.

Spill Handling: Evacuate and restrict persons not wearing protective equipment from area of spill or leak until clean up is complete. Ventilate area of spill or leak. Absorb liquids in vermiculite, dry sand, earth, peat, carbon, or a similar material and deposit in sealed containers. Collect powdered material in the most convenient and safe manner and deposit in sealed containers for later disposal. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable.

Fire Extinguishing: Hazardous decomposition includes oxides of nitrogen, carbon and phosphorus. Solid glyphosate may burn, but does not readily ignite. As an immediate precautionary measure, isolate spill or leak area in all directions for at least 50 meters/150 feet for liquids and at least 25 meters/75 feet for solids. *Fire involving storage or vehicular tanks:* isolate for 800 meters/0.5 mile in all directions; also, consider initial evacuation for 800 meters/0.5 mile in all directions. *On a small fire:* use dry chemical, CO_2, water spray or regular foam. *On a large fire:* use water spray, fog or regular foam. Do not scatter spilled material with high-pressure streams of water. Move containers from fire area if you can do it without risk. Dike fire-control water for later disposal. *Fire involving tanks:* from a secure, explosion-proof location, use water spray to cool exposed containers. If cooling streams are ineffective (venting sound increases in volume and pitch, tank discolors, or shows any signs of deforming), withdraw immediately to a secure position. Always stay away from tanks engulfed in fire. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode.

Disposal Method Suggested: Do not discharge into drains or sewers. Dispose of waste material as hazardous waste using a licensed disposal contractor to an approved landfill. Consult with environmental regulatory agencies for guidance on acceptable disposal practices. The best way to dispose of small amounts of excess pesticides is to use them – apply them – according to the directions on the label. If you cannot use them, ask your neighbors whether they have a similar pest control problem and can use them. If all of the remaining pesticide cannot be properly used, check with your local solid waste management authority, environmental agency, or health department to find out whether your community has a household hazardous waste collection program or a similar program for getting rid of unwanted, leftover pesticides. These authorities can also inform you of any local requirements for pesticide waste disposal. Safe Disposal of Pesticides. An empty pesticide container can be as hazardous as a full one because of residues left inside. Never reuse such a container. When empty, a pesticide container should be rinsed carefully three times and the rinsewater thoroughly drained back onto the sprayer or the container previously used to mix the pesticide. Use the rinse water as a pesticide, following label directions. Replace the cap or closure securely. Dispose of the container according to label instructions. Do not puncture or burn a pressurized container like an aerosol – it could explode. Do cut or puncture other empty pesticide containers made of metal or plastic to prevent someone from reusing them. Wrap the empty container and put it in the trash after you have rinsed it[83].

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- EXTOXNET, Extension Toxicology Network, "Pesticide Information Profile, Glyphosate," Oregon State University, Corvallis, OR (June 1996). http://extoxnet.orst.edu/pips/glyphosa.htm
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H

Heptachlor H:0140

Use Type: Insecticide
CAS Number: 76-44-8
Formula: $C_{10}H_5Cl_7$
Synonyms: 3-Chlorochlordene; E 3314; ENT 15,152; GPKh; HEPTA; 3,4,5,6,7,8,8-Heptachlorodicyclopentadiene; 3,4,5,6,7,8,8a-Heptachlorodicyclopentadiene; Heptachlorane; 1,4,5,6,7,8,8-Heptachloro-3a,4,7,7a-tetrahydro-4,7-methano-1H-indene; 1,4,5,6,7,10,10-Heptachloro-4,7,8,9-tetrahydro-4,7-endomethyleneindene; 1,4,5,6,7,8,8a-Heptachloro-3a,4,7,7a-tetrahydro-4,7-methanoindene; 1,4,5,6, 7,8,8-Heptachloro-3a,4,7,7a-tetrahydro-4,7-methanoindene; 1(3a),4,5,6,7,8,8-Heptachloro-3a(1),4,7,7a-tetrahydro-4,7-methanoindene; 1,4,5,6,7,8,8-Heptachloro-3a,4,7,7a-tetrahydro-4,7-methanol-1H-indene; 1,4,5,6,7,8,8-Heptachloro-3a,4,7,7,7a-tetrahydro-4,7-methelene Indene; Heptacloro (Spanish); 4,7-Methanoindene, 1,4,5,6,7,8,8-heptachloro-3a,4,7,7a-tetrahydro-; NCI-C00180
Trade Names: AAHEPTA®; AGROCERES®; ARBINEX 30TN®; BIARBINEX®; CUPINCIDA®; DRINOX®; E 3314®; FENNOTOX®; HEPTAGRAN®; HEPTAMUL®; HEPTOX®; INDENE®; RHODIACHLOR®; TERMIDE®; VELSICOL 104. ®[C];
Chemical class: Organochlorine
EPA/OPP PC Code: 044801
California DPR Chemical Code: 317
HSDB Number: 554
UN/NA & ERG Number: UN2761 (solid)/151
RTECS® Number: PC0700000
EC Number: 200-962-3 [*Annex I Index No.:* 602-046-00-2]]
Uses: Heptachlor is an organochlorine cyclodiene insecticide, first isolated from technical chlordane in 1946. During the 1960s and 1970s, it was used primarily by farmers to kill termites, ants, and soil insects in seed grains and on crops, as well as by exterminators and home owners to kill termites. An important metabolite of heptachlor is heptachlor epoxide, which is an oxidation product formed from heptachlor by many plant and animal species. Not currently registered in the U.S. The only commercial use still permitted is for fire ant control in power transformers. Heptachlor had been found in at least 206 of the 1662 current or former EPA National Priorities List (NPL) sites. Heptachlor epoxide has been found in at least 195 NPL sites. Banned for use in EU countries[115]. In the U.S., registration of heptachlor-containing pesticides was canceled in 1988 with the exception of its use for fire ant control in power transformers.
U.S. Maximum Allowable Levels for heptachlor: The Food and Drug Administration (FDA) limits the amount of heptachlor and heptachlor epoxide on raw food crops and on edible seafood to 0–10 parts per billion (ppb), depending on the type of food product. The limit on edible seafood is 300 ppb, and for the fat of food-producing animals is 200 ppb.
Human toxicity (long-term)[101]: Extra high–0.40 ppb, MCL (Maximum Contaminant Level)
Fish toxicity (threshold)[101]: Extra high–0.05276 ppb, MATC (Maximum Acceptable Toxicant Concentration)
Regulatory Authority and Advisory Information:
Carcinogenicity[83]: EPA Group B2, Probable human carcinogen; EU GHS Category 2: Suspected human carcinogen; ACGIH A3 Confirmed animal carcinogen with unknown relevance to humans.
California Proposition 65 Chemical: Carcinogen (7/1/1998); Developmental toxin (8/20/1999)
Acute Oral Category: 2, WARNING
Health Advisory: Mutagen, Developmental/Reproductive Toxin.
Endocrine disruptor: Probable ED
Carcinogen (Animal Positive) (IARC) (NCI)(9)
Clean Air Act: Hazardous Air Pollutants (Title I, Part A, Section 112)
Clean Water Act: Section 311 Hazardous Substances/RQ 40CFR117.3 (same as CERCLA, see below); 40CFR423, Appendix A, Priority Pollutants; Section 313 Water Priority Chemicals (57FR41331, 9/9/92); 40CFR401.15 Section 307 Toxic Pollutants
EPA Hazardous Waste Number (RCRA No.): P059; D031
RCRA Toxicity Characteristic (Section 261.24), Maximum Concentration of Contaminants, regulatory level, 0.008 mg/L
RCRA 40CFR268.48; 61FR15654, Universal Treatment Standards: Wastewater (mg/L), 0.0012; Non-wastewater (mg/kg), 0.066
RCRA 40CFR264, Appendix 9; TSD Facilities Ground Water Monitoring List. Suggested test method(s) (PQL *u*g/L): 8080(0.05); 8270(10)
Safe Drinking Water Act: MCL, 0.0004 mg/L; MCLG, zero
Superfund/EPCRA 40CFR302.4 RQ: CERCLA, 1 lb (0.454 kg)
EPCRA Section 313 Form R *de minimus* concentration reporting level: 1.0%
U.S. DOT Regulated Marine Pollutant (49CFR172.101, Appendix B), severe pollutant
Rotterdam Convention Annex III [Chemicals Subject to the Prior Informed Consent Procedure (PIC)]
List of Stockholm Convention POPs: Annex A (Elimination)
European/International Regulations: Hazard Symbol: T, N; risk phrases: R24/25; R33; R40; R50/53; safety phrases: S1/2; S36/37; S45; S60; S61 (see Appendix 1)
Description: Pure heptachlor is a white waxy-looking solid or powder; technical grade is a tan waxy-looking solid or

powder and has a lower level of purity. The technical grade is the form used most often as a pesticide. Its odor is somewhat like camphor. Heptachlor is both a breakdown product and a component of the pesticide chlordane (approximately 10% by weight). It is a noncombustible solid, but may be dissolved in flammable liquids which may change the physical properties shown here. Molecular weight = 373.32; Specific gravity (H_2O:1) = 1.57 @ 9°C; Boiling point = (decomposes) 145°C; Freezing/Melting point = 95.5°C (pure); 46–74°C (technical product); Vapor pressure = 0.0004 mmHg[83]; 0.0003 mmHg @ 25°C[9]. Hazard Identification (based on NFPA-704M Rating System): Health 3, Flammability 0, Reactivity 0. Practically insoluble in water; solubility = <0.1 mg/L @ 25°C.

Incompatibilities: Reacts with strong oxidizers. Attacks metal. Forms hydrogen chloride gas with iron and rust above 74°C. Susceptible to epoxidation (see following record). Reacts with alkaline solutions, slowly releasing hydrogen chloride gas.

Permissible Exposure Limits in Air: OSHA PEL: 0.5 mg/m^3 TWA[skin]

NIOSH REL: 0.5 mg/m^3 TWA[skin]; A potential occupational carcinogen. Limit exposure to lowest feasible concentration. See *NIOSH Pocket Guide*, Appendix A

ACGIH TLV®[1]: 0.05 mg/m^3 TWA[skin]; confirmed animal carcinogen with unknown relevance to humans.

NIOSH IDLH: potential occupational carcinogen, 35 mg/m^3

Protective Action Criteria (PAC) Ver. 27[89]

PAC-1: 0.15 mg/m^3
PAC-2: 4.9 mg/m^3
PAC-3: 700 mg/m^3

DFG MAK: 0.5 mg/m3, inhalable fraction [skin]; Peak Limitation Category II(2); Pregnancy Risk Category D; Carcinogen Category 4

Determination in Air: Collection by Chromosorb tube-102; Toluene; Gas chromatography/Electrochemical detection; NIOSH II(5), Method #S287[18].

Permissible Concentration in Water: Federal Drinking Water Standards: EPA 0.4 μg/L[83]; 0.07 ppb[80]; State Drinking Water Standards: California 0.01 μg/L; Illinois 0.1 μg/L; State Drinking Water Guidelines: Arizona 0.008 μg/L; Maine 0.08 μg/L; Minnesota 0.08 μg/L.

Determination in Water: EPA Method D3086. GC method with ECD for the determination of organochlorine pesticides in water and wastewater. Methylene chloride extraction followed by gas chromatography with electron capture or halogen specific detection (EPA Method 608) or gas chromatography plus mass spectrometry (EPA Method 625). Log K_{ow} = >5.5. Values at or above 3.0 are likely to bioaccumulate in marine organisms.

Routes of Entry: Inhalation, skin absorption, ingestion, eye and/or dermal contact.

Harmful Effects and Symptoms

Short Term Exposure: Heptachlor can cause a feeling of anxiety, headache, dizziness, weakness, a sensation of "pins and needles" on the skin, and muscle twitching. Heptachlor has been demonstrated to be highly toxic to aquatic life, to persist for prolonged periods in the environment, to bioconcentrate in organisms at various trophic levels, and to exhibit carcinogenic activity in mice. The principal metabolite of heptachlor, heptachlor epoxide is more acutely toxic than heptachlor. Most of what we know about the health effects of these pesticides comes from studies on mice and rats fed heptachlor and heptachlor epoxide in the food or water. Very high levels for short periods produce serious liver problems. Mice had trouble walking and rats developed tremors. High levels of heptachlor in the feed for several weeks damaged the livers of rats and the livers and adrenal glands of mice. LD_{50} (oral, rat) = 40 mg/kg; (dermal, rat, male) = 119 mg/kg[83].

Long Term Exposure: May cause tumors. A potential carcinogen, tumorigenic, mutagen and reproductive toxin. Organochlorine pesticides are highly toxic to mammals and will accumulate in the tissues of living organisms. High or repeated exposure may cause brain damage with personality changes, decreased memory, difficult coordination and concentration. Higher levels can cause tremor, seizures, unconsciousness and death. This substance is possibly carcinogenic to humans. There is limited evidence that heptachlor may damage the developing fetus. A liver toxin; may cause liver and kidney damage.

Points of Attack: Central nervous system, liver. Cancer site in animals: liver cancer.

Medical Surveillance: This chemical is a suspected or known human carcinogen. Exposed persons should contact a physician for advice regarding the possible long term health effects and advice for medical monitoring. Consider the points of attack in preplacement and periodic physical examinations. Liver and kidney function tests. Evaluation for brain effects.

First Aid: If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least 15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately. If this chemical contacts the skin, remove contaminated clothing and wash immediately with soap and water. Seek medical attention immediately. If this chemical has been inhaled, remove from exposure, begin rescue breathing (using universal precautions) if breathing has stopped, and CPR if heart action has stopped. Transfer promptly to a medical facility. When this chemical has been swallowed, get medical attention. Give large quantities of water and induce vomiting. Do not make an unconscious person vomit.

Personal Protective Methods: Wear protective gloves and clothing to prevent any reasonable probability of dermal and/or eye contact. Safety equipment suppliers/manufacturers can provide recommendations on the most protective glove/clothing material for your operation. All protective clothing (suits, gloves, footwear, headgear) should be clean, available each day, and put on before work. Contact lenses should not be worn when working with this chemical. Wear dust-proof chemical goggles and face shield unless full facepiece respiratory protection is worn. Employees should wash immediately with soap when skin is wet or contaminated. Provide emergency showers and eyewash.

Respirator Selection: SCBA >0.15 mg/m^3. NIOSH: *At any concentrations above the NIOSH REL, or where there is no REL, at any detectable concentration:* SCBAF: Pd, Pp (APF = 10,000) (any self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode); or SaF: Pd,Pp: ASCBA (any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary self-contained breathing apparatus operated in a pressure-demand or other positive-pressure mode). *Escape:* GmFOv100 (APF = 50) [any air-purifying, full facepiece respirator (gas mask) with a chin-style, front- or back-mounted organic vapor canister having an N100, R100, or P100 filter]; or SCBAE (any appropriate escape-type, self-contained breathing apparatus).

Storage: Color Code-Blue: Health Hazard/Poison: Store in a secure poison location. Prior to working with this chemical you should be trained on its proper handling and storage. Store in tightly closed containers in a cool, well-ventilated area. Protect storage containers from physical damage. A regulated, marked area should be established where this chemical is handled, used, or stored in compliance with OSHA Standard 1910.1045. Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: Organochlorine pesticides, liquid or solid require a "poisonous materials" label. They fall in Hazard Class 6.1. This material may be in Packing Group II.

Spill Handling: First remove all sources of ignition. Evacuate persons not wearing protective equipment from area of spill or leak until clean up is complete. Collect powdered material in the most convenient and safe manner and deposit in sealed containers. Ventilate area after clean up is complete. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable.

Fire Extinguishing: Hazardous decomposition includes hydrogen chloride and chlorine gas. Use dry chemical, carbon dioxide; water spray; or foam extinguishers. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies. From a secure, explosion-proof location, use water spray to cool exposed containers. If cooling streams are ineffective (venting sound increases in volume and pitch, tank discolors, or shows any signs of deforming), withdraw immediately to a secure position. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode.

Disposal Method Suggested: Incineration (816°C, 0.5 sec minimum for primary combustion; 1760°C, 1.0 sec for secondary combustion) with adequate scrubbing and ash disposal facilities. Consult with environmental regulatory agencies for guidance on acceptable disposal practices. Generators of waste containing this contaminant (≥100 kg/mo) must conform with EPA regulations governing storage, transportation, treatment, and waste disposal. In accordance with 40CFR165, follow recommendations for the disposal of pesticides and pesticide containers. Containers must be disposed of properly by following package label directions or by contacting your local or federal environmental control agency, or by contacting your regional EPA office.

References

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Hexachlorobenzene H:0190

Use Type: Insecticide, Fungicide, Microbiocide

CAS Number: 118-74-1

Formula: C_6Cl_6

Synonyms: Benzene, hexachloro-; Granox NM; HCB; Hexa C. B; Pentachlorophenyl chloride

Trade Names: AMATIN®; ANTICARIE®; BUNT-CURE®; BUNT-NO-MORE®; CEKU C. B. ®; CO-OP HEXA®; GRANERO®; JULIN'S CARBON CHLORIDE®; NO BUNT[C]; RES-Q®[C]; SANOCID®; SANOCIDE®; SMUT-GO®[C]; SNIECIOTOX®; THIHEX®[C]; ZAPRAWA NASIENNA SNECIOTOX®

Chemical class: Organochlorine; Chlorinated hydrocarbon (aromatic)
EPA/OPP PC Code: 061001
California DPR Chemical Code: 321
HSDB Number: 1724
UN/NA & ERG Number: UN2729/152
RTECS® Number: DA2975000
EC Number: 204-273-9 [*Annex I Index No.:* 602-065-00-6]
Uses: Hexachlorobenzene was used widely as a pesticide to protect seeds of onions and sorghum, wheat, and other grains against fungus until 1965. It can be used with or without other seed treatments, fungicides and/or insecticides. It has fumigant action on fungal spores and is available as a dry seed treatment or slurry seed treatment. Not approved for use in EU countries[115]. Has been banned from use in the United States. Hexachlorobenzene (HCB) is an impurity in picloram. Not approved for use in EU countries[115]. Not registered for use in the U.S. There are more than 40 global suppliers[97].
Human toxicity (long-term)[101]: High–1.00 ppb, MCL (Maximum Contaminant Level)
Fish toxicity (threshold)[101]: Very low–1760.07814 ppb, MATC (Maximum Acceptable Toxicant Concentration)
Regulatory Authority and Advisory Information:
Carcinogenicity[83]: EPA Group 2B, Probable carcinogen NTP: 12th Report on Carcinogens, 2011: Reasonably anticipated to be a human carcinogen; EU GHS (1A, 1B) Known or presumed human carcinogen; ACGIH A3 Confirmed animal carcinogen with unknown relevance to humans.
California Proposition 65 Chemical: Carcinogen (10/1/1987) and developmental toxin (1/1/1989)
Acute Oral Category: 1, DANGER–POISON
Health Advisory: Mutagen, Developmental/Reproductive Toxin, Endocrine disruptor (confirmed)
Carcinogen (Animal Positive) (IARC)(9)
List of priority pollutants (U.S. EPA)
Clean Air Act: Hazardous Air Pollutants (Title I, Part A, Section 112)
Clean Water Act: Section 313 Water Priority Chemicals (57FR41331, 9/9/92)
EPA Hazardous Waste Number (RCRA No.): U127; D032
RCRA Toxicity Characteristic (Section 261.24), Maximum Concentration of Contaminants, regulatory level, 0.13 mg/L
RCRA 40CFR268.48; 61FR15654, Universal Treatment Standards: Wastewater (mg/L), 0.055; Non-wastewater (mg/kg), 10
RCRA 40CFR264, Appendix 9; TSD Facilities Ground Water Monitoring List. Suggested test method(s) (PQL *u*g/L): 8120(0.05); 8270(10)
Safe Drinking Water Act: MCL, 0.001 mg/L; MCLG, zero
Superfund/EPCRA 40CFR302.4 RQ: CERCLA, 10 lb (4.54 kg)
EPCRA Section 313 Form R *de minimus* concentration reporting level: 0.1%
Rotterdam Convention Annex III [Chemicals Subject to the Prior Informed Consent Procedure (PIC)]
List of Stockholm Convention POPs: Annex A (Elimination) POPs: Annex A & Annex C (Unintentional production and release) as HCB
European/International Regulations: Hazard Symbol: T, N; risk phrases: R45; R48/25; R50/53; safety phrases: S2; S45; S53; S60; S61 (see Appendix 1)
WGK (German Aquatic Hazard Class): 3-Severe hazard to waters
Description: Hexachlorobenzene is a solid, crystallizing in needles. Molecular weight = 284.78; Specific gravity (H_2O:1) = 2.04 @ 23°C; Boiling point = 325°C; Freezing/Melting point = 228.8°C; 232°C; Vapor pressure = 6×10^{-5} mmHg @ 25°C Flash point = 242°C. Hazard Identification (based on NFPA-704M Rating System): Health 1, Flammability 1, Reactivity 0. Slightly soluble in water.
Incompatibilities: May react violently with strong oxidizers, bromine, 90% hydrogen peroxide, chlorine solutions, phosphorus trichloride, silver powders or dust; *N,N*-dimethylformamide. Violent reaction in temperatures above 65°C[17].
Permissible Exposure Limits in Air:
OSHA PEL: None
NIOSH REL: None
ACGIH TLV®[1]: 0.002 TWA [skin]; confirmed animal carcinogen with unknown relevance to humans.
Protective Action Criteria (PAC) Ver. 27[89]
PAC-1: 0.006 mg/m^3
PAC-2: 8.9 mg/m^3
PAC-3: 160 mg/m^3
DFG MAK: [skin]; Carcinogen Category 4; Pregnancy Risk Group D
Determination in Air: Use NIOSH IV, Method # 1003, Halogenated hydrocarbons[18].
Permissible Concentration in Water: Federal Drinking Water Guidelines: 0.2 ppb[93] State Drinking Water Guidelines: Arizona 0.02 μg/L; Maine 0.2 μg/L; Minnesota 0.2 μg/L.
Determination in Water: Methylene chloride extraction followed by concentration and gas chromatography with electron capture detection (EPA Method 612) or gas chromatography plus mass spectrometry (EPA Method 625). Log K_{ow} = >5.0 Values at or above 3.0 are likely to bioaccumulate in marine organisms.
Routes of Entry: Inhalation, ingestion, eye and dermal contact.
Harmful Effects and Symptoms
Short Term Exposure: Irritates the eyes, skin, and respiratory tract. *Inhalation*: Coughing, shortness of breath and labored breathing have been reported from large, unmeasured doses or by decomposition to chlorine. *Skin:* Can cause irritation. Exposure to sunlight with (or soon after) exposure can increase effects. Following this reaction, changes in skin pigment and blistering may follow. Red or dark urine may be noticed. High doses may cause redness, pain and serious burns. *Eyes:* May cause irritation. Higher doses may cause redness, pain and blurred vision. *Ingestion*: Headache, dizziness, nausea, vomiting,

numbness of hands and arms, apprehension, excitement, tremors, partial paralysis of arms and legs, loss of muscle control, loss of sensory perception, convulsions and coma may result from high doses.

Long Term Exposure: May cause tumors. May affect the lungs, liver, skin, and nervous system. This substance causes cancer in laboratory animals, and may be carcinogenic to humans. May damage the developing fetus. May cause liver, thyroid, kidney and immune system damage. High, prolonged or repeated exposure may affect the nervous system. Repeated skin exposure can lead to permanent skin changes and increased hair growth. Animal tests show that this substance possibly causes toxic effects upon human reproduction. Ingestion of contaminated grain, estimated at doses of 0.05–0.2 grams/day, resulted in blisters, erosions on exposed skin areas, red-colored urine, skin sores, change in skin color, arthritis, and problems of the liver, nervous system, and stomach [porphyria cutanea tarda (PCT)] in Turkey. The following symptoms were also reported: enlarged livers, porphyria in the blood, loss of appetite, weight loss and wasting of skeletal muscles. Severe and long-standing poisoning caused abnormal hair growth, loss of vision, wasting of hands, black discoloration, and skin sores which became ulcerated, healing with pigmented scars. Breast-fed children developed "pink-sore," a condition which was 95% fatal. Toxic effects on blood and active symptoms persisted up to 20 years. Studies in animals show that ingestion of this chemical can damage the liver, thyroid, nervous system, bones, kidneys, blood, and immune and endocrine system.

Points of Attack: Liver, skin and thyroid.

Medical Surveillance: Liver function tests. Thyroid function tests. Evaluation by a qualified allergist and/or dermatologist. Iron as a dietary supplement could increase liver damage. Consult a physician before taking supplements. Guard against sunlight exposure to contaminated skin.

First Aid: If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least 15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately. If this chemical contacts the skin, remove contaminated clothing and wash immediately with soap and water. Seek medical attention immediately. If this chemical has been inhaled, remove from exposure, begin rescue breathing (using universal precautions) if breathing has stopped, and CPR if heart action has stopped. Transfer promptly to a medical facility. When this chemical has been swallowed, get medical attention. Give large quantities of water and induce vomiting. Do not make an unconscious person vomit. *Note to physician:* For ingestions of <10 mg/kg body weight occurring <1 hour before treatment, induce vomiting. For ingestions of more than 10 mg/kg body weight occurring <1 hour before treatment, use gastric lavage. For ingestion occurring more than 1 hour before treatment, use activated charcoal. There is no specific antidote, and supervision for at least 72 hours is recommended.

Personal Protective Methods: Wear protective gloves and clothing to prevent any reasonable probability of dermal and/or eye contact. Safety equipment suppliers/manufacturers can provide recommendations on the most protective glove/clothing material for your operation. All protective clothing (suits, gloves, footwear, headgear) should be clean, available each day, and put on before work. Contact lenses should not be worn when working with this chemical. Wear dust-proof chemical goggles and face shield unless full facepiece respiratory protection is worn. Employees should wash immediately with soap when skin is wet or contaminated. Provide emergency showers and eyewash.

Respirator Selection: *SCBA* >0.006 mg/m^3. *At any detectable concentration:* SCBAF: Pd,Pp (APF = 10,000) (any NIOSH/MSHA- or European Standard EN 149-approved self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode); or SaF: Pd,Pp: ASCBA (APF = 10,000) (any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary, self-contained breathing apparatus operated in a pressure-demand or other positive-pressure mode). *Escape:* GmFOv (APF = 50) [any air-purifying, full facepiece respirator (gas mask) with a chin-style, front or back-mounted organic vapor canister]; or SCBAE (any appropriate escape-type, self-contained breathing apparatus).

Storage: Color Code-Blue: Health Hazard/Poison: Store in a secure poison location. Prior to working with this chemical you should be trained on its proper handling and storage. Store in tightly closed containers in a cool, well- ventilated area away from oxidizers, dimethyl formamide and heat. A regulated, marked area should be established where this chemical is handled, used, or stored in compliance with OSHA Standard 1910.1045. Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: This compound requires a shipping label of “poisonous materials.” It usually falls in Hazard Class 6.1. STN: 49-251-91.

Spill Handling: First remove all sources of ignition. Evacuate persons not wearing protective equipment from area of spill or leak until clean up is complete. Collect powdered material in the most convenient and safe manner and deposit in sealed containers. Ventilate area after clean up is complete. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable.

Fire Extinguishing: Violent reaction in temperatures above 65°C[17]. Hazardous decomposition includes toxic hydrogen chloride gas and chlorine. This chemical may burn but does not easily ignite. Use dry chemical, carbon dioxide; water spray; or foam extinguishers. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies. Containers may explode in fire. From a secure, explosion-proof location, use water spray to cool exposed containers. If cooling streams are ineffective (venting sound increases in volume and pitch, tank discolors, or shows any signs of deforming), withdraw immediately to a secure position. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode.

Disposal Method Suggested: Incineration is most effective @ 1300°C and 0.25 sec. Consult with environmental regulatory agencies for guidance on acceptable disposal practices. Generators of waste containing this contaminant (≥100 kg/mo) must conform with EPA regulations governing storage, transportation, treatment, and waste disposal.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- EXTOXNET, Extension Toxicology Network, "Pesticide Information Profile, Hexachlorobenzene," Oregon State University, Corvallis, OR (June 1996). http://extoxnet.orst.edu/pips/hexachlo.htm
- New Jersey Department of Health and Senior Services, "Hazardous Substance Fact Sheet, Hexachlorobenzene," Trenton, NJ (November 1988, rev. July 2001). http://www.state.nj.us/health/eoh/rtkweb/0978.pdf
- USEPA, Chlorinated Benzenes: Ambient Water Quality Criteria. Washington DC (1980)
- USEPA, Status Assessment of Toxic Chemicals: Hexachlorobenzene, Report EPA-600/2-79-210 g, Cincinnati, OH (December 1979)
- USEPA, Hexachlombemene, Health and Environmental Effects Profile No. 110, Office of Solid Waste, Washington DC (April 30, 1980)
- Sax, N. I., Ed., Dangerous Properties of Industrial Materials Report, 4, No. 1, 88-92 (1984)
- New York State Department of Health, "Chemical Fact Sheet: Hexachlorobenzene (HCB)," Albany, NY, Bureau of Toxic Substance Assessment (May 1986)
- U.S. Department of Health and Human Services, "ATSDR ToxFAQs, Hexachlorobenzene" (Atlanta, GA, September 1997)

Hexaflumuron H:0248

Use Type: Insecticide, Termiticide

CAS Number: 86479-06-3

Formula: $C_{16}H_{18}Cl_2F_6N_2O_3$

Synonyms: AI3-29832; Benzamide, *N*-[((3,5-dichloro-4-(1,1,2,2-tetrafluoroethoxy)phenyl)amino)carbonyl]-2,6-difluoro-

Trade Names: CONHEX®; CONSULT®; DE-473®; NAF-46®; RECRUIT®; SONET®; TRUENO®; XRD 473®

Chemical class: Benzoyl urea

EPA/OPP PC Code: 118202

California DPR Chemical Code: 3899

HSDB Number: 7049

UN/NA & ERG Number: UN3077 (solid)/171

RTECS® Number: CV3800000

EC Number: 401-400-1

Uses: This is an insect growth regulator (IGR) that works by inhibiting the insect's growth by interfering with chitin synthesis, which termites need to form an exoskeleton. It is used to impregnate termite bait. There are more than 20 global suppliers[97]. Registered for use in the U.S. Not currently registered for agricultural use in many EU countries[115].

Fish toxicity (threshold) [101]***:*** Intermediate–28.07482 ppb, MATC (Maximum Acceptable Toxicant Concentration)

Regulatory Authority and Advisory Information:

Carcinogenicity[83]: Rats and mice fed up to 500 mg/kg/day for 104 weeks did not develop cancer. Based on the results of animal studies, hexaflumuron is not expected to increase the risk of cancer in humans.Acute Oral Category: 4, Caution.

European/International Regulations: Hazard Symbol: N; risk phrases: R50/53; safety phrases: S2; S60; S61 (see Appendix 1)

Description: White solid or powder. The commercial product may be an emulsifiable concentrate. Molecular weight = 461.16; Specific gravity (H_2O:1) = 1.675 @ 25°C; Boiling point = (decomposes); Freezing/Melting point = 203°C; Vapor pressure = 5×10^{-7} mmHg (very low/negligible). Practically insoluble in water; solubility = <0.1 ppm. Physical and toxicological properties may be affected by carrier solvents in commercial formulations.

Incompatibilities: Decomposes in temperatures above 275°C. Irritating or toxic fumes or gases in a fire.

Permissible Concentration in Water: Runoff from spills or fire control may cause water pollution.

Determination in Water: Log K_{ow} = >5.0. Values above 3.0 are likely to bioaccumulate in marine organisms.

Routes of Entry: Dermal contact, inhalation, ingestion.

Harmful Effects and Symptoms

Short Term Exposure: Contact with eyes or skin may cause irritation or injury. Inhalation should be avoided; use NIOSH- or CEN (UK)-approved air-purifying respirators for pesticides. May be harmful if swallowed. LD_{50} (oral, rat) = >5 g/kg; LD_{50} (dermal, rat) = >5 g/kg.

Long Term Exposure: Fluorides may cause bone disease (pain and tenderness of the bones); mottled teeth in children. May effect the blood; formation of methemoglobin. In long-term (chronic) feeding tests, hexaflumuron increased the incidence and severity of a liver cell abnormality[83].

Points of Attack: Blood, eyes, kidney, liver, bones.

Medical Surveillance: For those with frequent or potentially high exposure, the following are recommended before beginning work and at regular times after that: Lung function tests. If overexposure is suspected, also consider: Complete blood count and test for methemoglobin.

First Aid: If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least 15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately. If this chemical contacts the skin, remove contaminated clothing and wash immediately with soap and water. Seek medical attention immediately. If this chemical has been inhaled, remove from exposure, begin rescue breathing (using universal precautions) if breathing has stopped, and CPR if heart action has stopped. Transfer promptly to a medical facility. When this chemical has been swallowed, get medical attention. Give large quantities of water and induce vomiting. Do not make an unconscious person vomit. Do not induce vomiting when formulations containing petroleum solvents are ingested

Personal Protective Methods: For emergency situations, wear a positive-pressure, pressure-demand, full facepiece self-contained breathing apparatus (SCBA) or pressure-demand supplied-air respirator with escape SCBA and a fully encapsulating, chemical-resistant suit[83] such as DuPont™ Tychem® suit fabrics.

Respirator Selection: Wherever and whenever workplace conditions warrant respirator use, a respiratory protection program must be followed that meets one or more of the following government standards: OSHA's 29 CFR 1910.134, ANSI Z88.2, or European Standard EN 149.

Storage: Color Code-Blue: Health Hazard/Poison. Store in a tightly closed container in a dry, well-ventilated and secure poison location. Prior to working with this chemical you should be trained on its proper handling and storage. Where possible, automatically transfer material from other storage containers to process containers. Always store pesticides in their original containers, complete with labels that list ingredients, directions for use, and first aid steps in the case of accidental poisoning. Never store pesticides in cabinets with or near food, animal feed, or medical supplies. Do not store pesticides in places where flooding is possible or where they might spill or leak into wells, drains, ground water, or surface water. Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: Environmentally hazardous substances, solid or liquid, usually fall in Hazard Class 9.

Spill Handling: Dampen the spilled material with water. Clean up with dampened absorbent paper and transfer material to a suitable trash container. Seal the absorbent paper and your clothing in a vapor-tight plastic bag for eventual disposal. Wash all contaminated surfaces with a soap and water solution. Do not reenter the contaminated area until an expert verifies that the area has been properly cleaned.

Fire Extinguishing: Decomposition products in fire include toxic nitrogen oxides, hydrogen chloride, and hydrogen fluoride. As an immediate precautionary measure, isolate spill or leak area in all directions for at least 50 meters/150 feet for liquids and at least 25 meters/75 feet for solids. *Fire involving storage or vehicular tanks:* isolate for 800 meters/0.5 mile in all directions; also, consider initial evacuation for 800 meters/0.5 mile in all directions. *On a small fire:* use dry chemical, CO_2, water spray or regular foam. *On a large fire:* use water spray, fog or regular foam. Do not scatter spilled material with high-pressure streams of water. Move containers from fire area if you can do it without risk. Dike fire-control water for later disposal. *Fire involving tanks:* from a secure, explosion-proof location, use water spray to cool exposed containers. If cooling streams are ineffective (venting sound increases in volume and pitch, tank discolors, or shows any signs of deforming), withdraw immediately to a secure position. Always stay away from tanks engulfed in fire. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode.

Disposal Method Suggested: Do not discharge into drains or sewers. Dispose of waste material as hazardous waste using a licensed disposal contractor to an approved landfill. Consult with environmental regulatory agencies for guidance on acceptable disposal practices. Incineration with effluent gas scrubbing is recommended. Containers must be disposed of properly by following package label directions or by contacting your local or federal environmental control agency, or by contacting your regional EPA office.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- National Pesticides Information Center (NPIC), "Fact Sheet, Hexaflumuron," Corvallis, OR. http://www.npic.orst.edu/factsheets/hextech.pdf
- USEPA, Office of Pesticide Programs, Pesticide fact sheet: Hexaflumuron. Washington DC. March 10, 1994.

Hexazinone H:0320

Use Type: Herbicide

CAS Number: 51235-04-2

Formula: $C_{11}H_{20}O_2N_3$

Synonyms: 3-Cyclohexyl-6-(Dimethylamino)-1-methyl-*s*-triazine-2,4(1*H*,3*H*)-dione;3-Cyclohexyl-6-dimethylamino-1-methyl-1,2,3,4-tetrahydro-1,3,5-triazine-2-,4-dione; 3-Cyclohexyl-6-(dimethylamino)-1-methyl-1,3,5-triazine-2,4(1*H*,3*H*)-dione; 3-Cyclohexyl-1-methyl-

6-(dimethylamino)-*s*-trazine-2,4(1*H*,3*H*)-dione; 1,3,5-Triazine-2,4(1*H*,3*H*)-dione, 3-Cyclohexyl-6-(dimethylamino)-1-methyl-;*s*-Triazine-2,4(1*H*,3*H*)-dione, 3-Cyclohexyl-6-(dimethylamino)-1-methyl-

Trade Names: BO-RID®[C]; BRUSHKILLER®; DPX 3674®; K-4 HERBICIDE®; OUSTAR®; PRONONE®; VELPAR®; VELPAR WEED KILLER®

Chemical class: Triazine; Triazinone

EPA/OPP PC Code: 107201

California DPR Chemical Code: 1871

HSDB Number: 6670

UN/NA & ERG Number: UN3077(solid)/171

RTECS® Number: XY7850000

EC Number: 257-074-4 [*Annex I Index No.:* 613-132-00-4]

Uses: Hexazinone is used against many annual, biennial, and perennial weeds, as well as some woody plants. It is mostly used on non-crop areas; however, it is used selectively for the control of weeds among sugar cane, pineapples, and rangeland forage. Hexazinone is a systemic herbicide that works by inhibiting photosynthesis in the target plants. Rainfall or irrigation water is needed before it becomes activated. It is available in soluble concentrate, water-soluble powder, or granular formulations. Not approved for use in EU countries[115]. Registered for use in the U.S. and other countries.

U.S. Maximum Allowable Residue Levels for Hexazinone and its metabolites (calculated as hexazinone)[40 CFR 180.396(a)]: in or on the following food commodities: alfalfa green forage 2.0 ppm; alfalfa, hay 8.0 ppm; blueberry 0.2 ppm; cattle, fat 0.1 ppm; cattle, meat byproducts 0.1 ppm; cattle, meat 0.1 ppm; goat, fat 0.1 ppm; goat, meat byproducts 0.1 ppm; goat, meat 0.1 ppm; grass, pasture 10 ppm; grass, range 10 ppm; hog, fat 0.1 ppm; hog, meat byproducts 0.1 ppm; hog, meat 0.1 ppm; horse, fat 0.1 ppm; horse, meat byproducts 0.1 ppm; horse, meat 0.1 ppm; milk 0.1 ppm; pineapple (whole fruit) 0.5 ppm; sheep, fat 0.1 ppm; sheep, meat byproducts 0.1 ppm; and sheep, meat 0.1 ppm. ***A tolerance with regional registration, as defined in 180.1(n) and which excludes use of hexazinone on sugarcane in Florida, is established for combined residues of the herbicide hexazinone and its metabolites (calculated as hexazinone) [40 CFR 180.396(c)]:*** in or on the following food commodities: sugarcane, cane 0.2 ppm and sugarcane, molasses 5.0 ppm.

Human toxicity (long-term)[101]: Very low–400.00 ppb, Health Advisory

Fish toxicity (threshold)[101]: Very low–24566.31408 ppb, MATC (Maximum Acceptable Toxicant Concentration)

Regulatory Authority and Advisory Information:

Carcinogenicity[83]: EPA Group D, Not classifiable as a human carcinogen

Potential Ground Water Pollutant [California FAC Section 13145(d)/12811, active]

Acute Oral Category: 3, CAUTION

Health Advisory: Developmental/Reproductive Toxin, Skin irritant/sensitizer

EPCRA Section 313 Form R *de minimus* concentration reporting level: 1.0%

European/International Regulations: Hazard Symbol: Xi, Xn, N; risk phrases: R22; R36; R50/53; safety phrases: S2; S41; S60; S61 (see Appendix 1)

Description: Hexazinone is a white crystalline solid. Slight acrid odor. Commercial product may be granular, soluble liquid, or emulsifiable concentrate. It may be dissolved in a flammable carrier such as methanol. Molecular weight = 252.36; Specific gravity (H_2O:1) = 1.26 @ 25°C; Boiling point = (decomposes); Freezing/Melting point = 114–117°C; Vapor pressure = 3.0×10^{-7} mmHg; Flash point = 100°C[Sigma Aldrich]. Soluble in water; solubility = 3.4×10^5 ppm @ 25°C. Physical and toxicological properties may be affected by carrier solvents in commercial formulations.

Incompatibilities: Incompatible with oxidizers, acids, acid chlorides, acid halides, isocyanates, halogenated organics, peroxides, phenols (acidic), epoxides, anhydrides. Contact with strong reducing agents duch as halides may generate explosive flammable gas.

Permissible Concentration in Water: Federal Drinking Water Guidelines: 200 ppb[93]; EPA Health Advisory: 400 μg/L; State Drinking Water Guidelines: Maine 230 μg/L; Florida 230 μg/L.

Determination in Water: Solvent extraction with methylene chloride followed by analysis by gas chromatography with a thermionic bead detector. Log K_{ow} = <1.5. Unlikely to bioaccumulate in marine organisms.

Routes of Entry: Skin, inhalation and ingestion.

Harmful Effects and Symptoms

Short Term Exposure: Corrosive eye irritant. May cause severe eye and skin irritation and, possible permanent eye damage. In experience with humans, only one report was available on hexazinone. It involved a 26-year-old woman who inhaled hexazinone dust. Vomiting occurred within 24 hours. LD_{50} (oral, rat) = 1690 mg/kg; LD_{50} (dermal, rat) = >5 g/kg.

Long Term Exposure: May cause reproductive and fetal effects.

Points of Attack: Reproductive system.

Medical Surveillance: Preliminary medical exam to detect chronic diseases of central nervous system, liver, heart, kidneys, lung and skin, as well as endocrinological or immunological disturbances, should protect susceptible individuals. Periodical medical exams of internal organs, skin and eyes are important to avoid chronic occupational intoxications. They should include lab and patch tests when necessary[83]. In addition to comprehensive initial medical and work histories emphasizing reproductive experience and menstrual history, patient should have physical examination and testing of genito-urinary tract, sperm count, motility and morphology. If required, other tests, such as serum testosterone, serum follicle stimulating hormone (FSH), and serum lutenizing hormone (LH), may be indicated.

First Aid: If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least 15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately. If this chemical contacts the skin, remove contaminated clothing and wash immediately with soap and water. Seek medical attention immediately. If this chemical has been inhaled, remove from exposure, begin rescue breathing (using universal precautions) if breathing has stopped, and CPR if heart action has stopped. Transfer promptly to a medical facility. When this chemical has been swallowed, get medical attention. Give large quantities of water and induce vomiting. Do not make an unconscious person vomit.

Personal Protective Methods: Applicators and other handlers must wear: Coveralls worn over long-sleeved shirt and long pants; Chemical-resistant gloves such as DuPont™ Tychem® suit fabrics, barrier laminate, or Viton®; Chemical-resistant footwear plus socks; Protective eye wear; Chemical-resistant headgear for overhead exposure; Chemical-resistant apron when cleaning equipment, mixing, or loading[83]. Agricultural Use/Engineering Controls: When handlers use closed systems, enclosed cabs, or aircraft in a manner that meets the requirements listed in the Worker Protection Standard (WPS) for agricultural pesticides, 40 CFR 170.240(d)(4-6), the handler PPE requirements may be reduced or modified as specified in the Worker Protection Standard. Firefighters should wear NIOSH-approved self-contained breathing apparatus and full protective clothing.

Respirator Selection: Wherever and whenever workplace conditions warrant respirator use, a respiratory protection program must be followed that meets one or more of the following government standards: OSHA's 29 CFR 1910.134, ANSI Z88.2, or European Standard EN 149. Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: Environmentally hazardous substances, solid, usually fall in Hazard Class 9. This description may not apply to all shipping situations. Consult appropriate Dangerous Goods Regulations, including 49CFR, for additional description requirements, mode-specific, or quantity-specific shipping requirements.

Storage: Color Code-Blue: Health Hazard/Poison: Store in a tightly closed container in a dry, well-ventilated and secure poison location. Prior to working with this chemical you should be trained on its proper handling and storage. Where possible, automatically transfer material from other storage containers to process containers.

Spill Handling: Do not touch damaged containers or spilled material unless wearing appropriate protective clothing. Stop leak if you can do it without risk. Prevent entry into waterways, sewers, basements or confined areas. Cover with plastic sheet to prevent spreading. Absorb or cover with dry earth, sand or other noncombustible material and transfer to containers. Do not allow water to get inside containers.

Fire Extinguishing: Hazardous decomposition includes toxic oxides of nitrogen and carbon. As an immediate precautionary measure, isolate spill or leak area in all directions for at least 50 meters/150 feet for liquids and at least 25 meters/75 feet for solids. *Fire involving storage or vehicular tanks:* isolate for 800 meters/0.5 mile in all directions; also, consider initial evacuation for 800 meters/0.5 mile in all directions. *On a small fire:* use dry chemical, CO_2, water spray or regular foam. *On a large fire:* use water spray, fog or regular foam. Do not scatter spilled material with high- pressure streams of water. Move containers from fire area if you can do it without risk. Dike fire-control water for later disposal. *Fire involving tanks:* from a secure, explosion-proof location, use water spray to cool exposed containers. If cooling streams are ineffective (venting sound increases in volume and pitch, tank discolors, or shows any signs of deforming), withdraw immediately to a secure position. Always stay away from tanks engulfed in fire. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode.

Disposal Method Suggested: Recycle any unused portion of the material for its approved use or return it to the manufacturer or supplier. Incineration with effluent gas scrubbing is recommended. Containers must be disposed of properly by following package label directions or by contacting your local or federal environmental control agency, or by contacting your regional EPA office. Ultimate disposal of the chemical must consider: the material's impact on air quality; potential migration in soil or water; effects on animal, aquatic, and plant life; and conformance with environmental and public health regulations.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- EXTOXNET, Extension Toxicology Network, "Pesticide Information Profile, Hexazinone," Oregon State University, Corvallis, OR (June 1996). http://extoxnet.orst.edu/pips/hexazin.htm
- USEPA, Office of Pesticide Programs, Pesticide Residue Limits, "Hexazinone," ***40 CFR 180.396***. http://www.epa.gov/pesticides/food/viewtols.htm
- USEPA, "Health Advisory: Hexazinone," Washington DC, Office of Drinking Water (August 1987)

Hexythiazox H:0355

Use Type: Acaricide, Insect growth regulator

CAS Number: 78587-05-0

Formula: $C_{17}H_{21}ClN_2O_2S$

Synonyms: *trans*-5-(4-Chlorophenyl)-*N*-cyclohexyl-4-methyl-2-*oxo*-3-thiazolidinecarboxamide; HTZ; *trans*-4-Methyl-5-(4-chlorophenyl)-3-cyclohexylcarbamoyl-2-thiazolidone; 3-Thiazolidinecarboxamide, 5-(4-chlorophenyl)-*N*-cyclohexyl-4-methyl-2-*oxo*-, *trans*-

Trade Names: ACARFLOR®; ACARIFLOR®; CESAR®; DPX-Y5893®; HEXYGON® DF; NISSORUN®; NA 73®; ONAGER®; SAVEY®; TREVI®; ZELDOX®

Chemical class: Carboxamide

EPA/OPP PC Code: 128849

California DPR Chemical Code: 2303

HSDB Number: 6671

UN/NA & ERG Number: UN3077(solid)/171

RTECS® Number: XJ5396000

EC Number: [*Annex I Index No.:* 613-125-00-6]

U.S. Maximum Allowable Residue Levels for Hexythiazox [40 CFR 180.448(a)]: Almond, hulls 10 ppm; apple, wet pomace 2.5 ppm; caneberry subgroup 13A, 1.0 ppm; cattle, fat 0.02 ppm; cattle, meat byproducts 0.12 ppm; citrus, dried pulp 1.5 ppm; citrus, oil 0.90 ppm; date, dried fruit 1.0 ppm; fruit, pome, group 11, 1.7 ppm; fruit, stone, group 12, except plum 1.0 ppm; goat, fat 0.02 ppm; goat, meat byproducts 0.12 ppm; grape 0.75 ppm; hog, fat 0.02 ppm; hog, meat byproducts 0.02 ppm; hop 2.0 ppm; horse, fat 0.02 ppm; horse, meat byproducts 0.12 ppm; milk 0.02 ppm; nut, tree, group 14, 0.30 ppm; peppermint, tops 2.0 ppm; pistachio 0.30 ppm; plum 0.10 ppm; plum, prune, dried 0.40 ppm; plum, prune, fresh 0.10 ppm; sheep, fat 0.02 ppm; sheep, meat byproducts 0.12 ppm; spearmint, tops 2.0 ppm; strawberry 3.0 ppm. ***Regional registration, as defined in section 180.1(n)*** **[*40 CFR 180.448(c)*]:** Cotton, gin byproducts, California only 3.0 ppm; Cotton, undelinted seed, California only 0.20 ppm; Fruit, citrus group 10 (Arizona, California, Texas only) 0.35 ppm.

Human toxicity (long-term) [101]***:*** Intermediate–17.50 ppb, Health Advisory

Fish toxicity (threshold)[101]***:*** Intermediate–62.61862 ppb, MATC (Maximum Acceptable Toxicant Concentration)

Regulatory Authority and Advisory Information:

Carcinogenicity[83]: EPA Group C, Possible human carcinogen

Acute Oral Category: 4, Caution, not acutely toxic

Environmental hazard; highly toxic to marine life.

List of priority pollutants (U.S. EPA)

Clean Water Act: Toxic Pollutant (Section 401.15) other than those listed elsewhere; includes trichlorophenols

RCRA Section 261 Hazardous Constituents, waste number not listed

EPCRA Section 313 (as chlorophenols) Form R *de minimis* concentration reporting level: 1.0%

European/International Regulations: Hazard Symbol: N; risk phrases: R50/53; safety phrases: S2; S60; S61 (see Appendix 1)

Description: White to pale yellow crystalline solid, tan granules or powder. Odorless. Molecular weight = 352.89; Boiling point = 221.5°C; Freezing/Melting point = 105–108°; Vapor pressure = 2.3×10^{-8} mmHg. Hazard Identification (based on NFPA-704 M Rating System): Health 0, Flammability 1, Reactivity 0. Very slightly soluble in water; solubility = <1 ppm.

Incompatibilities: Dust forms an explosive mixture with air. Slowly hydrolyzes in water, releasing ammonia and forming acetate salts. Decomposes in temperatures >290°C.

Determination in Water: Log K_{ow} = 5.57 (est)[83]. Values above 3.0 are likely to bioaccumulate in aquatic organisms.

Routes of Entry: Ingestion, absorbed through the unbroken skin.

Short Term Exposure: Inhalation can cause severe irritation, burns to the nose and throat, headache, dizziness, vomiting, lung damage, muscle twitchings, spasms, tremors, weakness, staggering and collapse. Dermal contact may cause severe irritation and burns. Absorbed through the skin to cause or increase the severity of symptoms listed above. Eye contact causes severe irritation. May cause burns. Ingestion can cause irritation, burns to the mouth and throat, low blood pressure, profuse sweating, intense thirst, nausea, abdominal pain, stupor, vomiting, red blood cell damage and accumulation of fluid in the lungs followed by pneumonia. May also cause restlessness and increased breathing rate followed by rapidly developing muscle weakness. The substance irritates the eyes, the skin and the respiratory tract. LD_{50} (oral, dermal, rat) = >5 g/kg; LD_{50} (dermal, rat) = >5 g/kg.

Long Term Exposure: Skin sensitivity may develop. A possible liver toxin. May have effects on the blood, heart, liver, lung, kidney. The state of New Jersey lists the 2-chloro-isomer as a probable carcinogen, and that it causes leukemia and soft-tissue cancers in humans.

Points of Attack: Central nervous system, blood, bladder, liver.

Medical Surveillance: This chemical is a suspected or known human carcinogen. Exposed persons should contact a physician for advice regarding the possible long term health effects and advice for medical monitoring. If symptoms develop or overexposure is suspected, the following may be useful: Liver function tests. Kidney function tests. Examination by a qualified allergist. EKG

First Aid: If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least 15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately. If this chemical contacts the skin, remove contaminated clothing and wash immediately with soap and water. Seek medical attention immediately. If this chemical has been inhaled, remove from exposure, begin rescue breathing (using universal precautions) if breathing has stopped, and CPR if heart action has stopped. Transfer promptly to a medical facility. When this chemical has been swallowed, get medical attention. Give large quantities of water and induce vomiting. Do not make an unconscious person vomit. Do not induce vomiting when formulations containing petroleum solvents are ingested

Personal Protective Methods: Wear protective gloves and clothing to prevent any reasonable probability of dermal and/or eye contact. Safety equipment suppliers/manufacturers can provide recommendations on the most protective glove/clothing material for your operation. Employees should wash immediately with soap when skin is wet or contaminated. Provide emergency showers and eyewash.

Respirator Selection: Engineering controls should be used wherever feasible to maintain airborne concentrations of this chemical below the prescribed exposure limit. Respirators and protective equipment are less effective than engineering controls, and should be used only in non-routine or emergency situations which may result in exposure concentrations in excess of the TWA environmental limit. *At any concentrations above the NIOSH REL, or where there is no REL, at any detectable concentration:* SCBAF: Pd,Pp (APF = 10,000) (any NIOSH/MSHA- or European Standard EN 149-approved self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode); or SaF: Pd,Pp: ASCBA (APF = 10,000) (any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary, self-contained breathing apparatus operated in a pressure-demand or other positive-pressure mode).

Storage: Color Code-Blue: Health Hazard/Poison. Store in a secure poison location. Prior to working with carboxin you should be trained on its proper handling and storage. Store in tightly closed containers in a cool, well-ventilated area. Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: This material may be classified as Environmentally hazardous substances, liquid or solid, n.o.s. It usually falls in Hazard Class 9.

Spill Handling: First remove all sources of ignition. Evacuate persons not wearing protective equipment from area of spill or leak until clean up is complete. Collect powdered material in the most convenient and safe manner and deposit in sealed containers. Ventilate area after clean up is complete. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable.

Fire Extinguishing: Hazardous decomposition includes oxides of nitrogen and sulfur and hydrogen chloride gas. As an immediate precautionary measure, isolate spill or leak area in all directions for at least 50 meters/150 feet for liquids and at least 25 meters/75 feet for solids. *Fire involving storage or vehicular tanks:* isolate for 800 meters/0.5 mile in all directions; also, consider initial evacuation for 800 meters/0.5 mile in all directions. *On a small fire:* use dry chemical, CO_2, water spray or regular foam. *On a large fire:* use water spray, fog or regular foam. Do not scatter spilled material with high-pressure streams of water. Move containers from fire area if you can do it without risk. Dike fire-control water for later disposal. *Fire involving tanks:* from a secure, explosion-proof location, use water spray to cool exposed containers. If cooling streams are ineffective (venting sound increases in volume and pitch, tank discolors, or shows any signs of deforming), withdraw immediately to a secure position. Always stay away from tanks engulfed in fire. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode.

Disposal Method Suggested: Do not discharge into drains or sewers. Dispose of waste material as hazardous waste using a licensed disposal contractor to an approved landfill. Consult with environmental regulatory agencies for guidance on acceptable disposal practices. If allowed, incineration with effluent gas scrubbing is recommended. In accordance with 40CFR165, follow recommendations for the disposal of pesticides and pesticide containers. Containers must be disposed of properly by following package label directions or by contacting your local or federal environmental control agency, or by contacting your regional EPA office.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- Pesticide Management Education Program, “Hexythiazox, (Savey) Chemical Profile 4/89” Cornell University, Ithaca, NY (April 1989). http://pmep.cce.cornell.edu/profiles/insect-mite/fenitrothion-methyl-para/hexythiazox/insect-prof-hexythiazox.html
- USEPA, Office of Pesticide Programs, Pesticide Residue Limits, “Hexythiazox,” ***40 CFR 180.448***. http://www.epa.gov/pesticides/food/viewtols.htm

Hydramethylnon H:0365

Use Type: Insecticide

CAS Number: 67485-29-4

Formula: $C_{25}H_{24}F_6N_4$

Synonyms: AC 217300; AI3-29349; Amidinohydrazone; Caswell No. 642AB; Caswell No. 839A; Pyrimidinone; 1,4-Pentadien-3-one-1,5-bis(α,α,α-trifluoro-*p*-tolyl)-tetrahydro-5,5-dimethyl-2(1*H*)-pyrimidinylidene)hydrazone; 2(1*H*)-Pyrimidinone, tetrahydro-5,5-dimethyl-, [3-(4-(trifluoromethyl)phenyl]-1-[2-(4-(trifluoromethyl) phenyl] ethenyl-2-propenylidene]hydrazone; Tetrahydro-5,5-dimethyl-2(1*H*)-pyrimidinone[1,5-bis(α,α,α-trifluoro-*p*-tolyl)-1,4-pentadien-3-one]hydrazone; Tetrahydro-5,5-dimethyl-2(1*H*)-pyrimidinone[3-(4-(trifluoromethyl) phenyl)]-1-[2-(4-(trifluoromethyl) phenyl)ethenyl]-2-propenylidene] hydrazone

Trade Names: AC-217300; AMDRO®, BASF Agricultural Products Germany; CL 217,300®; COMBAT®, BASF Agricultural Products Germany; MATOX®; MAXFORCE®

ANT KILLER GRANULAR BAIT; MAXFORCE® ROACH GEL SENSIBLE®, BASF Agricultural Products Germany; SIEGE®, BASF Agricultural Products Germany; WIPEOUT®

Chemical class: Organofluorine

EPA/OPP PC Code: 118401

California DPR Chemical Code: 2203

HSDB Number: 6673

UN/NA & ERG Number: May vary by formulation. Consult appropriate Dangerous Goods Regulations, including 49CFR.

RTECS® Number: UW7583000

EC Number: 405-090-9 [*Annex I Index No.:* 613-181-00-1]

U.S. Maximum Allowable Residue Levels for Hydramethylnon [40 CFR 180.395(a)]: grass, forage 2.0 ppm; grass, hay 2.0 ppm; pineapple 0.05 ppm.

Uses: Hydramethylnon is a slow-acting toxicant used primarily to control ants in grasses and rangelands and other non-crop lands such as lawns, turf, and non-bearing nursery stock. Hydramethylnon is also registered for the control of household ant species and cockroaches in non-food use areas in and around domestic dwellings and commercial establishments. Hydramethylnon has established tolerances from use on grasses in pastures and rangeland; however, hydramethylnon is almost completely metabolized within the body of ruminants and there are no detectable residues in meat, milk, or meat byproducts. Therefore, tolerances are not required for these commodities even though hydramethylnon is considered a food use pesticide for the purposes of re-registration and tolerance reassessment. Not approved for use in EU countries[115] Registered for use in the U.S.

Human toxicity (long-term)[101]: Extra high–0.21 ppb, Health Advisory

Fish toxicity (threshold)[101]: High–8.90567 ppb, MATC (Maximum Acceptable Toxicant Concentration)

Regulatory Authority and Advisory Information:

Carcinogenicity[83]: EPA Group C, Possible human carcinogen

California Proposition 65 Chemical: Developmental/Reproductive toxin (male) (3/5/1999)

Health Advisory: Endocrine disruptor, Developmental toxin (TRI)

Acute Oral Category: 3, CAUTION

EPCRA Section 313 Form R *de minimis* concentration reporting level: 1.0%

European/International Regulations: Hazard Symbol: T+, N; risk phrases: R22; R36; R48/25; R50/53; safety phrases: S1/2; S22; S36/37; S45; S60; S61 (see Appendix 1)

Description: Dark yellow to tan crystalline solid, granules, or powder. Commercial products are available in various forms. Characteristic vegetable oil odor. Molecular weight = 494.475; Specific gravity (H_2O:1) = 1.68 @ 25°C; Freezing/Melting point = 190°C; Vapor pressure = 2.3×10^{-8} mmHg; Flash point = 94°C (cc)[BASF]; Henry's Law constant = 2.20×10^{-6}atm-m^3/mol @ 25°C (est)[83]. Practically insoluble in water; solubility = 0.005 mg/L @ 25°C. Physical and toxicological properties may be affected by carrier solvents in commercial formulations.

Determination in Water: Log K_{ow} = <2.5. Unlikely to bioaccumulate in marine organisms.

Harmful Effects and Symptoms

Short Term Exposure: Contact with eyes or skin may cause irritation or injury. Inhalation should be avoided; use NIOSH- or CEN (UK)-approved air purifying respirators for pesticides. Toxic if inhaled, ingested, or absorbed through the skin. LD_{50} (oral, rat) = 1200 mg/kg; LD_{50} (dermal, rabbit) = >5g/kg.

Long Term Exposure: A male reproductive toxin. Fluorides may cause bone disease (pain and tenderness of the bones); mottled teeth in children.

Points of Attack: Testes, reproductive system, bones.

Medical Surveillance: This chemical is a suspected or known human carcinogen. Exposed persons should contact a physician for advice regarding the possible long term health effects and advice for medical monitoring. Comprehensive physical examination with emphasis on the genito-urinary tract including testicle size and consistency in males. Semen analysis to include sperm count, motility and morphology. Other tests, such as serum testosterone, serum follicle stimulating hormone (FSH), and serum lutenizing hormone (LH), may be carried out if, in the opinion of a physician, they are indicated.

First Aid: If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least 15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately. If this chemical contacts the skin, remove contaminated clothing and wash immediately with soap and water. Seek medical attention immediately. If this chemical has been inhaled, remove from exposure, begin rescue breathing (using universal precautions) if breathing has stopped, and CPR if heart action has stopped. Transfer promptly to a medical facility. When this chemical has been swallowed, get medical attention. Give large quantities of water and induce vomiting. Do not make an unconscious person vomit. Do not induce vomiting when formulations containing petroleum solvents are ingested.

Personal Protective Methods: Applicators and other handlers must wear: Coveralls worn over long-sleeved shirt and long pants; Chemical-resistant gloves such as DuPont™ Tychem® suit fabrics, barrier laminate, or Viton®; Chemical-resistant footwear plus socks; Protective eye wear (minimum EN 166 or equivalen); Chemical-resistant headgear for overhead exposure; Chemical-resistant apron when cleaning equipment, mixing, or loading[83]. Agricultural Use/Engineering Controls: When handlers use closed systems, enclosed cabs, or aircraft in a manner that meets the requirements listed in the Worker Protection Standard (WPS) for agricultural pesticides, 40 CFR 170.240(d)(4-6), the handler PPE requirements may be reduced or modified as specified in the Worker Protection Standard. Firefighters should wear NIOSH-approved self-contained breathing apparatus and full protective clothing.

Respirator Selection: *At concentrations above the NIOSH REL, or where there is no REL, at any detectable concentration:* SCBAF:Pd,Pp (APF = 10,000): (any self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode); or SaF:Pd,Pp:ASCBA (APF = 10,000) (any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary self-contained positive-pressure breathing apparatus). *Escape*: GmFOv100 (APF = 50) [any air-purifying, full facepiece respirator (gas mask) with a chin-style, front- or back-mounted organic vapor canister having an N100, R100, or P100 filter]; or SCBAE (any appropriate escape-type, self-contained breathing apparatus).

Storage: Color Code-Blue: Health Hazard/Poison. Store in a secure poison location. Prior to working with this chemical you should be trained on its proper handling and storage. Store in tightly closed containers in a cool, well-ventilated area. Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: Consult appropriate Dangerous Goods Regulations, including 49CFR, for additional description requirements, mode-specific, or quantity-specific shipping requirements.

Spill Handling: First remove all sources of ignition. Evacuate persons not wearing protective equipment from area of spill or leak until clean up is complete. Ventilate area of spill or leak. Use water spray to reduce vapor. Absorb liquids in vermiculite, dry sand, earth, or a similar material and deposit in sealed containers. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable.

Fire Extinguishing: Hazardous decomposition includes hydrogen fluoride, fluorine, carbon dioxide, and nitrogen oxide. Use dry chemical, carbon dioxide; or alcohol-resistant foam extinguishers. Vapors are heavier than air and will collect in low areas. Vapors may travel long distances to ignition sources and flashback. Vapors in confined areas may explode when exposed to fire. Storage containers and parts of containers may rocket great distances, in many directions. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies. From a secure, explosion-proof location, use water spray to cool exposed containers. If cooling streams are ineffective (venting sound increases in volume and pitch, tank discolors, or shows any signs of deforming), withdraw immediately to a secure position. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode.

Disposal Method Suggested: It is the responsibility of chemical waste generators to determine the toxicity and physical properties and of a discarded chemical and to properly identify its classification and certification as a hazardous waste and to determine the disposal method. U.S. EPA guidelines for the classification determination are listed in 40 CFR Parts 261.3. Additionally, waste generators must consult and follow all regional, national, state and local hazardous waste laws to ensure complete and accurate classification and disposal methods.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- USEPA, “Reregistration Eligibility Decision (RED), Hydramethylnon,” Office of Prevention, Pesticides and Toxic Substances, Washington DC (December 1998). http://www.epa.gov/REDs/2585red.pdf

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Imazalil I:0075

Use Type: Fungicide; Veterinary medicine
CAS Number: 35554-44-0
Formula: $C_{14}H_{14}Cl_2N_2O$
Synonyms: Allyl-1-(2,4-dichlorophenyl)-2-imidazol-1-ylethyl ether; (±)1-(*β*-Allyloxy-2,4-dichlorophenethyl) imidazole; (±)-1-[*β*-(Allyloxy)-2,4-dichlorophenethyl] imidazole; 1-[2-(Allyloxy)-2-(2,4-dichlorophenyl)ethyl]-1*H*-imidazole; Caswell No. 497AB; Chloramizol; 1-(2-(2,4-Dichlorophenyl)-2-(2-propenyloxy)ethyl)-1*H*-imidazole; 1-[2-((2,4-Dichlorophenyl)-2-propenyloxy)-ethyl]-1 *H*-imidazole; Enilconazole; 1*H*-Imidazole, 1-[2-(2,4-dichlorophenyl)-2-(2-propenyloxy)ethyl]-; 1*H*-Imidazole, 1-[2-(2,4-dichlorophenyl)-2-(2-propenyloxy)ethyl]-, (±)-
Trade Names: BAYTAN IM®; BROMAZIL® Imazalil; CEREVAX® EXTRA; CLINAFARM®; DECCOZIL®, Cerexagri Inc (France); FECUNDAL® 100EC; FF4961®; FLO-PRO IMZ®; FRESHGARD®; FUNGAFLOR®; IMAVEROL®; MAGNET®; MIST-O-MATIC® liquid seed treatment; NUZONE®; RAXIL®; RTU-VITAVAX EXTRA®; R 23979®; VITAVAX EXTRA®
Chemical class: Imidazole derivative
EPA/OPP PC Code: 111901
California DPR Chemical Code: 2084
HSDB Number: 6672
UN/NA & ERG Number: UN2811/154
RTECS® Number: NI47760000
EC Number: 212-615-0 [*Annex I Index No.:* 613-042-00-5]
Uses: Imazalil is a systemic fungicide used on fruit, vegetables and ornamentals to control powdery mildew, black spot and other fungi. Also used as a seed dressing and for post-harvest applications to bananas, citrus and other fruit. It has been shown that the use of imazalil is less likely to lead to resistant fungi strains than other fungicides.
U.S. Maximum Allowable Residue Levels for Imazalil and its metabolite, 1-(2,4-dichlorophenyl)-2-(1H-imidazole-1-yl)-1-ethanol, in or on the following food commodities [40 CFR 180.413(a)(1)]: banana (whole) 3.00 ppm; banana, pulp 0.20 ppm; barley, grain 0.05 ppm; barley, straw 0.5 ppm; citrus, oil 25.0 ppm; citrus, dried pulp 25.0 ppm; fruit, citrus, post harvest 10.0 ppm; wheat, forage 0.5 ppm; wheat, grain 0.05 ppm; wheat, straw 0.5 ppm; ppm. [***40 CFR 180.413(a)(2)***]: cattle, fat 0.01 ppm; cattle, liver 0.50 ppm; cattle, meat 0.01 ppm; cattle, meat byproducts 0.01 ppm; goat, fat 0.01 ppm; goat, liver 0.50 ppm; goat, meat 0.01 ppm; goat, meat byproducts 0.01 ppm; hog, fat 0.01 ppm; hog, liver 0.50 ppm; hog, meat 0.01 ppm; hog, meat byproducts 0.01 ppm; horse, fat 0.01 ppm; horse, liver 0.50 ppm; horse, meat 0.01 ppm; horse, meat byproducts 0.01 ppm; milk 0.01 ppm; sheep, fat 0.01 ppm; sheep, liver 0.50 ppm; sheep, meat 0.01 ppm; sheep, meat byproducts 0.01 ppm; ppm.
Human toxicity (long-term)[101]: Intermediate–17.50 ppb, Health Advisory
Fish toxicity (threshold)[101]: Low–193.77060 ppb, MATC (Maximum Acceptable Toxicant Concentration)
Regulatory Authority and Advisory Information:
U.S. EPA Carcinogens: Likely to be carcinogenic to humans
Acute Oral Category: 2, WARNING
Health Advisory: Developmental/Reproductive Toxin, Skin irritant/sensitizer, Developmental toxin (TRI)
EPCRA Section 313 Form R *de minimis* concentration reporting level: 1.0%
European/International Regulations: Hazard Symbol: Xi, Xn, N; risk phrases: R20/22; R41; R50/53; safety phrases: S1/2; S26; S39; S60; S61 (see Appendix 1)
Description: Yellow to brown wax-like, solidified oil or crystalline solid. Commercial products are in various forms including emulsifiable concentrate. Liquid formulations in organic solvents are combustible. Molecular weight = 297.18; Freezing/Melting point = 51–52 °C; Boiling point = (decomposes) 320–350 °C (estimated); Vapor pressure = 6.8×10^{-8} mmHg. Flash point = 191.5 °C. Low to moderate solubility in water. Physical and toxicological properties may be affected by carrier solvents in commercial formulations.
Incompatibilities: Incompatible with oxidizers and alkaline materials. May react with mineral or clay-based absorbents. Decomposes >250 °C.
Routes of Entry: Inhalation, skin absorption, ingestion, eye and/or dermal contact.
Determination in Water: Log K_{ow} = >3.5. Values above 3.0 are likely to bioaccumulate in marine organisms.
Harmful Effects and Symptoms
Short Term Exposure: Causes eye irritation with pain. May cause skin and respiratory tract irritation. May cause nausea if ingested; toxic. Liver and kidney toxin. LD_{50} (oral, rat) = 250 mg/kg; LD_{50} (dermal, rat) = >4 g/kg.
Long Term Exposure: May cause cancer and developmental problems. May cause liver and kidney problems. May cause skin sensitization.
Medical Surveillance: If skin sensitization is suspected, an evaluation by a qualified allergist, including exposure history and testing, may help diagnose allergy. Liver and kidney function tests. Comprehensive physical examination with emphasis on the genito-urinary tract analysis to include sperm count, motility and morphology. Other tests, such as serum testosterone, serum follicle stimulating hormone (FSH), and serum lutenizing hormone (LH), may be carried out if, in the opinion of a physician, they are indicated.
First Aid: If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least

15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately. If this chemical contacts the skin, remove contaminated clothing and wash immediately with soap and water. Seek medical attention immediately. If this chemical has been inhaled, remove from exposure, begin rescue breathing (using universal precautions) if breathing has stopped, and CPR if heart action has stopped. Transfer promptly to a medical facility. When this chemical has been swallowed, get medical attention. Give large quantities of water and induce vomiting. Do not make an unconscious person vomit. Do not induce vomiting when formulations containing petroleum solvents are ingested.

Personal Protective Methods: Wear protective gloves and clothing to prevent any reasonable probability of dermal and/or eye contact. Safety equipment suppliers/manufacturers can provide recommendations on the most protective glove/clothing material for your operation. All protective clothing (suits, gloves, footwear, headgear) should be clean, available each day, and put on before work. Contact lenses should not be worn when working with this chemical. Wear dust-proof chemical goggles and face shield unless full facepiece respiratory protection is worn. Employees should wash immediately with soap when skin is wet or contaminated. Provide emergency showers and eyewash. For emergency situations, wear a positive-pressure, pressure-demand, full facepiece self-contained breathing apparatus (SCBA); or pressure-demand supplied-air respirator with escape SCBA and a fully encapsulating, chemical resistant suit.

Respirator Selection: May react with mineral or clay-based absorbents. Follow regulations in OSHA 29CFR1910.134 or European Standard EN149. Use a NIOSH/MSHA- or European Standard EN149-approved respirator; or use an approved supplied-air respirator with a full facepiece operated in the positive-pressure mode, or with a full facepiece, hood, or helmet in the continuous-flow mode; or use a NIOSH/MSHA- or European Standard EN149-approved self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive-pressure mode.

Storage: Color Code-Blue: Health Hazard/Poison: Store in a secure poison location. Prior to working with this chemical you should be trained on its proper handling and storage. Store in tightly closed containers in a cool, well-ventilated area. Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: Pesticides, solid, toxic, n.o.s. require a label of "poisonous materials." It falls into Hazard Class 6.1.

Spill Handling: First remove all sources of ignition. Evacuate persons not wearing protective equipment from area of spill or leak until clean up is complete. Do not touch spilled material; stop leak if you can do so without risk. Use water spray to reduce vapors. *Small spills*: absorb with sand or other noncombustible absorbent material and place into containers for later disposal. *Small dry spills*: with clean shovel place material into clean, dry container and cover; move containers from spill area. *Large spills*: dike far ahead of spill for later disposal. Ventilate area after clean up is complete. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable.

Fire Extinguishing: Heated to decomposition, above 285 °C, it releases toxic fumes including oxides of nitrogen and carbon and hydrogen chloride gas. *Fire involving storage or vehicular tanks:* isolate for 800 meters/0.5 mile in all directions; also, consider initial evacuation for 800 meters/0.5 mile in all directions. *Small fire:* dry chemical, carbon dioxide or water spray. *Large fire:* dry chemical, carbon dioxide, alcohol-resistant foam or water spray. Move containers from fire area if you can do it without risk. Dike fire-control water for later disposal; do not scatter the material. *Fire involving tanks or car/trailer loads:* fight fire from maximum distance or use unmanned hose holders or monitor nozzles. Do not get water inside containers. Cool containers with flooding quantities of water until well after fire is out. Withdraw immediately in the case of rising sound from venting safety devices or discoloration of tank. Always stay away from tanks engulfed in fire. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies.

Disposal Method Suggested: In accordance with 40CFR 165 recommendations for the disposal of pesticides and pesticide containers. Containers must be disposed of properly by following package label directions or by contacting your local or federal environmental control agency, or by contacting your regional EPA office.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- EXTOXNET, Extension Toxicology Network, "Pesticide Information Profile, Imazalil," Oregon State University, Corvallis, OR (June 1996). http://extoxnet.orst.edu/pips/imazalil.htm
- USEPA, "Reregistration Eligibility Decision (RED), Imazalil" Office of Prevention, Pesticides and Toxic Substances, Washington DC (July 12, 2002). http://www.epa.gov/REDs/imazalil_tred.pdf
- USEPA, Office of Pesticide Programs, Pesticide Residue Limits, "Imazalil," 40 CFR 180.413. http://www.epa.gov/pesticides/food/viewtols.htm

- International Programme on Chemical Safety (IPCS), "Health and Safety Guide, Pesticide Residues in Food, 2000, Imazalil," Geneva, Switzerland (2000). http://www.inchem.org/documents/jmpr/jmpmono/v00pr08.htm

Imazethabenz-methyl I:0078

Use Type: Herbicide
CAS Number: 81405-85-8
Formula: $C_{16}H_{20}N_2O_3$
Synonyms: Benzoic acid, 2-(4,5-dihydro-4-methyl-4-(1-methylethyl)-5-xox-1H-imidazol-2-yl)-4 (or 5)-methyl-, methyl ester; 2[4,5-Dihydro-4-methyl-4-(1-methylethyl)-5-oxo-1H-imidazol-2-yl]-4 (or 5)-methylbenzoic acid methyl ester; Imazamethabenz; (Methyl 6-(4-isopropyl-4-methyl-5-oxo-2-imidazolin-2-yl)-m-toluate plus; Methyl 6-(4-isopropyl-4-methyl-5-oxo-2-imidazolin-2-yl)-m-toluate); (Methyl 6-(4-isopropyl-4-methyl-5-oxo-2-imidazolin-2-yl)-m-toluate plus Methyl 6-(4-isopropyl-4-methyl-5-oxo-2-imidazolin-2-yl)-m-toluate); m-(or p-)Toluic acid, 6-(4-isopropyl-4-methyl-5-oxo-2-imidazolin-2-yl)-, methyl ester; m-(or p-)Toluic acid, 2-(4,5-dihydro-4-methyl-4-isopropyl-5-oxo-1H-imidazol-2-yl)-, methyl ester
Trade Names: DAGGER®; ASSERT®
Chemical class: Imidazolinone
EPA/OPP PC Code: 128842
California DPR Chemical Code: 2240
HSDB Number: 6675
UN/NA & ERG Number: Consult appropriate Dangerous Goods Regulations, including 49CFR
RTECS® Number: DG8576140
Uses: Generally used as a herbicide on small grain crops. Registered for use in the U.S. Banned for use in EU as imazamethabenz
Human toxicity (long-term)[101]: Very low–441.00 ppb, Health Advisory
Fish toxicity (threshold)[101]: Very low–515.35916 ppb, MATC (Maximum Acceptable Toxicant Concentration)
U.S. Maximum Allowable Residue Levels for Imazamethabenz-methyl [40 CFR 180.437]: in or on the following raw agricultural commodities: barley, grain 0.10 ppm; barley straw 2.00 ppm; sunflower seed 0.10 ppm; wheat grain 0.10 ppm; wheat straw 2.00 ppm.
Regulatory Authority and Advisory Information:
Carcinogenicity[83]: EPA Group D, Not classifiable as a human carcinogen
Acute Oral Category: 3, CAUTION
Description: White or slightly yellow powder. Musty odor. Molecular weight = 288.33; Specific gravity (H_2O:1) = 0.33 @ 20 °C; Freezing/Melting point = 133–145 °C; Vapor pressure = 1.2×10^{-8} mmHg @ 25 °C; Flash point = 91 °C. Soluble in water. Physical and toxicological properties may be affected by carrier solvents in commercial formulations.
Incompatibilities: Incompatible with oxidizers, chlorates nitrates, peroxides; and alkaline materials. Strongly acidic, a corrosive material; may attack some metals, including aluminum and steel, and some coatings, especially in the presence of moisture.
Permissible Concentration in Water: Runoff from spills or fire control may cause water pollution.
Determination in Water: Log K_{ow} = <2.0. Unlikely to bioaccumulate in marine organisms.
Harmful Effects and Symptoms
Short Term Exposure: May cause irritation to the eyes, skin, or respiratory tract. High levels may cause permanent eye damage. May be toxic if ingested or absorbed through the skin. LD_{50} (oral, rat) = >5 g/kg; LD_{50} (dermal, rat) = >2 g/kg.
Medical Surveillance: Preliminary medical exam to detect chronic diseases of central nervous system, liver, heart, kidneys, lung and skin, as well as endocrinological or immunological disturbances, should protect susceptible individuals. Periodical medical exams of internal organs, skin and eyes are important to avoid chronic occupational intoxications. They should include lab and patch tests when necessary[83].
First Aid: If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least 15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately. If this chemical contacts the skin, remove contaminated clothing and wash immediately with soap and water. Seek medical attention immediately. If this chemical has been inhaled, remove from exposure, begin rescue breathing (using universal precautions) if breathing has stopped, and CPR if heart action has stopped. Transfer promptly to a medical facility. When this chemical has been swallowed, get medical attention. Give large quantities of water and induce vomiting. Do not make an unconscious person vomit.
Personal Protective Methods: Applicators and other handlers must wear: Coveralls worn over long-sleeved shirt and long pants; Chemical-resistant gloves such as DuPont™ Tychem® suit fabrics, barrier laminate, or Viton®; Chemical-resistant footwear plus socks; Protective eye wear; Chemical-resistant headgear for overhead exposure; Chemical-resistant apron when cleaning equipment, mixing, or loading[83]. Agricultural Use/Engineering Controls: When handlers use closed systems, enclosed cabs, or aircraft in a manner that meets the requirements listed in the Worker Protection Standard (WPS) for agricultural pesticides, ***40 CFR 170.240(d)(4-6)***, the handler PPE requirements may be reduced or modified as specified in the Worker Protection Standard. Firefighters should wear NIOSH-approved self-contained breathing apparatus and full protective clothing.
Respirator Selection: Wherever and whenever workplace conditions warrant respirator use, a respiratory protection program must be followed that meets one or more of the following government standards: OSHA's 29 CFR 1910.134, ANSI Z88.2, or European Standard EN 149.
Storage: Color Code-White: Corrosive or Contact Hazard; Store separately in a corrosion resistant location. Prior to working with this chemical you should be trained on its proper handling and storage. Store in tightly closed containers in a cool, well-ventilated area. Store pesticides in original containers, complete with labels listing ingredients, use

directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: Consult appropriate Dangerous Goods Regulations, including 49CFR, for additional description requirements, mode-specific, or quantity-specific shipping requirements.

Fire Extinguishing: Hazardous decomposition includes oxides of nitrogen and carbon. As an immediate precautionary measure, isolate spill or leak area in all directions for at least 50 meters/150 feet for liquids and at least 25 meters/75 feet for solids. *Fire involving storage or vehicular tanks:* isolate for 800 meters/0.5 mile in all directions; also, consider initial evacuation for 800 meters/0.5 mile in all directions. *On a small fire:* use dry chemical, CO_2, water spray or regular foam. *On a large fire:* use water spray, fog or regular foam. Do not scatter spilled material with high-pressure streams of water. Move containers from fire area if you can do it without risk. Dike fire-control water for later disposal. *Fire involving tanks:* from a secure, explosion-proof location, use water spray to cool exposed containers. If cooling streams are ineffective (venting sound increases in volume and pitch, tank discolors, or shows any signs of deforming), withdraw immediately to a secure position. Always stay away from tanks engulfed in fire. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full face-pieces and are operated in a pressure-demand or other positive-pressure mode.

Disposal Method Suggested: It is the responsibility of chemical waste generators to determine if a discarded chemical is classified as a hazardous waste. See ***40 CFR Parts 261.3*** for U.S. EPA guidelines for the classification determination. Additionally, in order to ensure complete and accurate classification, waste generators must consult state and local hazardous waste regulations.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov

Imazapyr I:0080

Use Type: Herbicide
CAS Number: 81334-34-1
Formula: $C_{13}H_{15}N_3O_3$
Synonyms: 2-(4,5-Dihydro-4-methyl-4-(1-methylethyl)-5-oxo-1H-imidazol-2-yl)-3-pyri dinecarboxylic acid; 2-(4-Isopropyl-4-methyl-5-oxo-2-imidazolin-2-yl) nicotinic acid; 3-Pyridinecarboxylic acid, 2-(4,5-dihydro-4-methyl-4-(1-methylethyl)-5-oxo-1H-im idazol- 2-yl)-
Trade Names: OPTION® Imazapyr; OPTION®-35WDG[83]
Chemical class: Imidazolinone
EPA/OPP PC Code: 128821
California DPR Chemical Code: 2256
HSDB Number: 6676
UN/NA&ERG Number: UN3077(solid)/171; UN3082 (liquid)/171
RTECS® Number: US5682500
EC Number: 617-219-8 [*Annex I Index No.:* 613-216-00-1]

U.S. Maximum Allowable Residue Levels for Imazapyr (40 CFR 180.500): Cattle, fat 0.05 ppm; cattle, kidney 0.20 ppm; cattle, meat 0.05 ppm; cattle, meat byproducts, except kidney 0.05 ppm; corn, field, forage 0.05 ppm; corn, field, grain 0.05 ppm; corn, field, stover 0.05 ppm; fish 1.0 ppm; goat, fat 0.05 ppm; goat, kidney 0.20 ppm; goat, meat 0.05 ppm; goat, meat byproducts, except kidney 0.05 ppm; grass, forage 100 ppm; grass, hay 30 ppm; horse, fat 0.05 ppm; horse, kidney 0.20 ppm; horse, meat 0.05 ppm; horse, meat byproducts, except kidney 0.05 ppm; milk 0.01 ppm; sheep, fat 0.05 ppm; sheep, kidney 0.20 ppm; sheep, meat 0.05 ppm; sheep, meat byproducts, except kidney 0.05 ppm; shellfish 0.10 ppm; ppm.

Uses: Not approved for use in EU countries[115]. A U.S. EPA restricted Use Pesticide (RUP). Imazapyr is a systemic, non-selective herbicide used for the pre- and post-emergence control of a broad range of weeds, including terrestrial annual and perennial grasses, broad-leaved herbs, woody species, and riparian and emergent aquatic species. Imazapyr may be used in a variety of agricultural, commercial, and residential settings. Use sites include corn, forestry sites, rights-of-way, fence rows, hedge rows, drainage systems, outdoor industrial areas, outdoor buildings and structures, domestic dwellings, paved areas, driveways, patios, parking areas, walkways, various water bodies (including ponds, lakes, streams, swamps, wetlands, and stagnant water), and urban areas. Imazapyr may also be used on recreation areas, athletic fields, and golf course roughs[83].

Regulatory Authority and Advisory Information:
Carcinogenicity[83]: EPA Group E, evidence of non-carcinogenicity for humans.
Acute Oral Category: 4, Caution, not acutely toxic
European/International Regulations: Hazard Symbol: Xi, N; risk phrases: R36; R50/53; safety phrases: S2; S26; S61 (see Appendix 1)

Description: White to tan crystalline solid or powder. Slight ammoniacal odor. Commercial formulations include liquid, wettable powder, granules, emusifyible concentrate. Molecular Weight = 261.28; Melting point = 169–173 °C; Vapor pressure = 1.79×10^{-11} mmHg @ 25 °C (est)[83]; Henry's Law constant = 7.08×10^{-17} atm-m^3/mol @ 25 °C (est)[83]. Highly soluble in water. Physical and toxicological properties may be affected by carrier solvents in commercial formulations.

Incompatibilities: Corrosive to iron and steel but not corrosive to some stainless steel alloys.

Permissible Exposure Limits in Air: No standards set.

Determination in Water: Log K_{ow} = <0.5. Unlikely to bioaccumulate in marine organisms.

Routes of Entry: Inhalation, dermal contact, ingestion.

Harmful Effects and Symptoms

Short Term Exposure: May cause irritation to the eyes, skin, or respiratory tract. Corrosive; can cause corneal injury to the eyes. May be toxic if ingested or absorbed through the skin. Ingestion may cause vomiting, pulmonary dysfunction, oral mucosal and gastro-intestinal irritation, and transient liver andrenal dysfunction[83]. LD_{50} (oral, rat) = >5 g/kg; LD_{50} (dermal, rabbit) = >2 g/kg.

Medical Surveillance: Preliminary medical exam to detect chronic diseases of central nervous system, liver, heart, kidneys, lung and skin, as well as endocrinological or immunological disturbances, should protect susceptible individuals. Periodical medical exams of internal organs, skin and eyes are important to avoid chronic occupational intoxications. They should include lab and patch tests when necessary[83].

First Aid: *Eyes:* First check the victim for contact lenses and remove if present. Flush victim's eyes with water or normal saline solution for 20 to 30 minutes while simultaneously calling a hospital or poison control center. Do not put any ointments, oils, or medication in the victim's eyes without specific instructions from a physician. *Immediately* transport the victim after flushing eyes to a hospital even if no symptoms (such as redness or irritation) develop.

Skin: *Immediately* flood affected skin with water while removing and isolating all contaminated clothing. Gently wash all affected skin areas thoroughly with soap and water. If symptoms such as redness or irritation develop, *immediately* call a physician and be prepared to transport the victim to a hospital for treatment. *Inhalation: Immediately* leave the contaminated area; take deep breaths of fresh air. If symptoms (such as wheezing, coughing, shortness of breath, or burning in the mouth, throat, or chest) develop, call a physician and be prepared to transport the victim to a hospital. Provide proper respiratory protection to rescuers entering an unknown atmosphere. Whenever possible, self-contained breathing apparatus (SCBA) should be used; if not available, use a level of protection greater than or equal to that advised under Protective Clothing. *Ingestion: Do not induce vomiting.* If the victim is conscious and not convulsing, give 1 or 2 glasses of water to dilute the chemical and *immediately* call a hospital or poison control center. Be prepared to transport the victim to a hospital if advised by a physician. If the victim is convulsing or unconscious, do not give anything by mouth, ensure that the victim's airway is open and lay the victim on his/her side with the head lower than the body. *Do not induce vomiting. Immediately* transport the victim to a hospital[88].

Personal Protective Methods: Smoking, eating, and drinking before washing should be absolutely prohibited when any pesticide is being handled or used. Applicators and other handlers must wear: Coveralls worn over long-sleeved shirt and long pants; Chemical-resistant gloves such as DuPont™ Tychem® suit fabrics, barrier laminate, or Viton®; Chemical-resistant footwear plus socks; Protective eye wear; Chemical-resistant headgear for overhead exposure; Chemical-resistant apron when cleaning equipment, mixing, or loading[83]. Agricultural Use/Engineering Controls: When handlers use closed systems, enclosed cabs, or aircraft in a manner that meets the requirements listed in the Worker Protection Standard (WPS) for agricultural pesticides, ***40 CFR 170.240(d)(4-6)***, the handler PPE requirements may be reduced or modified as specified in the Worker Protection Standard.

Respirator Selection: Wherever and whenever workplace conditions warrant respirator use, a respiratory protection program must be followed that meets one or more of the following government standards: OSHA's 29 CFR 1910.134, ANSI Z88.2, or European Standard EN 149.

Storage: Color Code-White: Corrosive or Contact Hazard; Store separately in a corrosion-resistant location. Prior to working with this chemical you should be trained on its proper handling and storage. Store in tightly closed containers in a cool, well-ventilated area. Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: Environmentally hazardous substances, solid or liquid, usually fall in Hazard Class 9.

Spill Handling: Evacuate and restrict persons not wearing protective equipment from area of spill or leak until clean up is complete. Ventilate area of spill or leak. Absorb liquids in vermiculite, dry sand, earth, peat, carbon, or a similar material and deposit in sealed containers. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable.

Fire Extinguishing: Hazardous decomposition includes oxides of nitrogen and carbon. As an immediate precautionary measure, isolate spill or leak area in all directions for at least 50 meters/150 feet for liquids and at least 25 meters/75 feet for solids. *Fire involving storage or vehicular tanks:* isolate for 800 meters/0.5 mile in all directions; also, consider initial evacuation for 800 meters/0.5 mile in all directions. *On a small fire:* use dry chemical, CO_2, water spray or regular foam. *On a large fire:* use water spray, fog or regular foam. Do not scatter spilled material with high-pressure streams of water. Move containers from fire area if you can do it without risk. Dike fire-control water for later disposal. *Fire involving tanks:* from a secure, explosion-proof location, use water spray to cool exposed containers. If cooling streams are ineffective (venting sound increases in volume and pitch, tank discolors, or shows any signs of deforming), withdraw immediately to a secure position. Always stay away from tanks engulfed in fire. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full face-pieces and are operated in a pressure-demand or other positive-pressure mode.

Disposal Method Suggested: It is the responsibility of chemical waste generators to determine the toxicity and physical properties and of a discarded chemical and to properly identify its classification and certification as a hazardous waste and to determine the disposal method. US EPA guidelines for the classification determination are listed in ***40 CFR Parts 261.3***. Additionally, waste generators must consult and follow all regional, national, state and local hazardous waste laws to ensure complete and accurate classification and disposal methods.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- USEPA; Imazapyr: HED Chapter of the Reregistration Eligibility Document (RED). Document ID: EPA-HQ-OPP-2005-0495-0004. p.5 (December 8, 2005). Available from, as of June 2, 2011

Imazaquin I:0084

Use Type: Herbicide, Plant growth regulator

CAS Number: 81335-37-7; 81335-47-9 (ammonium salt)

Formula: $C_{17}H_{17}N_3O_3$; $C_{17}H_{20}N_4O_3$ (ammonium salt)

Synonyms: 2-[4,5-Dihydro-4-methyl-4-(1-methylethyl)-5-*oxo*-1*H*-imidazol-2-yl]-3-quinolinecarboxylic acid; 2-(5-Isopropyl-5-methyl-4-*oxo*-2-imidazolin-2-yl)-3-quinolinecarboxylic acid; Quinolinecarboxylic acid, 2-(5-isopropyl-5-methyl-4-*oxo*-2-imidazolin-2-yl)-; 3-Quinolinecarboxylic acid, 2-[4,5-dihydro-4-methyl-4-(1-methylethyl)-5-*oxo*-1*H*-imidazol-2-yl]-
ammonium salt: Ammonium imazaquin; 2-(4,5-Dihydro-4-methyl-4-(1-methylethyl)-5-oxo-1 h-imidazol-2-yl)-3-quinolinecarboxylic acid monoammonium salt

Trade Names: AC 252,214®; ALA-SCEPT®; BACKDRAFT®; CL 252,214®; DETAIL®; IMAGE® herbicide consumer concentrate (ammonium salt); METEOR®; MON-9850®; SCEPTER®; SQUADRON® (with Pendimethalin); TRI-SCEPT®; PARTNER® Imazaquin; UPRIGHT®

Chemical class: Imidazolinone

EPA/OPP PC Code: 128848; 128840 (ammonium salt)

California DPR Chemical Code: 2613*; 3006* (ammonium salt)

HSDB Number: 6677

UN/NA & ERG Number: UN3077(solid)

RTECS® Number: VB2009800

Uses: Imazaquin is a selective, pre-emergence and post-emergence herbicide used to control grasses and broadleaf weeds. It is used on corn, wheat, soybeans, turf and ornamentals.

U.S. Maximum Allowable Residue Levels for Imazaquin (40 CFR 180.426): soybean 0.05 ppm.

Human toxicity (long-term)[101]: Very low–1750.00 ppb, Health Advisory

Fish toxicity (threshold)[101]: Very low–61926.11430 ppb, MATC (Maximum Acceptable Toxicant Concentration)

Regulatory Authority and Advisory Information:
Acute Oral Category: 4, Caution

Description: A gray crystalline solid. Commercial products available as a concentrated liquid. Pungent odor. Molecular weight = 311.337; 328.27 (ammonium salt); Boiling point = (decomposes); Freezing/Melting point = 220 °C; 219–224 ºC (ammonium salt); Vapor pressure = 7×10^{-9} mmHg @ 25 °C. Soluble in water; solubility = 100 mg/L. Physical and toxicological properties may be affected by carrier solvents in commercial formulations.

Incompatibilities: May react violently with strong oxidizers, bromine, 90% hydrogen peroxide, phosphorus trichloride, silver powders or dust. Incompatible with silver compounds. Mixture with some silver compounds forms explosive salts of silver oxalate. Decomposes in temperatures >240 °C.

Permissible Concentration in Water: Runoff from spills or fire control may cause water pollution.
Determination in Water: Log K_{ow} = negative. Unlikely to bioaccumulate in marine organisms.

Harmful Effects and Symptoms

Short Term Exposure: May cause irritation to the eyes, skin, or respiratory tract. May be toxic if ingested or absorbed through the skin. LD_{50} (oral, rat) = 5 g/kg; LD_{50} (dermal, rat) = >2 g/kg.

Medical Surveillance: Preliminary medical exam to detect chronic diseases of central nervous system, liver, heart, kidneys, lung and skin, as well as endocrinological or immunological disturbances, should protect susceptible individuals. Periodical medical exams of internal organs, skin and eyes are important to avoid chronic occupational intoxications. They should include lab and patch tests when necessary[83].

First Aid: If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least 15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately. If this chemical contacts the skin, remove contaminated clothing and wash immediately with soap and water. Seek medical attention immediately. If this chemical has been inhaled, remove from exposure, begin rescue breathing (using universal precautions) if breathing has stopped, and CPR if heart action has stopped. Transfer promptly to a medical facility. When this chemical has been swallowed, get medical attention. Give large quantities of water and induce vomiting. Do not make an unconscious person vomit.

Personal Protective Methods: Applicators and other handlers must wear: Coveralls worn over long-sleeved shirt and long pants; Chemical-resistant gloves such as DuPont™ Tychem® suit fabrics, barrier laminate, or Viton®; Chemical-resistant footwear plus socks; Protective eye wear; Chemical-resistant headgear for overhead exposure;

Chemical-resistant apron when cleaning equipment, mixing, or loading[83]. Agricultural Use/Engineering Controls: When handlers use closed systems, enclosed cabs, or aircraft in a manner that meets the requirements listed in the Worker Protection Standard (WPS) for agricultural pesticides, ***40 CFR 170.240(d)(4-6)***, the handler PPE requirements may be reduced or modified as specified in the Worker Protection Standard. Firefighters should wear NIOSH-approved self-contained breathing apparatus and full protective clothing.

Respirator Selection: Wherever and whenever workplace conditions warrant respirator use, a respiratory protection program must be followed that meets one or more of the following government standards: OSHA's 29 CFR 1910.134, ANSI Z88.2, or European Standard EN 149.

Spill Handling: Evacuate and restrict persons not wearing protective equipment from area of spill or leak until clean up is complete. Ventilate area of spill or leak. Absorb liquids in vermiculite, dry sand, earth, peat, carbon, or a similar material and deposit in sealed containers. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable.

Fire Extinguishing: Hazardous decomposition includes oxides of nitrogen and carbon. As an immediate precautionary measure, isolate spill or leak area in all directions for at least 50 meters/150 feet for liquids and at least 25 meters/75 feet for solids. *Fire involving storage or vehicular tanks:* isolate for 800 meters/0.5 mile in all directions; also, consider initial evacuation for 800 meters/0.5 mile in all directions. *On a small fire:* use dry chemical, CO_2, water spray or regular foam. *On a large fire:* use water spray, fog or regular foam. Do not scatter spilled material with high-pressure streams of water. Move containers from fire area if you can do it without risk. Dike fire-control water for later disposal. *Fire involving tanks:* from a secure, explosion-proof location, use water spray to cool exposed containers. If cooling streams are ineffective (venting sound increases in volume and pitch, tank discolors, or shows any signs of deforming), withdraw immediately to a secure position. Always stay away from tanks engulfed in fire. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode.

Disposal Method Suggested: It is the responsibility of chemical waste generators to determine the toxicity and physical properties and of a discarded chemical and to properly identify its classification and certification as a hazardous waste and to determine the disposal method. US EPA guidelines for the classification determination are listed in ***40 CFR Parts 261.3***. Additionally, waste generators must consult and follow all regional, national, state and local hazardous waste laws to ensure complete and accurate classification and disposal methods.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- EXTOXNET, Extension Toxicology Network, "Pesticide Information Profile, Imazaquin," Oregon State University, Corvallis, OR. http://extoxnet.orst.edu/pips/imazaqui.htm
- USEPA, Office of Pesticide Programs, Pesticide Residue Limits, "Imazaquin," 40 CFR 180.426. http://www.epa.gov/pesticides/food/viewtols.htm

Imazethapyr I:0090

Use Type: Herbicide, Plant growth regulator

CAS Number: 81335-77-5; 101917-66-2 (ammonium salt)

Formula: $C_{15}H_{19}N_3O_3$; $C_{15}H_{22}N_4O_3$ (ammonium salt)

Synonyms: Ammonium salt of (±)-2-(4,5-dihydro-4-methyl-4-(1-methylethyl)-5-*oxo*-1H-imidazol-2-yl)-5-ethyl-3-pyridinecarboxylic acid;(±)-2-(4,5-Dihydro-4-methyl-4-(1-methylethyl)-5-oxo-1H-imidazol-2-yl)-5-ethyl-3-pyridinecarboxylic acid, ammonium salt; (±)-2-[4,5-Dihydro-4-methyl-4-(1-methylethyl)-5-*oxo*-1*H*-imadazol-2-yl]-5-ethyl-3-pyridinecarboxylicacid;(±)-5-Ethyl-2-(4-isopropyl-4-methyl-5-*oxo*-2-imidazolin-2-yl)nicotinic acid; (±)-5-Ethyl-2-(4-isopropyl-4-methyl-5-*oxo*-1H-imidazolin-2-yl)nicotinic acid (ammonium salt)

Trade Names: AC-263499®; CL-263499®; CONTOUR®; EXTREME®; HAMMER®; LIGHTNING®; ODYSSEY®, (imazamox+imazethapyr); OVERTOP®; PATRIOT®, (atrazine+imazethapyr); PASSPORT®; PIVOT®; PURSUIT®; (ammonium salt of); PURSUIT DG® Herbicide; RESOLVE®; STANDOUT®; VALOR®, (imazethapyr+pendimethalin)

Chemical class: Imidazolinone

EPA/OPP PC Code: 128922; 128923 (ammonium salt)

California DPR Chemical Code: 2340

HSDB Number: 6678

UN/NA & ERG Number: None found

RTECS® Number: US5682900

EC Number: 617-222-4

Uses: Imazethapyr is a general use, selective pre-emergence herbicide that is used to control grasses and broadleaf weeds on a variety of field and vegetable crops including dry and edible beans, peas, soybeans, peanuts, alfalfa and corn. Not approved for use in EU countries[115]. Registered for use in the U.S. and other countries.

U.S. Maximum Allowable Residue Levels for Imazethapyr applied as its acid or ammonium salt [40 CFR

180.447(a)(1)]: in or on the following commodities: soybean 0.1 ppm; vegetable, legume, group 6, 0.1 ppm; *Imazethapyr* **its metabolite CL 288511, 2-[4,5-dihydro-4-methyl-4-(1-methylethyl)-5-oxo-1H-imidazol-2-yl]-5-(1-hydroxyethyl)-3-pyridine carboxylic acid; and its metabolite CL 182704, 5-[1-(beta-D-glucopyranosyloxy)ethyl]-2-[4,5-dihydro-4-methyl-4-(1-methylethyl)-5-oxo-1H-imidazol-2-yl]-3-pyridinecarboxylic acid, applied as its acid or ammonium salt [*40 CFR 180.447(a)(2)*]:** in or on the following commodities: alfalfa, seed 0.15 ppm; alfalfa, seed screenings 0.15 ppm; animal feed, nongrass, group 18, forage 3.0 ppm; animal feed, nongrass, group 18, hay 5.5 ppm; peanut 0.1 ppm; rice, bran 1.2 ppm; Rice, grain 0.3 ppm; 0ice, straw 0.4 ppm; *Imazethapyr* **and its metabolite CL 288511, 2-[4,5-dihydro-4-methyl-4-(1-methylethyl)-5-oxo-1H-imidazol-2-yl]-5-(1-hydroxyethyl)-3-pyridine carboxylic acid, applied as its acid or ammonium salt [*40 CFR 180.447(a)(3)*]:** in or on the following commodities: cattle, meat byproducts 0.10 ppm; corn, field, forage 0.1 ppm; corn, field, grain 0.1 ppm; corn, field, stover 0.1 ppm; crayfish 0.15 ppm; goat, meat byproducts 0.10 ppm; hog, meat byproducts 0.10 ppm; horse, meat byproducts 0.10 ppm; sheep, meat byprducts 0.10 ppm; *Imazethapyr* **as its ammonium salt, and its metabolite, 2- [4,5-dihydro-4-methyl-4-(1-methylethyl)-5-oxo-1H-imidazol-2-yl]-5-(1- hydroxyethyl)-3-pyridine carboxylic acid, both free and conjugated, applied as its acid or ammonium salt [*40 CFR 180.447 (c)*]:** in or on the following commodities: endive 0.1 ppm; lettuce, head 0.1 ppm; lettuce, leaf 0.1 ppm.

Human toxicity (long-term)[101]: Very low–1750.00 ppb, Health Advisory

Fish toxicity (threshold)[101]: Very low–52267.57728 ppb, MATC (Maximum Acceptable Toxicant Concentration)

Regulatory Authority and Advisory Information:

Carcinogenicity[83]: EPA, Not likely to be carcinogenic to humans.

Acute Oral Category: 4, Caution

Potential Ground Water Pollutant [California FAC Section 13145(d)/12811, inactive; ammonium salt is active)

Description: Colorless to slightly yellowish crystalline solid. Pungent odor. Molecular weight = 289.33; Specific gravity (H_2O:1) = 1.11; Boiling point = (decomposes); Freezing/Melting point = 173 °C. Highly soluble in water; solubility = 1.42×10^3 mg/L.

Incompatibilities: May react violently with strong oxidizers, bromine, 90% hydrogen peroxide, phosphorus trichloride, silver powders or dust. Incompatible with silver compounds. Corrosive to zinc, mild steel, brass, copper and aluminum. Mixture with some silver compounds forms explosive salts of silver oxalate.

Permissible Concentration in Water: Runoff from spills or fire control may cause water pollution.

Determination in Water: Log K_{ow} = <2.0. Unlikely to bioaccumulate in marine organisms.

Harmful Effects and Symptoms

Short Term Exposure: May cause irritation to the eyes, skin, or respiratory tract. May be toxic if ingested or absorbed through the skin. LD_{50} (oral, rat) = >5 g/kg; (dermal, rat) = >2 g/kg; (inhalation, rat) = 3.27 mg/L[83].

Medical Surveillance: Preliminary medical exam to detect chronic diseases of central nervous system, liver, heart, kidneys, lung and skin, as well as endocrinological or immunological disturbances, should protect susceptible individuals. Periodical medical exams of internal organs, skin and eyes are important to avoid chronic occupational intoxications. They should include lab and patch tests when necessary[83].

First Aid: If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least 15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately. If this chemical contacts the skin, remove contaminated clothing and wash immediately with soap and water. Seek medical attention immediately. If this chemical has been inhaled, remove from exposure, begin rescue breathing (using universal precautions) if breathing has stopped, and CPR if heart action has stopped. Transfer promptly to a medical facility. When this chemical has been swallowed, get medical attention. Give large quantities of water and induce vomiting. Do not make an unconscious person vomit.

Personal Protective Methods: Applicators and other handlers must wear: Coveralls worn over long-sleeved shirt and long pants; Chemical-resistant gloves such as DuPont™ Tychem® suit fabrics, barrier laminate, or Viton®; Chemical-resistant footwear plus socks; Protective eye wear; Chemical-resistant headgear for overhead exposure; Chemical-resistant apron when cleaning equipment, mixing, or loading[83]. Agricultural Use/Engineering Controls: When handlers use closed systems, enclosed cabs, or aircraft in a manner that meets the requirements listed in the Worker Protection Standard (WPS) for agricultural pesticides, ***40 CFR 170.240(d)(4-6)***, the handler PPE requirements may be reduced or modified as specified in the Worker Protection Standard. Firefighters should wear NIOSH-approved self-contained breathing apparatus and full protective clothing.

Respirator Selection: Wherever and whenever workplace conditions warrant respirator use, a respiratory protection program must be followed that meets one or more of the following government standards: OSHA's 29 CFR 1910.134, ANSI Z88.2, or European Standard EN 149.

Storage: Color Code-Green: General storage may be used. Prior to working with this chemical you should be trained on its proper handling and storage. Store in tightly closed containers in a cool, well-ventilated area.

Spill Handling: If a spill occurs, clean it up promptly. Don't wash it away. Instead, sprinkle the spill with sawdust, vermiculite, or kitty litter. Sweep it into a plastic garbage bag, and dispose of it as directed on the pesticide product label. Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: No information.

Fire Extinguishing: Hazardous decomposition includes oxides of nitrogen and carbon. As an immediate precautionary measure, isolate spill or leak area in all directions for at least 50 meters/150 feet for liquids and at least 25 meters/75 feet for solids. *Fire involving storage or vehicular tanks:* isolate for 800 meters/0.5 mile in all directions; also, consider initial evacuation for 800 meters/0.5 mile in all directions. *On a small fire:* use dry chemical, CO_2, water spray or regular foam. *On a large fire:* use water spray, fog or regular foam. Do not scatter spilled material with high-pressure streams of water. Move containers from fire area if you can do it without risk. Dike fire-control water for later disposal. *Fire involving tanks:* from a secure, explosion-proof location, use water spray to cool exposed containers. If cooling streams are ineffective (venting sound increases in volume and pitch, tank discolors, or shows any signs of deforming), withdraw immediately to a secure position. Always stay away from tanks engulfed in fire. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode.

Disposal Method Suggested: It is the responsibility of chemical waste generators to determine if a discarded chemical is classified as a hazardous waste. See ***40 CFR Parts 261.3*** for U.S. EPA guidelines for the classification determination. Additionally, in order to ensure complete and accurate classification, waste generators must consult state and local hazardous waste regulations.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- EXTOXNET, Extension Toxicology Network, "Pesticide Information Profile, Imazethapyr," Oregon State University, Corvallis, OR (February 1996). http://extoxnet.orst.edu/pips/imazetha.htm
- USEPA, Office of Pesticide Programs, Pesticide Residue Limits, "Imazethapyr," 40 CFR 180.447. http://www.epa.gov/pesticides/food/viewtols.htm

Imidacloprid I:0092

Use Type: Insecticide

CAS Number: 138261-41-3; 105827-78-9

Formula: $C_9H_{10}ClN_5O_2$

Synonyms: 1-[(6-Chloro-3-pyridinyl)methyl]-*N*-nitro-2-imidazolidiniminebenzoate; 1-[(6-Chloro-3-pyridinyl)methyl]-4,5-dihydro -*N*-nitro-1*H*-imidazol-2-amine; 1-(2-Chloro-5- pyridylmethyl)-2-(nitroamino)imidazolidine; 1*H*-Imidazol-2-amine, 1-[(6-chloro-3-pyridinyl)methyl]-4,5-dihydro-*N*-nitro-; 2-Imidazolidinimine, 1-[(6-chloro-3-pyridinyl)methyl]-*N*-nitro-benzoate

Trade Names: ADMIRE®; CONFIDOR® 2.5% granular; CONFIDOR® 2 flowable; ENCORE®; GAUCHO®; IMICIDE®; LEVERAGE®; MARATHON®; MERIT®; NTN 33893®; PREMIER®; PREMISE®; PRESCRIBE™; PROTREAT®; PROVADO®; TRIMAX®

Chemical class: Neonicotinoid; Chloronicotinyl

EPA/OPP PC Code: 129099; 129059

California DPR Chemical Code: 3849

HSDB Number: 7373

UN/NA & ERG Number: UN3082 (liquid)/171

RTECS® Number: NJ0560000

EC Number: 428-040-8 [*Annex I Index No.:* 612-252-00-4]

Uses: One of the most heavily used pesticides in the world. A systemic insecticide used to control sucking insects in the soil, seeds and foliar environments. It is one of the most-used pesticides in the world and has a broad variety of both agriculture and non-agricultural uses, including on pets and household environments. Used on rice, cereals, maize, vegetables, fruit, sugar beets, potatoes, cotton, hops and turf. It is related to nicotine and acts on the nervous system. A U.S. EPA restricted Use Pesticide (RUP). Effective 12/1/2013, A two-year ban and severe restriction on the use of neonicotinoids for seed treatment, soil application (granules) and foliar treatment on bee attractive plants and cereals.

U.S. Maximum Allowable Residue Levels for Imidacloprid and its metabolites containing the 6-chloropyridinyl moiety, all expressed as 1-[(6-chloro-3-pyridinyl)methyl]-N-nitro-2-imidazolidinimine [40 CFR 180.472(a)]: in or on the following food commodities: acerola 1.0 ppm; apple 0.5 ppm; apple, wet pomace 3.0 ppm; artichoke, globe 2.5 ppm; avocado 1.0 ppm; banana (there are no US registrations as of June 13, 2003 for use on banana) 0.02 ppm; barley, grain 0.05 ppm; barley, hay 0.5 ppm; barley, straw 0.5 ppm; beet, sugar, roots 0.05 ppm; beet, sugar, tops 0.5 ppm; beet, sugar, molasses 0.3 ppm; blueberry 3.5 ppm; brassica vegetables crop group 3.5 ppm; canistel 1.0 ppm; canola, seed 0.05 ppm; cattle, fat 0.3 ppm; cattle, meat byproducts 0.3 ppm; cattle, meat 0.3 ppm; citrus, dried pulp 5.0 ppm; citrus, fruit, group 0.7 ppm; coriander 3.5 ppm; corn, field, forage 0.10 ppm; corn, field, grain 0.05 ppm; corn, field, stover 0.20 ppm; corn, pop, grain 0.05 ppm; corn, pop, stover 0.20 ppm; corn, sweet, forage 0.10 ppm; corn, sweet, kernel plus cob with husks removed 0.05 ppm; corn, sweet, stover 0.20 ppm; cotton, gin byproducts 4.0 ppm; cotton, undelinted seed 6.0 ppm; cotton, meal 8.0 ppm; cranberry 0.05 ppm; currant 3.5 ppm; egg 0.02 ppm; elderberry 3.5 ppm; feijoa 1.0 ppm; fruit, pome, group 11, 0.6 ppm; fruit, stone, group 12, 3.0 ppm; goat, fat 0.3 ppm; goat, meat byproducts 0.3 ppm; goat, meat 0.3 ppm; gooseberry 3.5 ppm; grape, juice 1.5 ppm; grape, pomace (wet or dried) 5.0 ppm; grape, raisin 1.5 ppm; grape, raisin, waste 15.0 ppm; grape 1.0 ppm; guava 1.0 ppm; hog, fat 0.3 ppm; hog, meat byproducts 0.3 ppm; hog, meat 0.3 ppm; hop, dried cone 6.0 ppm; horse, fat 0.3 ppm; horse, meat byproducts 0.3 ppm; horse, meat 0.3 ppm; huckleberry 3.5 ppm; jaboticaba 1.0 ppm; juneberry 3.5 ppm; leaf petioles, subgroup 4B, 6.0 ppm; leafy greens, subgroup 4A, 3.5 ppm; lettuce, head and leaf 3.5 ppm; lingonberry 3.5 ppm; longan

3.0 ppm; lychee 3.0 ppm; mango 1.0 ppm; milk 0.1 ppm; mustard, seed 0.05 ppm; okra 1.0 ppm; passionfruit 1.0 ppm; papaya 1.0 ppm; pecans 0.05 ppm; persimmon 3.0 ppm; potato, chip 0.4 ppm; potato, waste 0.9 ppm; poultry, fat 0.05 ppm; poultry, meat byproducts 0.05 ppm; poultry, meat 0.05 ppm; pulasan 3.0 ppm; rambutan 3.0 ppm; salal 3.5 ppm; sapodilla 1.0 ppm; sapote, black 1.0 ppm; sapote, mamey 1.0 ppm; sheep, fat 0.3 ppm; sheep, meat byproducts 0.3 ppm; sheep, meat 0.3 ppm; sorghum, forage 0.10 ppm; sorghum, grain 0.05 ppm; sorghum, straw 0.1 ppm (expiration/revocation date 11/17/97); sorgum, stover 0.10 ppm; soybean, meal 4.0 ppm; soybean, seed 1.0 ppm; spanish lime 3.0 ppm; star apple 1.0 ppm; starfruit 1.0 ppm; strawberry 0.50 ppm; tomato, paste 6.0 ppm; tomato, pomace (wet or dried) 4.0 ppm; tomato, puree 3.0 ppm; vegetable, cucurbit, group 9, 0.5 ppm; vegetable, fruiting, group 8, 1.0 ppm; vegetable, leaves of root and tuber, group 2, 4.0 ppm; vegetable, legume, except soybean, group 6, 4.0 ppm; vegetable, root and tuber, group 1, except sugar beet 0.40 ppm; watercress 3.5 ppm; watercress, upland 3.5 ppm; wax jambu 1.0 ppm; wheat, (forage) 7.0 ppm; wheat, grain 0.05 ppm; wheat, hay 0.5 ppm; and wheat, straw 0.5 ppm. ***[40 CFR 180.472(d)]*** Tolerances are established for indirect or inadvertent combined residues of the insecticide imidacloprid and its metabolites containing the 6-chloropyridinyl moiety, all expressed as 1-[(6-chloro-3-pyridinyl)methyl]-*N*-nitro-2-imidazolidinimine, when present therein as a result of the application of the pesticide to growing crops listed in this section and other non-food crops as follows: forage, fodder, and straw of grain, cereal crop group (forage) 2.0 ppm; forage, fodder, and straw of grain, cereal crop group (hay) 6.0 ppm; forage, fodder, and straw of grain, cereal crop group (stover) 0.3 ppm; forage, fodder, and straw of grain, cereal crop group (straw) 3.0 ppm; grain, cereal, group 15, 0.05 ppm; safflower, meal 0.5 ppm; safflower, seed 0.05 ppm; soybean, meal 0.5 ppm; sweet corn, kernel plus cob with husks removed 0.05 ppm; vegetable, cucurbit 0.2 ppm (expiration/revocation date 12/31/97); vegetable, foliage of legume, group 7, 2.5 ppm; and vegetable, legume, crop group 6, 0.3 ppm.

Human toxicity (long-term)[101]: Very low–399.00 ppb, Health Advisory

Fish toxicity (threshold)[101]: Very low–1199.99656 ppb, MATC (Maximum Acceptable Toxicant Concentration)

Regulatory Authority and Advisory Information:

Carcinogenicity[83]: EPA Group E, evidence of non-carcinogenicity for humans.

Acute Oral Category: 2, WARNING

Potential Ground Water Pollutant [California FAC Section 13145(d)/12811, active]

European/International Regulations: Hazard Symbol: Xi, Xn, N; risk phrases: R22; R50/53; safety phrases: S2; S22; S57; S60; S61 (see Appendix 1)

Description: Colorless (when pure) to off-white crystalline solid. Slight characteristic odor. The commercial product is often water-soluble granules. Molecular weight = 255.7; Specific gravity (H_2O:1) = 1.55 @ 25 °C; Boiling point = (decomposes); Freezing/Melting point = 145°C; Vapor pressure = 5×10^{-12} mmHg @ 25 °C. Highly soluble in water; solubility = 600 mg/L. Physical and toxicological properties may be affected by carrier solvents in commercial formulations.

Incompatibilities: Combustible solid. Dust forms explosive mixure with air. Incompatible with oxidizers. Decomposes in temperatures above 225 °C.

Permissible Concentration in Water: Federal Drinking Water Guidelines: 400 ppb[14].

Determination in Water: Log K_{ow} = <0.6. Unlikely to bioaccumulate in marine organisms.

Routes of Entry: Dermal contact, inhalation, ingestion.

Harmful Effects and Symptoms

Short Term Exposure: *Inhalation:* Causes labored breathing. *Ingestion:* May cause convulsions, vomiting, diarrhea. May attack central nervous system causing apathy, incoordination. LD_{50} (oral, rat) = 450–500 mg/kg; (dermal, rat) = >5 g/kg.

Long Term Exposure: May affect the central nervous system.

Points of Attack: Central nervous system, lungs, digestive system.

Medical Surveillance: Consider the points of attack in preplacement and periodic physical examinations.

First Aid: If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least 15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately. If this chemical contacts the skin, remove contaminated clothing and wash immediately with soap and water. Seek medical attention immediately. If this chemical has been inhaled, remove from exposure, begin rescue breathing (using universal precautions) if breathing has stopped, and CPR if heart action has stopped. Transfer promptly to a medical facility. When this chemical has been swallowed, get medical attention. Give large quantities of water and induce vomiting. Do not make an unconscious person vomit.

Personal Protective Methods: Applicators and other handlers must wear: Coveralls worn over long-sleeved shirt and long pants; Chemical-resistant gloves such as DuPont™ Tychem® suit fabrics, barrier laminate, or Viton®; Chemical-resistant footwear plus socks; Protective eye wear; Chemical-resistant headgear for overhead exposure; Chemical-resistant apron when cleaning equipment, mixing, or loading[83]. Agricultural Use/Engineering Controls: When handlers use closed systems, enclosed cabs, or aircraft in a manner that meets the requirements listed in the Worker Protection Standard (WPS) for agricultural pesticides, ***40 CFR 170.240(d)(4-6)***, the handler PPE requirements may be reduced or modified as specified in the Worker Protection Standard. Firefighters should wear NIOSH-approved self-contained breathing apparatus and full protective clothing.

Respirator Selection: Where the neat (undiluted) test chemical is weighed and diluted, wear a NIOSH-approved half-face respirator equipped with a combination filter cartridge, i.e. organic vapor/acid gas/HEPA (specific for organic vapors, HCl, acid gas, SO_2 and a high-efficiency particulate filter)[88].

Storage: Color Code-Blue: Health Hazard/Poison. Store in a tightly closed container in a dry, well-ventilated and secure poison location. Prior to working with this chemical you should be trained on its proper handling and storage. Where possible, automatically transfer material from other storage containers to process containers. Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: This material may be classified as Environmentally hazardous substances, liquid or solid, n.o.s. It usually falls in Hazard Class 9.

Spill Handling: Evacuate and restrict persons not wearing protective equipment from area of spill or leak until clean up is complete. Ventilate area of spill or leak. Absorb liquids in vermiculite, dry sand, earth, peat, carbon, or a similar material and deposit in sealed containers. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable.

Fire Extinguishing: Hazardous decomposition includes oxides of nitrogen and carbon and hydrogen chloride gas. This chemical is combustible; it may burn but does not easily ignite. As an immediate precautionary measure, isolate spill or leak area in all directions for at least 50 meters/150 feet for liquids and at least 25 meters/75 feet for solids. *Fire involving storage or vehicular tanks:* isolate for 800 meters/0.5 mile in all directions; also, consider initial evacuation for 800 meters/0.5 mile in all directions. *On a small fire:* use dry chemical, CO_2, water spray or regular foam. *On a large fire:* use water spray, fog or regular foam. Do not scatter spilled material with high-pressure streams of water. Move containers from fire area if you can do it without risk. Dike fire-control water for later disposal. *Fire involving tanks:* From a secure, explosion-proof location, use water spray to cool exposed containers. If cooling streams are ineffective (venting sound increases in volume and pitch, tank discolors, or shows any signs of deforming), withdraw immediately to a secure position. Always stay away from tanks engulfed in fire. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode.

Disposal Method Suggested: Containers must be disposed of properly by following package label directions or by contacting your local or federal environmental control agency, or by contacting your regional EPA office. If this material cannot be disposed of according to label instructions, it may be dissolved or mixed with a combustible solvent and burned in a chemical incinerator equipped with an afterburner and scrubber. In accordance with 40CFR165, follow recommendations for the disposal of pesticides and pesticide containers.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- EXTOXNET, Extension Toxicology Network, "Pesticide Information Profile, Imidacloprid," Oregon State University, Corvallis, OR http://extoxnet.orst.edu/pips/imidaclo.htm
- *Journal of Pesticide Reform,* "Insecticide Factsheet, Imidacloprid," Northwest Coalition for Alternatives to Pesticides, Spring 2001, Vol.21, No. 1. http://www.pesticide.org/imidacloprid.pdf
- USEPA, Office of Pesticide Programs, Pesticide Residue Limits, "Imidacloprid", 40 CFR 180.472. http://www.epa.gov/pesticides/food/viewtols.htm
- Fishel, Frederick M., Document PI-80, Pesticide Information Office, Florida Cooperative Extension Service, Institute of Food and Agricultural Sciences, University of Florida, Gainesville, FL, October 2005; Revised February 2013
- Gervais, J. A.; Luukinen, B.; Buhl, K.; Stone, D., *Imidacloprid Technical Fact Sheet*; National Pesticide Information Center, Oregon State University Extension Services, Corvallis, OR (2010)

Indole-3-butyric acid I:0125

Use Type: Plant growth regulator, Pesticide

CAS Number: 133-32-4

Formula: $C_{12}H_{13}NO_2$

Synonyms: IBA; 1*H*-Indole-3-butanoic acid; Indole butyric; Indole butyric acid; β-Indolebutyric acid; γ-(Indole-3)-butyric acid; 3-Indolebutyric acid; γ-(Indol-3-yl) butyric acid; Indolyl-3-butyric acid; 3-Indolyl-γ-butyric acid; γ-(3-Indolyl)butyric acid; 4-(Indolyl)butyric acid; 4-(Indol-3-yl)butyric acid; 4-(3-Indolyl)butyric acid

Trade Names: ASSET PGR®; BOLL-SET®; CROP BOOSTER®; CYTOPLEX®; GOLDENGRO®; HORMEX®; HORMODIN®; JIFFY GROW®; MAXON®; MEPEX®; PGR-IV®; RHIZOPON®; ROOTGRO®; ROOTONE® (with 1-Naphthaleneacetamide and 1-Naphthaleneacetic acid)[C]; SERADIX®; SNIPPER®

Chemical class: Botanical; Auxin

EPA/OPP PC Code: 046701

California DPR Chemical Code: 323

HSDB Number: 7214

UN/NA & ERG Number: UN2811 (Toxic solids, organic, n.o.s.)/154

RTECS® Number: NL5250000

EC Number: 205-101-5

Uses: Biochemical pesticide, plant growth regulator. Used as a growth hormone and stimulant for root cuttings. Not listed for use in EU countries[115]. Registered for use in the U.S. and other countries.

U.S. Maximum Allowable Residue Levels for indole-3-butyric acid: An exemption from the requirement of a tolerance is established for residues of auxins [***40 CFR 180.1158***]: in or on all food commodities when used as plant regulators on plants, seeds, or cuttings and on all food commodities after harvest in accordance with good agricultural practices.

Regulatory Authority and Advisory Information:
Health Advisory: Mutagen
Acute Oral Category: 3, CAUTION

Description: White or off-white crystalline solid or powder. Odorless. Technical grade: 97.0%. Dust: 0.01%–4.5%; soluble concentrate/liquid: 0.0004%–1.03%; wettable powder/dust: 0.1%–0.8%[83]. Molecular weight = 203.258; Boiling point = (decomposes); Freezing/Melting point = 122–125 °C; Vapor pressure = 1.8×10^{-6} mmHg @ 25 °C (est)[83]. Hazard Identification (based on NFPA-704 M Rating System): Health 2, Flammability 0, Reactivity 0. Soluble in water. Physical and toxicological properties may be affected by carrier solvents in commercial formulations.

Incompatibilities: Incompatible with oxidizers, chlorates nitrates, peroxides, and high temperatures. This material may be combustible and light sensitive.

Permissible Concentration in Water: Runoff from spills or fire control may cause water pollution.

Determination in Water: Log K_{ow} = <2.5. Unlikely to bioaccumulate in marine organisms.

Harmful Effects and Symptoms

Short Term Exposure: May cause irritation of the eyes, skin, or respiratory tract. Toxic if ingested. LD_{50} (oral, rat) = >500 mg/kg.

Long Term Exposure: May be mutagenic.

Points of Attack: Reproductive cells. May cause reproductive and fetal effects.

Medical Surveillance: In addition to comprehensive initial medical and work histories emphasizing reproductive experience and menstrual history, patient should have physical examination and testing of genito-urinary tract, sperm count, motility and morphology. If required, other tests, such as serum testosterone, serum follicle stimulating hormone (FSH), and serum lutenizing hormone (LH), may be indicated.

First Aid: If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least 15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately. If this chemical contacts the skin, remove contaminated clothing and wash immediately with soap and water. Seek medical attention immediately. If this chemical has been inhaled, remove from exposure, begin rescue breathing (using universal precautions) if breathing has stopped, and CPR if heart action has stopped. Transfer promptly to a medical facility. When this chemical has been swallowed, get medical attention. If swallowed, do not induce vomiting unless directed to do so by medical personnel. Never give anything by mouth to an unconscious person. Do not make an unconscious person vomit. Do not induce vomiting when formulations containing petroleum solvents are ingested.

Personal Protective Methods: Wear protective gloves and clothing to prevent any reasonable probability of dermal and/or eye contact. Safety equipment suppliers/manufacturers can provide recommendations on the most protective glove/clothing material for your operation. All protective clothing (suits, gloves, footwear, headgear) should be clean, available each day, and put on before work. Contact lenses should not be worn when working with this chemical. Wear dust-proof chemical goggles and face shield unless full facepiece respiratory protection is worn. Employees should wash immediately with soap when skin is wet or contaminated. Provide emergency showers and eyewash.

Respirator Selection: Wherever and whenever workplace conditions warrant respirator use, a respiratory protection program must be followed that meets one or more of the following government standards: OSHA's 29 CFR 1910.134, ANSI Z88.2, or European Standard EN 149.

Storage: Color Code-Blue: Health Hazard/Poison. Store in a secure poison location. Prior to working with this chemical you should be trained on its proper handling and storage. Store in tightly closed containers in a cool, well-ventilated area. Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: This chemical requires a label of "poisonous materials." It usually falls in Hazard Class 6.1.

Spill Handling: First remove all sources of ignition. Evacuate persons not wearing protective equipment from area of spill or leak until clean up is complete. Ventilate area of spill or leak. Use water spray to reduce vapor. Absorb liquids in vermiculite, dry sand, earth, or a similar material and deposit in sealed containers. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable.

Fire Extinguishing: Hazardous decomposition includes oxides of nitrogen and carbon. May be combustible at high temperatures. *Fire involving storage or vehicular tanks:* isolate for 800 meters/0.5 mile in all directions; also, consider initial evacuation for 800 meters/0.5 mile in all directions. *Small fire:* dry chemical, carbon dioxide or water spray. *Large fire:* dry chemical, carbon dioxide, alcohol-resistant foam or water spray. Move containers from fire area if you can do it without risk. Dike fire-control water for later disposal; do not scatter the material. *Fire involving tanks or car/trailer loads:* fight fire from maximum distance or use unmanned hose holders or monitor nozzles. Do not get water inside containers. Cool containers with flooding quantities of water until well after fire is out. Withdraw immediately in the case of rising sound from venting safety devices or discoloration of tank. Always stay away from tanks engulfed in fire. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies.

Disposal Method Suggested: If allowed, incineration with effluent gas scrubbing is recommended. In accordance with 40CFR165, follow recommendations for the disposal of pesticides and pesticide containers. Containers must be disposed of properly by following package label directions or by contacting your local or federal environmental control agency, or by contacting your regional EPA office.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- United States National Library of Medicine, *ChemIDplus Advanced*, Bethesda, MD. http://chem.sis.nlm.nih.gov/chemidplus/rn/133-32-4

Iprodione I:0185

Use Type: Fungicide

CAS Number: 36734-19-7

Formula: $C_{13}H_{13}Cl_2N_3O_3$

Synonyms: 3-(3,5-Dichlorophenyl)-*N*-(1-methylethyl)-2,4-dioxo-1-imidazolidinecarboxamide; 3-(3,5-Dichlorophenyl)-*N*-sopropyl-2,4-dioxo-1-imidazolidinecarboximide; Glycophen; 1-Isopropyl carbamoyl-3-(3,5-dichlorophenyl)- hydantoin

Trade Names: ANFOR®; CHIPCO®; 26019DIVA®; DOP® 26019; GLYCOPHENE®; IPRODINE®; KIDEN®; LFA 2043®; MRC 910®; PROMIDIONE®; PROTURF®; ROP 500F®; ROVRAL®; RP-26019®; VERISAN®

Chemical class: Dicarboximide

EPA/OPP PC de: 109801; (209900 old EPA code number)

California DPR Chemical Code: 2081

HSDB Number: 6855

UN/NA & ERG Number: UN3077(solid)/171; UN3082 (liquid)/171

RTECS® Number: NI8870000

EC Number: 253-178-9 [*Annex I Index No.:* 616-054-00-9]

Uses: Iprodione is a contact and/or locally systemic fungicide used to control a broad range of root and stem rots, molds and mildews on a variety of field, fruit, and vegetable crops including almonds, grapes, peaches, potatoes, rice, berries, onions, peanuts and lettuce. Registration does not permit uses on turf, ornamentals and vegetable and small fruit gardens. End-uses for the formulations have been classified for outdoor use only; the application methods have been restricted so as to avoid undue human contact. Iprodione can also be used as a post-harvest fungicide and seed treatment

Human toxicity (long-term)[101]: High–7.97268 ppb, CHCL (Chronic Human Carcinogen Level)

Fish toxicity (threshold)[101]: Low–378.15513 ppb, MATC (Maximum Acceptable Toxicant Concentration)

U.S. Maximum Allowable Residue Levels for iprodione, its isomer 3-(1-methylethyl)-N-(3,5-dichlorophenyl)-2,4-dioxo-1-imidazolidinecarboxamide, and its metabolite 3-(3,5-dichlorophenyl)-2,4-dioxo-1-imidazolidinecarboxamide [40 CFR 180.399(a)]: in or on the following raw agricultural commodities: almonds (hulls) 2.0 ppm; almonds (nutmeat) 0.3 ppm; apricots 20.0 ppm; beans (dried, vine hay) 90.0 ppm; beans (dry) 2.0 ppm; beans (forage) 90.0 ppm; beans (succulent) 2.0 ppm; blueberries 15.0 ppm; boysenberries 15.0 ppm; broccoli 25.0 pm; caneberries 25.0 ppm; carrots 5.0 ppm; cherries, sour 20.0 ppm; cherries, sweet, (pre- and post-harvest) 20.0 ppm; cottonseed 0.10 ppm; currants 15.0 ppm; garlic 0.1 ppm; ginseng 2.0 ppm; ginsend, dried 4.0 ppm; grapes 60.0 ppm; kiwi fruit 10.0 ppm; lettuce 25.0 ppm; nectarines (pre- and post-harvest) 20.0 ppm; onions (dry bulb) 0.5 ppm; peaches (pre- and post-harvest) 20.0 ppm; peanuts 0.5 ppm; peanut forage 150.0 ppm; peanut hay 150.0 ppm; plums (pre- and post-harvest) 20.0 ppm; potatoes 0.5 ppm; prunes 20.0 ppm; raisins 300.0 ppm; rasberries 15.0 ppm; rice bran 30.0 ppm; rice grain 10.0 ppm; rice hulls 50.0 ppm; rice straw 20.0 ppm; and strawberries 15.0 ppm. [***40 CFR 180.399(b)***]: Tolerances are established for the combined residues iprodione, its isomer and its metabolite (see above) all expressed as iprodione equivalents in or on the following raw agricultural commodities of animal origin: cattle, fat 0.5 ppm; cattle, kidney 3.0 ppm; cattle, liver 3.0 ppm; cattle, meat 0.5 ppm; cattle, meat byproducts (except kidney and liver) 0.5 ppm; eggs 1.5 ppm; goats, fat 0.5 ppm; goats, kidney 3.0 ppm; goats, liver 3.0 ppm; goats, meat 0.5 ppm; goat, meat byproducts (except kidney and liver) 0.5 ppm; hogs, fat 0.5 ppm; hogs, kidney 3.0 ppm; hogs, liver 3.0 ppm; hogs, meat 0.5 ppm; hogs, meat byproducts (except kidney and liver) 0.5 ppm; horses, fat 0.5 ppm; horses, kidney 3.0 ppm; horses, liver 3.0 ppm; horses, meat 0.5 ppm; horses, meat byproducts (except kidney and liver) 0.5 ppm; milk 0.5 ppm; poultry, fat 3.5 ppm; poultry, liver 5.0 ppm; poultry, meat 1.0 ppm; poultry, meat byproducts (except liver) 1.0 ppm; sheep, fat 0.5 ppm; sheep, kidney 3.0 ppm; sheep, liver 3.0 ppm; sheep, meat 0.5 ppm; sheep meat byproducts (except kidney and liver) 0.5 ppm. *Regional registration, as defined in section 180.1(n)* **[*40 CFR 180.399(c)*]:** in or on the following raw agricultural commodity: Chinese mustard 15.0 ppm.

Regulatory Authority and Advisory Information:

Carcinogenicity[83]: EPA, Likely to be carcinogenic to humans; EU GHS Category 2: Suspected human carcinogen.

California Proposition 65 Chemical: Carcinogen (5/1/1996)

Acute Oral Category: 3, CAUTION

Health Advisory: Endocrine disruptor (S!)

Potential Ground Water Pollutant [California FAC Section 13145(d)/12811, active]

European/International Regulations: Hazard Symbol: Xn, N; risk phrases: R40; R50/53; safety phrases: S2; S36/37; S60; S61 (see Appendix 1)

Description: White crystalline solid. Odorless. Molecular weight = 330.18; Specific gravity (H_2O:1) = 1.0; Freezing/Melting point = 135–136 °C. Vapor pressure = 1.2×10^{-7} mmHg; Flash point = 150 °C. Low solubility in water; solubility = 15 mg/L.

Incompatibilities: Slowly hydrolyzes in water, releasing ammonia and forming acetate salts. Incompatible with oxidizers, chlorates, nitrates, peroxides, and alkaline materials. Imides react with azo and diazo compounds to generate toxic gases. Flammable gases are formed by the reaction of organic imides with strong reducing agents. Imides are extremely weak bases (weaker than water). React with strong bases to form salts. That is, they can react as acids.

Permissible Exposure Limits in Air: No standards set.

Determination in Air: Filter; none; Gravimetric; NIOSH IV [Particulates NOR; #0500 (total), #0600 (respirable)].[18].

Permissible Concentration in Water: State Drinking Water Guidelines: Florida 280 μg/L. Runoff from spills or fire control may cause water pollution.

Determination in Water: Log K_{ow} = >3.0. Values above 3.0 are likely to bioaccumulate in aquatic organisms.

Harmful Effects and Symptoms

Short Term Exposure: Contact with eyes or skin may cause irritation or injury. Inhalation should be avoided; use NIOSH- or CEN (UK)-approved air purifying respirators for pesticides. May be harmful if swallowed. LD_{50} (oral, rat) = >3 g/kg; LD_{50} (dermal, rat) = >2.5 g/kg.

Long Term Exposure: May cause lung, pulmonary problems. May cause cancer.

Points of Attack: Lungs. Endocrine disruptor.

Medical Surveillance: This chemical is a suspected or known human carcinogen. Exposed persons should contact a physician for advice regarding the possible long term health effects and advice for medical monitoring.

First Aid: If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least 15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately. If this chemical contacts the skin, remove contaminated clothing and wash immediately with soap and water. Seek medical attention immediately. If this chemical has been inhaled, remove from exposure, begin rescue breathing (using universal precautions) if breathing has stopped, and CPR if heart action has stopped. Transfer promptly to a medical facility. When this chemical has been swallowed, get medical attention. Give large quantities of water and induce vomiting. Do not make an unconscious person vomit. Do not induce vomiting when formulations containing petroleum solvents are ingested

Personal Protective Methods: Wear protective gloves and clothing to prevent any reasonable probability of dermal and/or eye contact. Safety equipment suppliers/manufacturers can provide recommendations on the most protective glove/clothing material for your operation. DuPont™ Tychem® suit fabrics[88]. All protective clothing (suits, gloves, footwear, headgear) should be clean, available each day, and put on before work. Contact lenses should not be worn when working with this chemical. Wear splash-proof chemical goggles and face shield unless full facepiece respiratory protection is worn. Employees should wash immediately with soap when skin is wet or contaminated. Provide emergency showers and eyewash.

Respirator Selection: *At any detectable concentration:* SCBAF: Pd,Pp (APF = 10,000) (any NIOSH/MSHA- or European Standard EN 149-approved self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode); or SaF: Pd,Pp: ASCBA (APF = 10,000) (any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary, self-contained breathing apparatus operated in a pressure-demand or other positive-pressure mode). *Escape:* 100 F (APF = 50) (any air purifying, full facepiece respirator with and N100, R100, or P100 filter k-mounted organic vapor canister having a high-efficiency particulate filter); or SCBAE (any appropriate escape-type, self-contained breathing apparatus).

Storage: Color Code-Blue: Health Hazard/Poison. Store in a secure poison location. Prior to working with this chemical you should be trained on its proper handling and storage. Store in tightly closed containers in a cool, well-ventilated area away from water, heat and incompatible materials. Metal containers involving the transfer of this chemical should be grounded and bonded. Drums must be equipped with self-closing valves, pressure vacuum bungs, and flame arresters. Use only non-sparking tools and equipment, especially when opening and closing containers of this chemical. If this material contains a flammable carrier, sources of ignition, such as smoking and open flames, are prohibited where this chemical is used, handled, or stored in a manner that could create a potential fire or explosion hazard. A regulated, marked area should be established where this chemical is handled, used, or stored in compliance with OSHA Standard 1910.1045. Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: Environmentally hazardous substances, solid or liquid, usually fall in Hazard Class 9.

Spill Handling: First remove all sources of ignition. Evacuate persons not wearing protective equipment from area of spill or leak until clean up is complete. Collect powdered material in the most convenient and safe manner and deposit in sealed containers. Absorb liquid containing this chemical in vermiculite, dry sand, earth, or similar material. Ventilate area after clean up is complete. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable.

Fire Extinguishing: Captan may burn, but does not ignite readily. May be combustible at temperatures above 150 °C. Hazardous decomposition includes toxic oxides of nitrogen, carbon and hydrogen chloride gas. As an immediate precautionary measure, isolate spill or leak area in all directions for at least 50 meters/150 feet for liquids and at least 25 meters/75 feet for solids. *Fire involving storage or vehicular tanks:* isolate for 800 meters/0.5 mile in all directions; also, consider initial evacuation for 800 meters/0.5 mile in all directions. *On a small fire:* use dry chemical, CO_2, water spray or regular foam. *On a large fire:* use water spray, fog or regular foam. Do not scatter spilled material with high-pressure streams of water. Move containers from fire area if you can do it without risk. Dike fire-control water for later disposal. *Fire involving tanks:* from a secure, explosion-proof location, use water spray to cool exposed containers. If cooling streams are ineffective (venting sound increases in volume and pitch, tank discolors, or shows any signs of deforming), withdraw immediately to a secure position. Always stay away from tanks engulfed in fire. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode.

Disposal Method Suggested: It is the responsibility of chemical waste generators to determine the toxicity and physical properties and of a discarded chemical and to properly identify its classification and certification as a hazardous waste and to determine the disposal method. U.S. EPA guidelines for the classification determination are listed in ***40 CFR Parts 261.3***. Additionally, waste generators must consult and follow all regional, national, state and local hazardous waste laws to ensure complete and accurate classification and disposal methods.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- USEPA, "Reregistration Eligibility Decision (RED), Iprodione," Office of Prevention, Pesticides and Toxic Substances, Washington DC (November 1998). http://www.epa.gov/REDs/2335.pdf
- EXTOXNET, Extension Toxicology Network, "Pesticide Information Profile, Iprodione," Oregon State University, Corvallis, OR (June 1996). http://extoxnet.orst.edu/pips/iprodion.htm

Isobenzan I:0250

Use Type: Insecticide

CAS Number: 297-78-9

Formula: $C_9H_4Cl_8O$

Synonyms: CP 14,957; ENT 25,545; ENT 25,545-x; Isobenzano (Spanish); Octochlorohexahydromethano isobenzofuran; 1,3,4,5,6,8,8-Octochloro-1,3,3a,4,7,7a-hexahydro-4,7-methanoisobenzofuran; 1,3,4,5,6,7,10,10-Octochloro-4,7-endo-methylene-4,7,8,9-tetrahydrophthalan; 1,3,4,5,6,7,8,8-Octochloro-2-oxa-3a,4,7,7a-tetrahydro-4,7-methanoindene

Trade Names: OMTAN®; R 6700®; SD 440®; SHELL 4402®; SHELL WL 1650®; TELODRIN®; WL 1650®

Chemical class: Cyclodiene

EPA/OPP PC Code: 058501

HSDB Number: 6388

UN/NA & ERG Number: UN2761 (solid)/151

RTECS® Number: PC1225000

EC Number: 206-045-4 [*Annex I Index No.*: 602-053-00-0]

Uses: This broad-spectrum insecticide was used throughout the world and manufactured from 1958 to 1965. Its use in agriculture was restricted because of its persistence and toxicity. Not listed for use in EU countries[115]. Not registered for use in the U.S. There are 15 global suppliers[97].

Regulatory Authority and Advisory Information:

Health Advisory: Tumorigen

Acute Oral Category: 1, DANGER–POISON

Superfund/EPCRA 302 Extremely Hazardous Substances: TPQ = 100/10,000 lb (45.4/4,540 kg)

Superfund/EPCRA 40CFR302.4 RQ: EHS, 1 lb (0.454 kg)

European/International Regulations: Hazard Symbol: T+, N; risk phrases: R27/28; R50; safety phrases: S1/2; S28; S36/37; S45; S61 (see Appendix 1)

Description: Isobenzan is a white to light brown crystalline solid or powder. It has a mild odor. Molecular weight = 411.73; Specific gravity (H_2O:1) = 1.87; Freezing/Melting point = 121 °C; Vapor pressure = 1×10^{-5} mmHg @ 25 °C. Henry's Law constant = 5.9×10^{-8} atm-m^3/mol @ 25 °C (est)[83]. Hazard Identification (based on NFPA-704 M Rating System): Health 4, Flammability 0, Reactivity 0. Practically insoluble in water; solubility = 0.09 mg/L @20 °C.

Incompatibilities: Strong oxidizers.

Permissible Exposure Limits in Air: Protective Action Criteria (PAC) Ver. 27[89]

PAC-1: 0.091 mg/m^3
PAC-2: 1 mg/m^3
PAC-3: 1 mg/m^3

Permissible Concentration in Water: Runoff from spills or fire control may cause water pollution.

Determination in Water: EPA Method D3086. GC method with ECD for the determination of organochlorine pesticides in water and wastewater. Log K_{ow} = 4.51[83]. Values above 3.0 are likely to bioaccumulate in aquatic organisms.

Routes of Entry: Inhalation, ingestion, dermal and/or eye contact.

Harmful Effects and Symptoms

Short Term Exposure: This material is highly toxic. It is absorbed by the skin as well as by the respiratory and gastrointestinal tract. Symptoms may last for a long time because the material is eliminated slowly; its half-life in human blood is 2.77 years. Symptoms of exposure include headache, dizziness, drowsiness, irritability, and numbness of the legs. Convulsions may occur. LD_{50} (oral, rat) = 6.2–11.1 mg/kg[83].

LD_{50} (oral, rat) = 4800 μg/kg; LD_{50} (dermal, rat) = 5 mg/kg.

Long Term Exposure: Organochlorine pesticides are highly toxic to mammals and will accumulate in the tissues of living organisms.

Points of Attack: Central nervous system.

First Aid: Speed in removing material from eyes and skin is of extreme importance. If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least 15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately. If this chemical contacts the skin, remove contaminated clothing and wash immediately with soap and water. Shampoo hair promptly if contaminated. Seek medical attention immediately. If this chemical has been inhaled, remove from exposure, begin rescue breathing (using universal precautions) if breathing has stopped, and CPR if heart action has stopped. Transfer promptly to a medical facility. When this chemical has been swallowed, get medical attention. Give large quantities of water and induce vomiting. Do not make an unconscious person vomit.

Personal Protective Methods: Wear protective gloves and clothing to prevent any reasonable probability of dermal and/or eye contact. Safety equipment suppliers/manufacturers can provide recommendations on the most protective glove/clothing material for your operation. All protective clothing (suits, gloves, footwear, headgear) should be clean, available each day, and put on before work. Contact lenses should not be worn when working with this chemical. Wear dust-proof chemical goggles and face shield unless full facepiece respiratory protection is worn. Employees should wash immediately with soap when skin is wet or contaminated. Provide emergency showers and eyewash.

Respirator Selection: SCBA >0.091 mg/m^3. Wherever and whenever workplace conditions warrant respirator use, a respiratory protection program must be followed that meets one or more of the following government standards: OSHA's 29 CFR 1910.134, ANSI Z88.2, or European Standard EN 149. Where the neat (undiluted) test chemical is weighed and diluted, wear a NIOSH-approved half-face respirator equipped with a combination filter cartridge, i. e. organic vapor/acid gas/HEPA (specific for organic vapors, HCl, acid gas, SO_2 and a high-efficiency particulate filter)[88].

Storage: Color Code-Blue: Health Hazard/Poison. Store in a secure poison location. Prior to working with this chemical you should be trained on its proper handling and storage. Where possible, automatically transfer material from other storage containers to process containers. Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: Organochlorine pesticides, liquid or solid require a "poisonous materials" label. They fall in Hazard Class 6.1.

Spill Handling: For solids, isolate spill or leak area in all directions for at least 25 meters/75 feet. Increase, in the downwind direction, as necessary. Do not touch damaged containers or spilled material unless wearing appropriate protective clothing. Stop leak if you can do it without risk. Prevent entry into waterways, sewers, basements or confined areas. Cover with plastic sheet to prevent spreading. Absorb or cover with dry earth, sand or other non-combustible material and transfer to containers. Do not allow water to get inside containers.

Fire Extinguishing: Hazardous decomposition includes toxic hydrogen chloride gas. *On a small fire:* use dry chemical, carbon dioxide or water spray. *On a large fire:* use water spray, fog or regular foam. Move containers from fire area if you can do it without risk. Dike fire-control water for later disposal. Use water spray or fog; do not scatter material using straight water jet streams. *Fire involving storage or vehicular tanks:* isolate for 800 meters/0.5 mile in all directions; also, consider initial evacuation for 800 meters/0.5 mile in all directions. fight fire from maximum distance or use unmanned hose holders or monitor nozzles. Do not allow water to get inside containers. Cool containers with flooding quantities of water until well after fire is out. Withdraw immediately in the case of rising sound from venting safety devices or discoloration of tank. *Always* stay away from tanks engulfed in fire. For massive fire, use unmanned hose holders or monitor nozzles; if this is impossible, withdraw from area and let fire burn.

Disposal Method Suggested: An extremely hazardous waste. Do not discharge into drains or sewers. Dispose of waste material as hazardous waste using a licensed disposal contractor to an approved landfill. Consult with environmental regulatory agencies for guidance on acceptable disposal practices. Incineration with effluent gas scrubbing is recommended. Containers must be disposed of properly by following package label directions or by contacting your local or federal environmental control agency, or by contacting your regional EPA office.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- New Jersey Department of Health and Senior Services, "Hazardous Substance Fact Sheet, Isobenzan," Trenton, NJ (August 2000). http://www.state.nj.us/health/eoh/rtkweb/2494.pdf
- USEPA, "Chemical Profile: Isobenzan," Washington DC, Chemical Emergency Preparedness Program (Nov.30, 1987)

Isofenphos I:0345

Use Type: Insecticide

CAS Number: 25311-71-1

Formula: $C_{15}H_{24}NO_4PS$

Synonyms: AI3-27748; Benzoic acid, 2-[(ethoxy-((1-

methylethyl)amino)phosphinothioyl)oxy]-, 1-methylethyl ester; Benzoic acid, 2-[(ethoxy((1-methylethyl)amino) phosphinothioyl)oxy]-, 1-methyl ester; Caswell No. 447AB; Dipropylene glycol; 2-[(Ethoxyl((1-methylethyl) amino)phosphinothioyl)oxy]benzoic acid 1-methylethyl ester; 2-[(Ethoxy((1-methylethyl)amino) phosphinothioyl) oxy]benzoic acid 1-methylethyl ester; *O*-Ethyl *O*-(2-isopropoxycarbonyl)phenylisopropyl phosphoramidothioate; Isopropyl *O*-[ethoxy(isopropylamino)phosphinothioyl] salicylate; Isopropyl *O*-[ethoxy-*N*-isopropylamino(thiop hosphoryl)] salicylate; Isopropyl salicylate *O*-ester with *O*-ethyl isopropylphosphoramidothioate; 1-Methylethyl 2-[(ethoxy((1-methylethyl)amino)phosphinothioyl)oxy] benzoate; Phosphoramidoth ioic acid, isopropyl-, *O*-ethyl *O*-(2-isopropoxycarbonylphenyl) ester; Phosphoramidothioic acid, isopropyl-, *O*-ethyl ester, *O*-ester with isopropyl salicylate; Propanol, oxybis-; Salicylic acid, isopropyl ester, *O*-ester with *O*-ethyl isopropyl phosphoramidothioate

Trade Names: 40 SD®; AMAZE®[C]; BAY 92114®[C]; BAY-SRA-12869®[C]; OFTANOL®[C]; PRYFON 6®; SRA 12869®; SRA 128691®

Chemical class: Organophosphate

EPA/OPP PC Code: 109401; (512400 old EPA code number)

California DPR Chemical Code: 2194

HSDB Number: 6983

UN/NA & ERG Number: UN3018 (liquid)/152

RTECS® Number: VO43955000

EC Number: 246-814-1 [*Annex I Index No.:* 015-129-00-8]

Uses: All food tolerances have been revoked in the U.S. Isofenphos was marketed under the basic producer's trade name Oftanol, and was used in the United States on turf and ornamental trees and shrubs to control white grubs, mole crickets, and other insects (mostly subterranean species). Isofenphos was first registered in the United States in 1980 by Bayer Corporation for use on corn for control of the corn rootworm and was also used as a pre-emergence soil treatment in fruit crops and vegetables such as maize and carrots. Registered products containing isofenphos were voluntarily canceled in the U.S. in 1999. Not approved for use in EU countries[115]. There are 17 global suppliers[97].

Human toxicity (long-term)[101]: High–3.50 ppb, Health Advisory

Fish toxicity (threshold)[101]: Low–116.60189 ppb, MATC (Maximum Acceptable Toxicant Concentration)

Regulatory Authority and Advisory Information:

Carcinogenicity[83]: EPA Group E, evidence of non-carcinogenicity for humans.

Acute Oral Category: 1, Toxicity (oral) Category: 1, DANGER-Poison

Health Advisory: Nerve Toxin

EPCRA Section 313 Form R *de minimis* concentration reporting level: 1.0%

Marine pollutant (49CFR, Subchapter 172.101, Appendix B)

DOT Inhalation Hazard Chemicals as organophosphates

European/International Regulations: Hazard Symbol: T, N; risk phrases: R24/25; R50/53; safety phrases: S1/2; S36/ S37; S45; S60; S61 (see Appendix 1)

WGK (German Aquatic Hazard Class): 3-Severe hazard to waters

Description: A colorless, oily liquid. Molecular weight = 345.4; Specific gravity (H_2O:1) = 1.13 @ 20 °C; Boiling point = (decomposes) 220 °C[Bayer]; Freezing/ Melting point = –12 °C; Vapor pressure = 1.6×10^{-6} mmHg @ 20 °C; Flash point = 115 °C; Explosive limits: LEL = 2.2%; UEL 18.8%. Low solubility in water; solubility = 23.8 mg/kg @ 20 °C.

Incompatibilities: Sensitive to heat and moisture. May react violently with antimony(V) pentafluoride. Incompatible with lead diacetate, magnesium, silver nitrate. In the presence of strong reducing agents such as hydrides, organophosphates form highly toxic and flammable phosphine gas. Contact with oxidizers can cause the release of toxic oxides of phosphorus. May react violently with aliphatic amines, alkalies, boranes, isocyanates, nitric acid, sulfuric acid.

Determination in Air: OSHA versatile sampler-2; Toluene/Acetone; Gas chromatography/Flame ionization detection; NIOSH IV, Method #5600, Organophosphorus Pesticides [18].

Permissible Concentration in Water: Runoff from spills or fire control may cause water pollution.

Determination in Water: Log K_{ow} = >4. Values above 3.0 are likely to bioaccumulate in aquatic organisms.

Routes of Entry: Dermal contact, inhalation, ingestion.

Harmful Effects and Symptoms

Short Term Exposure: Highly toxic in contact with skin or if swallowed. Can be absorbed through the unbroken skin. Eye pupils are small; blurred vision; eye watering; runny nose; cough; shortness of breath; salivation; dizziness; nausea, stomach cramps, diarrhea, and vomiting; increased blood pressure; profuse sweating; hypermotility, hallucinations; irritability; tingling of the skin; drowsiness; slow heartbeat; convulsions; fluid in lungs; loss of consciousness; incontinence; breathing stops; death. Organophosphates inhibit the action of acetylcholinesterase enzymes, and alter the way in which nervous impulses are transmitted. The effects can last for hours, days, or much longer. The action of the enzymes is reestablished after new enzymes are formed. LD_{50} (oral, rat) = <50 mg/kg; LD_{50} (dermal, rat) = <200 mg/kg.

Long Term Exposure: Cholinesterase inhibitor; cumulative effect is possible. Organophosphates may damage the nervous system with repeated exposure, resulting in convulsions, respiratory failure. May cause liver damage. A neurotoxin.

Points of Attack: Respiratory system, central nervous system, peripheral nervous system, cardiovascular system, blood cholinesterase.

Medical Surveillance: Medical observation is recommended for 24 to 48 hours following breathing overexposure, as pulmonary edema may be delayed. As first aid for pulmonary edema, consider administering a corticosteroid spray. Cigarette smoking may exacerbate pulmonary injury and should be discouraged for at least 72 hours following exposure

First Aid: Speed in removing material from eyes and skin is of extreme importance. *Eyes:* Eye contact can cause dangerous amounts of these chemicals to be quickly absorbed through the mucous membrane into the bloodstream. Immediately and gently flush eyes with plenty of warm or cold water (NO hot water) for at least 15 minutes, occasionally lifting the upper and lower eyelids. Get medical aid immediately. *Skin:* Get medical aid. Dermal contact can cause dangerous amounts of these chemicals to be absorbed into the bloodstream. Wearing the appropriate PPE equipment and respirator for organophosphate pesticides, immediately flush skin with plenty of soap and water for at least 15 minutes while removing contaminated clothing and shoes. Shampoo hair promptly if contaminated. *Ingestion:* Call poison control. Loosen all clothing. Never give anything by mouth to an unconscious person. Get medical aid. Do NOT induce vomiting. * If conscious, alert, and able to swallow, rinse mouth and have victim drink 4 to 8 ounces of water do NOT induce vomiting but immediately administer slurry of activated charcoal (2 oz in 8 oz of water). If victim is *unconscious or having convulsions,* do nothing except keep victim warm. **In some cases you may be specifically instructed by poison control to induce vomiting by way of 2 tablespoons of syrup of ipecac (adult) washed down with a cup of water*. Do NOT give activated charcoal before or with ipecac syrup. *Inhalation:* Get medical aid. Do not contaminate yourself. Wearing the appropriate PPE equipment and respirator for organophosphate pesticides, immediately remove the victim from the contaminated area to fresh air. If the victim is not breathing, administer artificial respiration. Do not use mouth-to-mouth method if victim ingested or inhaled the substance; give artificial respiration with the aid of a pocket mask equipped with a one-way valve or other proper respiratory medical device. If breathing is difficult, administer oxygen through bag/mask apparatus until medical help arrives. Do not leave victim unattended. *Note to physician or authorized medical personnel.* Administer atropine, 2 mg (1/30 gr) intramuscularly or intravenously as soon as any local or systemic signs or symptoms of an intoxication are noted; repeat the administration of atropine every 3 to 8 minutes until signs of atropinization (mydriasis, dry mouth, rapid pulse, hot and dry skin) occur; initiate treatment in children with 0.05 mg/kg of atropine; repeat at 5 to 10 minute intervals. Watch respiration, and remove bronchial secretions if they appear to be obstructing the airway; intubate if necessary. *Notes to physician or authorized medical personnel*: *N*-methylpyridinium-2-aldoxime (2-PAMCI) when used in conjunction with atropine reacts with the phosphorylated cholinesterase, thereby restoring normal activity to by removing the phosphorylating group. The combination of these two chemicals is synergistic and must be administered within minutes to a few hours following exposure (depending on the specific agent) to be effective. Give 2-PAMCI (Pralidoxime; Protopam), 2.5 g in 100 ml of sterile water or in 5% dextrose and water, intravenously, slowly, in 15–30 minutes; if sufficient fluid is not available, give 1 g of 2-PAMCI in 3 ml of distilled water by deep intramuscular injection; repeat this every half hour if respiration weakens or if muscle fasciculation or convulsions recur. Also diazepam, an anticonvulsant, might be considered

Personal Protective Methods: Wear protective gloves and clothing to prevent any reasonable probability of dermal and/or eye contact. Safety equipment suppliers/manufacturers can provide recommendations on the most protective glove/clothing material for your operation. One recommendation is the use of DuPont^{TM} Tychem® suit fabrics[88]. All protective clothing (suits, gloves, footwear, headgear) should be clean, available each day, and put on before work. Contact lenses should not be worn when working with this chemical. Wear splash-proof chemical goggles and face shield unless full facepiece respiratory protection is worn. Employees should wash immediately with soap when skin is wet or contaminated. Provide emergency showers and eyewash.

Respirator Selection: Engineering controls should be used wherever feasible to maintain airborne concentrations of this chemical below the prescribed exposure limit. Respirators and protective equipment are less effective than engineering controls, and should be used only in non-routine or emergency situations which may result in exposure concentrations in excess of the TWA environmental limit. *At any concentrations above the NIOSH REL, or where there is no REL, at any detectable concentration:* SCBAF: Pd,Pp (APF = 10,000) (any NIOSH/MSHA- or European Standard EN 149-approved self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode); or SaF: Pd,Pp: ASCBA (APF = 10,000) (any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary, self-contained breathing apparatus operated in a pressure-demand or other positive-pressure mode).

Storage: Color Code-Blue: Health Hazard/Poison. Store in a secure poison location. Prior to working with this chemical you should be trained on its proper handling and storage. Where possible, automatically transfer material from other storage containers to process containers. Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: Environmentally hazardous substances, solid or liquid, usually fall in Hazard Class 9 and Packing Group II.

Spill Handling: First remove all sources of ignition. Evacuate persons not wearing protective equipment from area of spill or leak until clean up is complete. Stay upwind; keep out of low areas. Ventilate area of spill or leak. Remove and isolate contaminated clothing at the site. Do not touch spilled material; stop leak if you can do so without risk. Use water spray to reduce vapors. *Small spills:* absorb with sand or other noncombustible absorbent material and place into containers for later disposal. *Large* *spills:* dike far ahead of spill for later disposal. Collect powdered material in the most convenient and safe manner and deposit in sealed containers. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable. Seek professional environmental engineering assistance from the U.S. EPA Environmental Response Team at (908) 548-8730 (24-hour response line).

Fire Extinguishing: Hazardous decomposition includes oxides of phosphorus, sulfur, and nitrogen. May be fatal if inhaled, ingested or absorbed through skin. Inhalation or contact with some of these materials will irritate or burn skin and eyes. Vapors may cause dizziness or suffocation. *Small fires:* dry chemical, carbon dioxide; water spray; or foam. *Large fires:* water spray, fog, or foam. Stay upwind; keep out of low areas. Ventilate closed spaces before entering them. Firefighting gear (including SCBA) may not provide adequate protection. If exposure occurs, remove and isolate gear immediately and thoroughly decontaminate personnel. Wear positive-pressure breathing apparatus and special protective clothing. Remove and isolate contaminated clothing at the site. Move container from fire area if you can do so without risk. fight fire from maximum distance. Dike fire-control water for later disposal; do not scatter the material. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies. From a secure, explosion-proof location, use water spray to cool exposed containers. If cooling streams are ineffective (venting sound increases in volume and pitch, tank discolors, or shows any signs of deforming), withdraw immediately to a secure position. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode.

Disposal Method Suggested: Destruction by alkali hydrolysis or incineration. Containers must be disposed of properly by following package label directions or by contacting your local or federal environmental control agency, or by contacting your regional EPA office.

References:

- EXTOXNET, Extension Toxicology Network, "Pesticide Information Profile, Isofenphos," Oregon State University, Corvallis, OR (June 1996). http://extoxnet.orst.edu/pips/isofenph.htm.
- USEPA, "Reregistration Eligibility Decision (RED) Facts, Isofenphos," Office of Prevention, Pesticides and Toxic Substances, Washington DC (December 1999). http://www.epa.gov/REDs/factsheets/2345fact.pdf
- Food and Agriculture Organization of the United Nations (FAO), " *FAO Plant Production and Protection Paper, Isofenphos*," Geneva, Switzerland, (November 1981). http://www.inchem.org/documents/jmpr/jmpmono/v81pr18.htm

Isoproturon I:0525

Use Type: Herbicide
CAS Number: 34123-59-6
Formula: $C_{12}H_{18}N_2O$
Synonyms: 3-(4-Isopropylphenyl)-1,1-dimethylurea; Urea, *N,N*-dimethyl-*N'*-[4-(1-methylethyl)phenyl]-
Trade Names: ARELON® DISPERSION; ATLAS FIELDGARD®; CALIPURON®; CGA 18731®; DAHR®; DPX 6774®; HARLEQUIN®, (isoproturon + simazine); HOE 16410®; JOSH®; PROTUGAN®
Chemical class: Phenyl urea
EPA/OPP PC Code: 512200
HSDB Number: Not assigned
UN/NA & ERG Number: UN3077(solid)/171
RTECS® Number: YTO170000
EC Number: 251-835-4 [*Annex I Index No.*:006-044-00-7]
Uses: Used as a pre-emergence and post-emergence selective herbicide for the control of grasses and broadleaf weeds in spring and winter wheat, spring and winter barley, and winter rye. Not currently registered in the U.S. Used in various European countries. There are more than 40 global suppliers[97].
Regulatory Authority and Advisory Information:
Carcinogenicity: GHS Category 2: Suspected human carcinogen
Health Advisory: Mutagen, Developmental/Reproductive Toxin
Acute Oral Category: 3, CAUTION
European/International Regulations: Hazard Symbol: Xn, N; risk phrases: R40; R50/53; safety phrases: S2; S36/37; S60; S61 (see Appendix 1)
Description: Colorless to off-white crystalline solid. Molecular weight = 206.29; Specific gravity (H_2O:1) = 1.18; Freezing/Melting point = 152 °C; Vapor pressure = 8.8×10^{-6} mmHg @ 20 °C; 3.5×10^{-4} mmHg @ 77 °C. Soluble in water; solubility = 70 mg/L @ 20 °C.
Permissible Concentration in Water: Runoff from spills or fire control may cause water pollution.
Determination in Water: Log K_{ow} = <2.5. Unlikely to bioaccumulate in marine organisms.
Harmful Effects and Symptoms
Short Term Exposure: Contact with eyes or skin may cause irritation or injury. Inhalation should be avoided; use NIOSH- or CEN (UK)-approved air purifying respirators for pesticides. May be harmful if swallowed. Dermal contact may cause severe irritation or burns. LD_{50} (oral, rat) = 1826 mg/kg; LD_{50} (dermal, rat) = >2 g/kg.
Long Term Exposure: May cause reproductive and fetal effects.
Points of Attack: Skin. Reproductive cells.
Medical Surveillance: In addition to comprehensive initial medical and work histories emphasizing reproductive

experience and menstrual history, patient should have physical examination and testing of genito-urinary tract, sperm count, motility and morphology. If required, other tests, such as serum testosterone, serum follicle stimulating hormone (FSH), and serum lutenizing hormone (LH), may be indicated. Preliminary medical exam to detect chronic diseases of central nervous system, liver, heart, kidneys, lung and skin, as well as endocrinological or immunological disturbances, should protect susceptible individuals. Periodical medical exams of internal organs, skin and eyes are important to avoid chronic occupational intoxications. They should include lab and patch tests when necessary[83].

First Aid: If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least 15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately. If this chemical contacts the skin, remove contaminated clothing and wash immediately with soap and water. Seek medical attention immediately. If this chemical has been inhaled, remove from exposure, begin rescue breathing (using universal precautions) if breathing has stopped, and CPR if heart action has stopped. Transfer promptly to a medical facility. When this chemical has been swallowed, get medical attention. Give large quantities of water. Do not induce vomiting when formulations containing petroleum solvents are ingested. Do not make an unconscious person vomit.

Personal Protective Methods: Wear protective gloves and clothing to prevent any reasonable probability of dermal and/or eye contact. Safety equipment suppliers/manufacturers can provide recommendations on the most protective glove/clothing material for your operation. All protective clothing (suits, gloves, footwear, headgear) should be clean, available each day, and put on before work. Contact lenses should not be worn when working with this chemical. Wear dust-proof chemical goggles and face shield unless full facepiece respiratory protection is worn. Employees should wash immediately with soap when skin is wet or contaminated. Provide emergency showers and eyewash.

Respirator Selection: Where the neat (undiluted) test chemical is weighed and diluted, wear a NIOSH-approved half-face respirator equipped with a combination filter cartridge, i. e. organic vapor/acid gas/HEPA (specific for organic vapors, HCl, acid gas, SO_2 and a high-efficiency particulate filter)[88]

Storage: Color Code-Blue: Health Hazard/Poison. Store in a tightly closed container in a dry, well-ventilated and secure poison location. Prior to working with this chemical you should be trained on its proper handling and storage. Where possible, automatically transfer material from other storage containers to process containers. Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: Phenyl urea pesticides, solid, toxic, require a label of "poisonous materials." This compound falls in Hazard Class 6.1 and Packing Group II.

Spill Handling: First remove all sources of ignition. Evacuate persons not wearing protective equipment from area of spill or leak until clean up is complete. Do not touch spilled material; stop leak if you can do it without risk. Use water spray to reduce vapors. Collect powdered material in the most convenient and safe manner and deposit in sealed containers. *Large spills:* dike far ahead of spill for later disposal. Ventilate area after clean up is complete. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable.

Fire Extinguishing: Hazardous decomposition includes oxides of nitrogen and carbon, and corrosive fumes of chlorides. As an immediate precautionary measure, isolate spill or leak area in all directions for at least 50 meters/150 feet for liquids and at least 25 meters/75 feet for solids. *Fire involving storage or vehicular tanks:* isolate for 800 meters/0.5 mile in all directions; also, consider initial evacuation for 800 meters/0.5 mile in all directions. *On a small fire:* use dry chemical, CO_2, water spray or regular foam. *On a large fire:* use water spray, fog or regular foam. Do not scatter spilled material with high-pressure streams of water. Move containers from fire area if you can do it without risk. Dike fire-control water for later disposal. *Fire involving tanks:* From a secure, explosion-proof location, use water spray to cool exposed containers. If cooling streams are ineffective (venting sound increases in volume and pitch, tank discolors, or shows any signs of deforming), withdraw immediately to a secure position. Always stay away from tanks engulfed in fire. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode.

Disposal Method Suggested: Incinerate in a unit with effluent gas scrubbing. Containers must be disposed of properly by following package label directions or by contacting your local or federal environmental control agency, or by contacting your regional EPA office.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- United States National Library of Medicine, ChemIDplus Advanced, Bethesda, MD. http://chem.sis.nlm.nih.gov/chemidplus/rn/34123-59-6

Isoxaben I:0530

Use Type: Herbicide
CAS Number: 82558-50-7
Formula: $C_{18}H_{24}N_2O_4$
Synonyms: Benzamide, 2,6-dimethoxy-*N*-[3-(1-ethyl-1-methylpropyl)-5-isoxazolyl]-; Benzamide, *N*-[3-(1-ethyl-1-methylpropyl)-5-isoxazolyl]-2,6-dimethoxy-; 2,6-Dimethoxy-*N*-[3-(1-ethyl-1-methylpropyl)-5-isoxazolyl]benzamide; *N*-[3-(1-Ethyl-1-methylpropyl) -5-isoxazolyl]-2,6-dimethoxybenzamide; *N*-3-(1-Ethyl-1-methylpropyl)-5-isoxazolyl-2,6-dimethoxybenzamide; Benzamizole
Trade Names: EL 107®; FLEXIDOR®; FLEXIDOR® 125; GALLERY®; NA 8318®; SNAPSHOT
Chemical class: Amide Herbicide; Benzamide
EPA/OPP PC Code: 125851
California DPR Chemical Code: 2289
HSDB Number: 6691
UN/NA & ERG Number: UN3077(solid)/171
RTECS® Number: CV4370300
EC Number: 407-190-8 [*Annex I Index No.:* 616-043-00-9]
Human toxicity (long-term)[101]: Intermediate–35.00 ppb, Health Advisory
Fish toxicity (threshold)[101]: Low–400.00001 ppb, MATC (Maximum Acceptable Toxicant Concentration)
Regulatory Authority and Advisory Information:
Carcinogenicity[83]: EPA. Group C, possible human carcinogen
Acute Oral Category: 4, Caution, not acutely toxic
Potential Ground Water Pollutant [California FAC Section 13145(d)/12811, active]
European/International Regulations: Hazard Symbol: N; risk phrases: R50/53; safety phrases: S2; S60; S61 (see Appendix 1)
Description: White crystalline solid, off-white granular solid, or waxy powder. Mild odor. Freezing/Melting point = 177.5 °C; Molecular weight = 332.44[9]; Vapor pressure = 4×10^{-7} mmHg @ 20 °C. Practically insoluble in water; solubility = <0.002 ppm.
Incompatibilities: Slowly hydrolyzes in water, releasing ammonia and forming acetate salts. Reacts with strong oxidizers and alkaline media. Benzamines can form flammable gases with strong reducing agents. May react with azo and diazo compounds to generate toxic gases.
Permissible Concentration in Water: Runoff from spills or fire control may cause water pollution.
Determination in Water: Log K_{ow} = >3.5. Values above 3.0 are likely to bioaccumulate in aquatic organisms.
Routes of Entry: Dermal contact, inhalation, ingestion.
Harmful Effects and Symptoms
Short Term Exposure: Contact with eyes or skin may cause irritation or injury. May be harmful if swallowed. Inhalation should be avoided; use NIOSH- or CEN (UK)-approved air purifying respirators for pesticides. LD_{50} (oral, rat) = >10 g/kg; LD_{50} (dermal, rabbit) = 200 mg/kg.
Long Term Exposure: May cause cancer, liver and kidney effects, birth defects.
Points of Attack: Skin, liver, kidneys. Reproductive cells.
Medical Surveillance: Preliminary medical exam to detect chronic diseases of central nervous system, liver, heart, kidneys, lung and skin, as well as endocrinological or immunological disturbances, should protect susceptible individuals. Periodical medical exams of internal organs, skin and eyes are important to avoid chronic occupational intoxications. They should include lab and patch tests when necessary[83].
First Aid: *Eyes*: First check the victim for contact lenses and remove if present. Flush victim's eyes with water or normal saline solution for 20 to 30 minutes while simultaneously calling a hospital or poison control center. Do not put any ointments, oils, or medication in the victim's eyes without specific instructions from a physician. *Immediately* transport the victim after flushing eyes to a hospital even if no symptoms (such as redness or irritation) develop. *Skin: Immediately* flood affected skin with water while removing and isolating all contaminated clothing. Gently wash all affected skin areas thoroughly with soap and water. If symptoms such as redness or irritation develop, *immediately* call a physician and be prepared to transport the victim to a hospital for treatment. *Inhalation*: *Immediately* leave the contaminated area; take deep breaths of fresh air. If symptoms (such as wheezing, coughing, shortness of breath, or burning in the mouth, throat, or chest) develop, call a physician and be prepared to transport the victim to a hospital. Provide proper respiratory protection to rescuers entering an unknown atmosphere. Ingestion: *do not induce vomiting*. If the victim is conscious and not convulsing, give 1 or 2 glasses of water to dilute the chemical and *immediately* call a hospital or poison control center. Be prepared to transport the victim to a hospital if advised by a physician. If the victim is convulsing or unconscious, do not give anything by mouth, ensure that the victim's airway is open and lay the victim on his/her side with the head lower than the body. *Do not induce vomiting*. Immediately transport the victim to a hospital[88].
Personal Protective Methods: Wear positive-pressure self-contained breathing apparatus (SCBA). Wear chemical protective clothing that is specifically recommended by the manufacturer. DuPont™ Tychem® Suit Fabrics is recommended by one government source[88]. It may provide little or no thermal protection. Structural firefighters' protective clothing provides limited protection in fire situations ONLY; it is not effective in spill situations where direct contact with the substance is possible.
Respirator Selection: SCBA >4.7 mg/m³ (for benzamide). Wherever and whenever workplace conditions warrant respirator use, a respiratory protection program must be followed that meets one or more of the following government standards: OSHA's 29 CFR 1910.134, ANSI Z88.2, or European Standard EN 149.
Storage: Color Code-Blue: Health Hazard/Poison: Store in a tightly closed container in a dry, well-ventilated and secure poison location and refrigerate 2 to 8 °C. Prior to working with this chemical you should be trained on its

proper handling and storage. Where possible, automatically transfer material from other storage containers to process containers. Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: Environmentally hazardous substances, solid or liquid, usually fall in Hazard Class 9.

Spill Handling: Small spills and leakage: should a spill occur while you are handling this chemical, first remove all sources of ignition, then you should dampen the solid spill material with 60–70% ethanol and transfer the dampened material to a suitable container. Use absorbent paper dampened with 60–70% ethanol to pick up any remaining material. Seal the absorbent paper, and any of your clothes which may be contaminated, in a vapor-tight plastic bag for eventual disposal. Solvent wash all contaminated surfaces with 60–70% ethanol followed by washing with a soap and water solution. Do not reenter the contaminated area until the safety officer (or other responsible person) has verified that the area has been properly cleaned.

Fire Extinguishing: Decomposition in fire releases toxic oxides of nitrogen and carbon. As an immediate precautionary measure, isolate spill or leak area in all directions for at least 50 meters/150 feet for liquids and at least 25 meters/75 feet for solids. *Fire involving storage or vehicular tanks:* isolate for 800 meters/0.5 mile in all directions; also, consider initial evacuation for 800 meters/0.5 mile in all directions. *On a small fire:* use dry chemical, CO_2, water spray or regular foam. *On a large fire:* use water spray, fog or regular foam. Do not scatter spilled material with high-pressure streams of water. Move containers from fire area if you can do it without risk. Dike fire-control water for later disposal. *Fire involving tanks:* from a secure, explosion-proof location, use water spray to cool exposed containers. If cooling streams are ineffective (venting sound increases in volume and pitch, tank discolors, or shows any signs of deforming), withdraw immediately to a secure position. Always stay away from tanks engulfed in fire. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode.

Disposal Method Suggested: Do not discharge into drains or sewers. Dispose of waste material as hazardous waste using a licensed disposal contractor to an approved landfill. Consult with environmental regulatory agencies for guidance on acceptable disposal practices. If allowed, incineration with effluent gas scrubbing is recommended. Containers must be disposed of properly by following package label directions or by contacting your local or federal environmental control agency, or by contacting your regional EPA office.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- USEPA, "Reregistration Eligibility Decision (RED) Facts, Isoxaben," Office of Prevention, Pesticides and Toxic Substances, Washington DC (September 1, 1991). http://www.epa.gov/REDs/factsheets/0339fact.pdf

Isoxaflutole I:0560

Use Type: Herbicide

CAS Number: 141112-29-0

Formula: $C_{15}H_{12}F_3NO_4S$

Synonyms: 4-(2-Methylsulfonyl-4-trifluoromethyl-benzoyl)-5-cyclopropylisoxazole; 5-Cyclopropylisoxazol-4-yl 2-mesyl-4-trifluoromethylphenyl ketone; 5-Cyclopropyl-4-isoxazolyl)[2-(methylsulfonyl)-4-(trifluoromethyl) phenyl]-methanone; 5-Cyclopropyl-1,2-oxazol-4-yl α,α,α-trifluoro-2-mesyl-*p*-tolyl ketone; 5-Cyclopropyl-4-(2-methanesulfonyl-4-trifluoromethylbenzoyl)isoxazole; 5-Cyclopropyl-4-(2-methylsulfonyl-4- trifluoromethyl-benzoyl)isoxazole

Trade Names: BALANCE® PRO; BALANCE® WDG; EPIC® (flufenacet+isoxaflutole); RPA 201772®

Chemical class: Cyclopropylisoxazole; Isoxazole

EPA/OPP PC Code: 123000

California DPR Chemical Code: None listed

HSDB Number: 7275

UN/NA & ERG Number: UN3077(solid)/171

EC Number: [*Annex I Index No.:* 606-054-00-7]

Uses: A U.S. EPA restricted Use Pesticide (RUP). Registered for use on field cotton. Registered for use in EU countries[115].

U.S. Maximum Allowable Residue Levels for Tolerances are established for combined residues of the herbicide Isoxaflutole and its metabolites 1-(2-methylsulfonyl-4-trifluoromethylphenyl)-2-cyano-3-cyclopropyl propan-1,3-dione (RPA 202248) and 2-methylsulphonyl-4-trifluoromethyl benzoic acid (RPA 203328), calculated as the parent compound [40 CFR 180.537(a)(1)]: in or on the following raw agricultural commodities: corn, field, forage 1.0 ppm; corn, field, grain 0.20 ppm; and corn, field, stover 0.50 ppm. [***40 CFR 180.537(a)(2)***] in or on the following raw agricultural commodities: cattle, fat 0.20 ppm; cattle, liver 0.50 ppm; cattle, meat 0.20 ppm; cattle, meat byproducts, except liver 0.10 ppm; egg 0.01 ppm; goat, fat 0.20 ppm; goat, liver 0.50 ppm; goat, meat 0.20 ppm; goat, meat byproducts, except liver 0.10 ppm; hog, fat 0.20 ppm; hog, liver 0.50 ppm; hog, meat 0.20 ppm; hog, meat byproducts, except liver 0.10 ppm; horse, fat 0.20 ppm; horse, liver 0.50 ppm; horse, meat 0.20 ppm; horse, meat byproducts, except liver 0.10 ppm; milk 0.02 ppm; poultry, fat 0.20 ppm; poultry, liver 0.30 ppm; poultry, meat 0.20 ppm; sheep, fat 0.20 ppm;

sheep, liver 0.50 ppm; sheep, meat 0.20 ppm; and sheep, meat byproducts, except liver 0.10 ppm.

Regulatory Authority and Advisory Information:
Carcinogenicity[83]: EPA, Likely to be carcinogenic to humans; suspected developmental toxin
California Proposition 65 Chemical: Carcinogen (12/22/2000)
European/International Regulations: Hazard Symbol: Xn, N; risk phrases: R50/53; R63; safety phrases: S2; S36/37; S60; S61 (see Appendix 1)

Description: Yellow to tan/beige granular solid. Slight acetic acid odor for technical grade; the end-use material is odorless. Molecular weight = 359.32; Specific gravity (H_2O:1) = 1.10; Boiling point = (decomposes); Freezing/Melting point = 138–140 °C. Low solubility in water.

Incompatibilities: Reacts with strong oxidizers. When heated to decomposition, this chemical forms toxic fumes of nitrogen oxides, sulfur oxides, hydrogen fluoride, and carbon mononoxide

Permissible Concentration in Water: Runoff from spills or fire control may cause water pollution.

Determination in Water: Log K_{ow} = <2.5. Unlikely to bioaccumulate in marine organisms.

Harmful Effects and Symptoms

Short Term Exposure: Contact with eyes or skin may cause irritation or injury. Inhalation should be avoided; use NIOSH- or CEN (UK)-approved air purifying respirators for pesticides. May be harmful if swallowed. LD_{50} (oral, rat) = >2 g/kg; also >5 g/kg; LD_{50} (dermal, rat) = >2 g/kg.

Long Term Exposure: Fluorides may cause bone disease (pain and tenderness of the bones); mottled teeth in children. This chemical is a probable carcinogen and it may be a reproduction hazard.

Points of Attack: Reproductive cells. May cause reproductive and fetal effects.

Medical Surveillance: Preliminary medical exam to detect chronic diseases of central nervous system, liver, heart, kidneys, lung and skin, as well as endocrinological or immunological disturbances, should protect susceptible individuals. Periodical medical exams of internal organs, skin and eyes are important to avoid chronic occupational intoxications. They should include lab and patch tests when necessary[83]. This chemical is a suspected or known human carcinogen. Exposed persons should contact a physician for advice regarding the possible long term health effects and advice for medical monitoring. In addition to comprehensive initial medical and work histories emphasizing reproductive experience and menstrual history, patient should have physical examination and testing of genito-urinary tract, sperm count, motility and morphology. If required, other tests, such as serum testosterone, serum follicle stimulating hormone (FSH), and serum lutenizing hormone (LH), may be indicated.

First Aid: If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least 15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately. If this chemical contacts the skin, remove contaminated clothing and wash immediately with soap and water. Seek medical attention immediately. If this chemical has been inhaled, remove from exposure, begin rescue breathing (using universal precautions) if breathing has stopped, and CPR if heart action has stopped. Transfer promptly to a medical facility. When this chemical has been swallowed, get medical attention. Give large quantities of water and induce vomiting. Do not make an unconscious person vomit. Do not induce vomiting when formulations containing petroleum solvents are ingested

Personal Protective Methods: Wear positive-pressure self-contained breathing apparatus (SCBA). Wear chemical protective clothing that is specifically recommended by the manufacturer. DuPont™ Tychem® Suit Fabrics is recommended by one government source[88]. It may provide little or no thermal protection. Structural firefighters' protective clothing provides limited protection in fire situations ONLY; it is not effective in spill situations where direct contact with the substance is possible.

Respirator Selection: *At any detectable concentration:* SCBAF: Pd,Pp (APF = 10,000) (any NIOSH/MSHA- or European Standard EN 149-approved self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode); or SaF: Pd,Pp: ASCBA (APF = 10,000) (any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary, self-contained breathing apparatus operated in a pressure-demand or other positive- pressure mode). *Escape:* 100 F (APF = 50) (any air purifying, full facepiece respirator with and N100, R100, or P100 filter k-mounted organic vapor canister having a high-efficiency particulate filter); or SCBAE (any appropriate escape-type, self-contained breathing apparatus).

Storage: Color Code-Blue: Health Hazard/Poison: Store in a tightly closed container in a dry, well-ventilated and secure poison location and refrigerate 2 to 8 °C. Prior to working with this chemical you should be trained on its proper handling and storage. Where possible, automatically transfer material from other storage containers to process containers. Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: Environmentally hazardous substances, solid or liquid, usually fall in Hazard Class 9.

Spill Handling: Small spills and leakage: should a spill occur while you are handling this chemical, first remove all sources of ignition, then you should dampen the solid spill material with 60–70% ethanol and transfer the dampened material to a suitable container. Use absorbent paper dampened with 60–70% ethanol to pick up any remaining material. Seal the absorbent paper, and any of your clothes which may be contaminated, in a vapor-tight plastic bag for eventual disposal. Solvent wash all contaminated surfaces with 60–70% ethanol followed by washing with a soap and water solution. Do not reenter the contaminated area until the safety officer (or other responsible person) has verified that the area has been properly cleaned.

Fire Extinguishing: Decomposes in temperatures >200 °C. Decomposition in fire releases toxic oxides of nitrogen oxides, sulfur oxides, hydrogen fluoride, and carbon mononoxide. As an immediate precautionary measure, isolate spill or leak area in all directions for at least 50 meters/150 feet for liquids and at least 25 meters/75 feet for solids. *Fire involving storage or vehicular tanks:* isolate for 800 meters/0.5 mile in all directions; also, consider initial evacuation for 800 meters/0.5 mile in all directions. *On a small fire:* use dry chemical, CO_2, water spray or regular foam. *On a large fire:* use water spray, fog or regular foam. Do not scatter spilled material with high-pressure streams of water. Move containers from fire area if you can do it without risk. Dike fire-control water for later disposal. *Fire involving tanks:* from a secure, explosion-proof location, use water spray to cool exposed containers. If cooling streams are ineffective (venting sound increases in volume and pitch, tank discolors, or shows any signs of deforming), withdraw immediately to a secure position. Always stay away from tanks engulfed in fire. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode.

Disposal Method Suggested: Do not discharge into drains or sewers. Dispose of waste material as hazardous waste using a licensed disposal contractor to an approved landfill. Consult with environmental regulatory agencies for guidance on acceptable disposal practices. If allowed, incineration with effluent gas scrubbing is recommended. Containers must be disposed of properly by following package label directions or by contacting your local or federal environmental control agency, or by contacting your regional EPA office.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- USEPA, Office of Pesticide Programs, Pesticide Residue Limits, "Isoxaflutole," 40 CFR 180.537. http://pmep.cce.cornell.edu/profiles/herb-growthreg/fatty-alcohol-monuron/isoxaflutole/Isoxaflutole_tol_998.html
- USEPA, Office of Pesticide Programs, "Pesticide Fact Sheet, Isoxaflutole" (September 15, 1998). http://www.epa.gov/opprd001/factsheets/isoxaflutole.pdf

K

Kinetin K:0120

Use Type: Plant growth regulator
CAS Number: 525-79-1
Formula: $C_{10}H_9N_5O$
Synonyms: Adenine, *N*-furfuryl-; Adenine, *N*^{6}-furfuryl-; Cytokinin; Cytokinin, as kinetin, based on biological activity; Cytokinins (with Cytokinin B, Cytokinin R); Cytokinins (derived from aqueous extract of seaweed); *N*^{6}-(Furfurylamino)purine; 6-(Furfurylamino)purine; *N*^{6}-Furfuryladenine; 1-*H*-Purin-6-amine, *N*-(2-furanylmethyl)-; 2-Furanmethanamine, *N*-1*H*-purin-6-yl-; *N*-(2-Furanylmethyl) -1*H*-purin-6-amine; 6-Furfurylaminopurine; 1-*H*-Purin-6-amine, *N*-(2-furanylmethyl)-
Trade Names: FAP®; FOLIAR TRIGGRR®; FOLIZYME®; GOLDENGRO®; HAPPYGRO®; MAXON®; MEGAGRO®; MEPEX®; NITROZYME®
Chemical class: Botanical
EPA/OPP PC Code: 116802
California DPR Chemical Code: 2082
HSDB Number: 7429
UN/NA & ERG Number: Consult appropriate Dangerous Goods Regulations, including 49CFR
RTECS® Number: AU6270000
EC Number: 208-382-2
Uses: Cytokinin is a group of plant regulators that promote cell division and leaf expansion and retard leaf aging. Cytokinin is composed of four naturally occurring cytokinins (derived from aqueous extract of seaweed meal). The extracts from these plant species (e.g., the naturally occurring cytokinins) are exempt from the requirements of tolerances when used as plant regulators in or on many raw agricultural commodities ***(40 CFR 180.1042)***. Cytokinin is applied to growing crops (field crops, vegetable crops, small fruits, vines and tree fruit), young trees, ornamental, and golf courses to increase fruit size, yield, blossoms, branching, healthy appearance, and other desirable growth effects. Not listed for use in EU countries[115]. Registered for use in the U.S.
Regulatory Authority and Advisory Information: Health Advisory: Mutagen
European/International Regulations: Hazard Symbol: Xi; risk phrases: R68; R36/37/38; safety phrases: S2; S22; S23; S24/25; S26; S27 (see Appendix 1)
WGK (German Aquatic Hazard Class): 3-Severe hazard to waters[CB]
Description: White crystalline solid. Commercial formulations may be liquid concentrates. Molecular weight = 215.22; Freezing/Melting point = 265°C; Henry's Law constant = 1.2×10^{-14} atm-m^3/mole @ 25°C (est)[83]; Vapor pressure = 1.8×10^{-8} mmHg @ 25[83]. Slightly soluble in water; solubility = 358 mg/L @25°C[83].
Determination in Water: Log K_{ow} = 0.6 (est)[83]. Unlikely to bioaccumulate in marine organisms.
Harmful Effects and Symptoms
Short Term Exposure: Contact with eyes or skin may cause irritation or injury. Inhalation should be avoided; use NIOSH- or CEN (UK)-approved air-purifying respirators for pesticides. May be harmful if swallowed.
Long Term Exposure: May cause reproductive and fetal effects.
Points of Attack: Reproductive cells.
Medical Surveillance: In addition to comprehensive initial medical and work histories emphasizing reproductive experience and menstrual history, patient should have physical examination and testing of genito-urinary tract, sperm count, motility and morphology. If required, other tests, such as serum testosterone, serum follicle stimulating hormone (FSH), and serum lutenizing hormone (LH), may be indicated.
First Aid: If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least 15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately. If this chemical contacts the skin, remove contaminated clothing and wash immediately with soap and water. Seek medical attention immediately. If this chemical has been inhaled, remove from exposure, begin rescue breathing (using universal precautions) if breathing has stopped, and CPR if heart action has stopped. Transfer promptly to a medical facility. When this chemical has been swallowed, get medical attention. Give large quantities of water and induce vomiting. Do not make an unconscious person vomit. Do not induce vomiting when formulations containing petroleum solvents are ingested
Respirator Selection: Wherever and whenever workplace conditions warrant respirator use, a respiratory protection program must be followed that meets one or more of the following government standards: OSHA's 29 CFR 1910.134, ANSI Z88.2, or European Standard EN 149.
Storage: Color Code-Blue: Health Hazard/Poison. Store in a secure poison location. Prior to working with this chemical you should be trained on its proper handling and storage. Store in tightly closed containers in a cool, well-ventilated area. Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.
Shipping: Consult appropriate Dangerous Goods Regulations, including 49CFR, for additional description requirements, mode-specific, or quantity-specific shipping requirements.
Spill Handling: First remove all sources of ignition. Evacuate persons not wearing protective equipment from

area of spill or leak until clean up is complete. Ventilate area of spill or leak. Use water spray to reduce vapor. Absorb liquids in vermiculite, dry sand, earth, or a similar material and deposit in sealed containers. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable.

Fire Extinguishing: Hazardous decomposition includes toxic oxides of nitrogen and carbon. Use dry chemical, carbon dioxide; or alcohol-resistant foam extinguishers. Vapors are heavier than air and will collect in low areas. Vapors may travel long distances to ignition sources and flashback. Vapors in confined areas may explode when exposed to fire. Storage containers and parts of containers may rocket great distances, in many directions. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies. From a secure, explosion-proof location, use water spray to cool exposed containers. If cooling streams are ineffective (venting sound increases in volume and pitch, tank discolors, or shows any signs of deforming), withdraw immediately to a secure position. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode.

Disposal Method Suggested: Do not discharge into drains or sewers. Dispose of waste material as hazardous waste using a licensed disposal contractor to an approved landfill. Consult with environmental regulatory agencies for guidance on acceptable disposal practices. If allowed, incineration with effluent gas scrubbing is recommended. Containers must be disposed of properly by following package label directions or by contacting your local or federal environmental control agency, or by contacting your regional EPA office.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- USEPA, "Reregistration Eligibility Decision (RED), Cytokinin," Office of Prevention, Pesticides and Toxic Substances, Washington DC (December 1995). http://www.epa.gov/REDs/4107.pdf
- USEPA, Office of Pesticide Programs, Pesticide Residue Limits, "Cytokinin (as kinetin)," ***40 CFR 180.1157***. http://www.epa.gov/pesticides/food/viewtols.htm

L

Lactofen L:0050

Use Type: Herbicide

CAS Number: 77501-63-4; (81362-49-4 obsolete); 62476-59-9 (lactofen-sodium, degradation product)

Formula: $C_{19}H_{15}ClF_3NO_7$

Synonyms: Benzoic acid, 5-[2-chloro-4-(trifluoromethyl) phenoxy]-2-nitro-2-ethoxy-1-methyl-2-oxoethyl ester; 1'-(Carboethoxy)ethyl-5-[2-chloro-4-(trifluoromethyl) phenoxy]-2-nitrobenzoate; 5-[2-Chloro-4-(trifluoromethyl) phenoxy]-2-nitrobenzoicacid2-ethoxy-1-methyl-2-oxoethyl ester; (±)-2-Ethoxy-1-methyl-2-oxoethyl-5-[2-chloro-4-(trifluoromethyl)phenoxy]-2-nitrobenzoate; Ethyl *O*-[5-(2-chloro-α,α,α-trifluoro-*p*-tolyloxy)-2-nitrobenzoyl]-*dl*-lactate

Trade Names: COBRA®; PPG-844®; STELLER®; V-10086®

Chemical class: Diphenyl ether

EPA/OPP PC Code: 128888

California DPR Chemical Code: 3538

HSDB Number: 6991; 6551 (lactofen-sodium)

UN/NA & ERG Number: UN3077(solid)/171

RTECS® Number: DG5643120

Uses: Lactofen is a broad-spectrum herbicide used for pre-emergence and post-emergent weed control on peanuts, snap beans, soybeans, cotton, and fruiting vegetables. Not registered for use in residential settings. Not approved for use in EU countries[115]. Registered for use in the U.S.

U.S. Maximum Allowable Residue Levels for Lactofen [40 CFR 180.432 (a)]: Beans, snap, succulent (excluding limas) 0.01 ppm; Cotton, gin byproducts 0.02 ppm; Cotton, undelinted seed 0.01 ppm; Peanut 0.01 ppm; Soybean, seed 0.01 ppm.

Human toxicity (long-term) [101]: High–2.05882 ppb, CHCL (Chronic Human Carcinogen Level)

Fish toxicity (threshold)[101]: High–1.97989 ppb, MATC (Maximum Acceptable Toxicant Concentration)

Regulatory Authority and Advisory Information: Carcinogenicity[83]: EPA, Unlikely to be a carcinogen at low doses and likely to be carcinogenic to humans in high doses.

California Proposition 65 Chemical: Carcinogen (1/1/1989)
Acute Oral Category: 1, DANGER–POISON
EPA Oral reference dose (RfD) = 0.002 mg/kg/day
EPA ADI (Acceptable Daily Intake) = 0.0015 mg/kg/day
Safe Drinking Water Act: Priority List (55 FR 1470)
EPCRA Section 313 Form R *de minimis* concentration reporting level: 1.0%

Description: Tan to dark brown solid. Technical product is a white crystalline solid. Commercial product may also be available as an emulsifiable concentrate. Molecular weight = 461.79; Specific gravity (H_2O:1) = 1.39; Freezing/Melting point = 43.9–45.5 °C. Vapor pressure = 7.9×10^{-9} mmHg @ 20 °C. Practically insoluble in water.

Permissible Concentration in Water: Runoff from spills or fire control may cause water pollution.

Determination in Water: High-Performance Liquid Chromatography. Log K_{ow} = >4. Values above 3.0 are likely to bioaccumulate in aquatic organisms.

Routes of Entry: Eyes, dermal contact, ingestion. May be absorbed through unbroken skin.

Harmful Effects and Symptoms

Short Term Exposure: This material can cause corrosive burns to the skin and eyes. *Ingestion:* Slight irritation. Mildly toxic via all routes of exposure. LD_{50} (oral, rat) = >5 g/kg; LD_{50} (dermal, rat) = >2 g/kg.

Long Term Exposure: Fluorides may cause bone disease (pain and tenderness of the bones); mottled teeth in children. May cause permanent eye damage. May be mutagenic.

Points of Attack: Liver and kidneys, eyes and skin.

Medical Surveillance: Preliminary medical exam to detect chronic diseases of central nervous system, liver, heart, kidneys, lung and skin, as well as endocrinological or immunological disturbances, should protect susceptible individuals. Periodical medical exams of internal organs, skin and eyes are important to avoid chronic occupational intoxications. They should include lab and patch tests when necessary[83]. This chemical is a suspected or known human carcinogen (in high doses). Exposed persons should contact a physician for advice regarding the possible long term health effects and advice for medical monitoring.

First Aid: If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least 15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately. If this chemical contacts the skin, remove contaminated clothing and wash immediately with soap and water. Seek medical attention immediately. If this chemical has been inhaled, remove from exposure, begin rescue breathing (using universal precautions) if breathing has stopped, and CPR if heart action has stopped. Transfer promptly to a medical facility. When this chemical has been swallowed, get medical attention. Give large quantities of water and induce vomiting. Do not make an unconscious person vomit. Do not induce vomiting when formulations containing petroleum solvents are ingested

Personal Protective Methods: Diphenyl ether derivatives may react with the following absorbent materials: Expanded Polymeric[88]. Wear protective gloves and clothing to prevent any reasonable probability of dermal and/or eye contact. Safety equipment suppliers/manufacturers can provide recommendations on the most protective glove/clothing material for your operation. DuPont™ Tychem® suit fabrics[88]. All protective clothing (suits, gloves, footwear, headgear) should be clean, available each day, and put on before work. Contact lenses should not be worn when working with this chemical. Wear splash-proof chemical goggles and face shield unless full facepiece respiratory protection is worn. Employees should wash immediately with soap when skin is wet or contaminated. Provide emergency showers and eyewash.

Respirator Selection: *At any detectable concentration:* SCBAF: Pd,Pp (APF = 10,000) (any NIOSH/MSHA- or European Standard EN 149-approved self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode); or SaF: Pd,Pp: ASCBA (APF = 10,000) (any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary, self-contained breathing apparatus operated in a pressure-demand or other positive-pressure mode). *Escape:* 100F (APF=50) (any air-purifying, full facepiece respirator with an N100, R100, or P100 filter k-mounted organic vapor canister having a high-efficiency particulate filter); or SCBAE (any appropriate escape-type, self-contained breathing apparatus).

Storage: Corrosive and poisonous. Color Code-White: Corrosive or Contact Hazard; Store separately in a corrosion-resistant location. Store in tightly closed containers in a cool, well-ventilated area. Color Code-Blue: Health Hazard/Poison. Store in a secure poison location. Prior to working with this chemical you should be trained on its proper handling and storage. Store in tightly closed containers in a cool, well-ventilated area away from water, heat and incompatible materials. Metal containers involving the transfer of this chemical should be grounded and bonded. Drums must be equipped with self-closing valves, pressure vacuum bungs, and flame arresters. Use only non-sparking tools and equipment, especially when opening and closing containers of this chemical. If this material may contain a flammable carrier, sources of ignition, such as smoking and open flames, are prohibited where this chemical is used, handled, or stored in a manner that could create a potential fire or explosion hazard. A regulated, marked area should be established where this chemical is handled, used, or stored in compliance with OSHA Standard 1910.1045. Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: Environmentally hazardous substances, solid or liquid, usually fall in Hazard Class 9.

Spill Handling: First remove all sources of ignition. Evacuate persons not wearing protective equipment from area of spill or leak until clean up is complete. Collect powdered material in the most convenient and safe manner and deposit in sealed containers. Absorb liquid containing this chemical in vermiculite, dry sand, earth, or similar material. Ventilate area after clean up is complete. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable.

Fire Extinguishing: Hazardous decomposition includes toxic hydrogen chloride and hydrogen fluoride gas and oxides of nitrogen and carbon. As an immediate precautionary measure, isolate spill or leak area in all directions for at least 50 meters/150 feet for liquids and at least 25 meters/75 feet for solids. *Fire involving storage or vehicular tanks:* isolate for 800 meters/0.5 mile in all directions; also, consider initial evacuation for 800 meters/0.5 mile in all directions. *On a small fire:* use dry chemical, CO_2, water spray or regular foam. *On a large fire:* use water spray, fog or regular foam. Do not scatter spilled material with high-pressure streams of water. Move containers from fire area if you can do it without risk. Dike fire-control water for later disposal. *Fire involving tanks:* from a secure, explosion-proof location, use water spray to cool exposed containers. If cooling streams are ineffective (venting sound increases in volume and pitch, tank discolors, or shows any signs of deforming), withdraw immediately to a secure position. Always stay away from tanks engulfed in fire. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode.

Disposal Method Suggested: It is the responsibility of chemical waste generators to determine the toxicity and physical properties and of a discarded chemical and to properly identify its classification and certification as a hazardous waste and to determine the disposal method. U.S. EPA guidelines for the classification determination are listed in ***40 CFR*** Parts 261.3. Additionally, waste generators must consult and follow all regional, national, state and local hazardous waste laws to ensure complete and accurate classification and disposal methods.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- EXTOXNET, Extension Toxicology Network, “Pesticide Information Profile, Lactofen,” Oregon State University, Corvallis, OR (July 1996). http://extoxnet.orst.edu/pips/lactofen.htm
- USEPA, Office of Pesticide Programs, Pesticide Residue Limits, “Lactofen,” ***40 CFR 180.432***. http://www.ehso.com/ehso.php

Lenacil L:0235

Use Type: Herbicide
CAS Number: 2164-08-1
Formula: $C_{13}H_{18}N_2O_2$
Synonyms: 3-Cyclohexyl-6,7-dihydro-1H-cyclopenta-pyrimidine-2,4-(3H,5H)-dione; Cyclohexyl-5,6-trimethyleneuracil; Cyclohexyl-6,7-dihydro-1H-cyclopenta-pyrimidine-2,4(3H,5H)-dione
Trade Names: LENAZAR FLO®; SAFARI LITE®; VENZAR Flowable®
Chemical class: Uracil
EPA/OPP PC Code: 525200
California DPR Chemical Code: Not assigned
UN/NA&ERG Number: UN3077 (solid)/171; UN3082 (liquid)/171
RTECS® Number: GY5875000
EC Number: 218-499-0
Uses: Systemic herbicide that attacks roots.
Fish toxicity (threshold): Acute aquatic toxicology (category 1). Very toxic to aquatic organisms, may cause long-term adverse effects in the aquatic environment.
Regulatory Authority and Advisory Information: Acute Oral Category: 4, Caution, not acutely toxic
European/International Regulations: Hazard Symbol: N; risk phrases: R51/53; safety phrases: S2; S61 (see Appendix 1)
Description: Off-white to tan solid or powder. Commercial product is available as an emulsifiable concentrate. Molecular weight=234.30; Specific gravity (H_2O:1)=1.3 @ 25 °C; Boiling point=(decomposes); Melting point=(decomposes). Vapor pressure=10^{-6} mmHg @ 25°; Autoignition temperature=~ 290 °C. Low solubility in water.
Incompatibilities: Incompatible with strong oxidizers. Decomposes in temperatures above 265 °C.
Permissible Exposure Limits in Air: No standards set.
Incompatibilities: Dust may form explosive mixture with air. Keep away from bases, strong oxidizers.
Determination in Water: Log K_{ow}=<2.5. Unlikely to bioaccumulate in marine organisms.
Routes of Entry: Inhalation, ingestion, dermal and/or eye contact. May pass through the unbroken skin.
Harmful Effects and Symptoms
Short Term Exposure: May cause irritating to eyes, respiratory tract, and skin. May cause sensitization by dermal and/or eye contact. LD_{50} (oral, rat)=11,000 mg/kg; LD_{50} (rat, oral, dermal) = >5 000 mg/kg.
Long Term Exposure: May cause skin allergy.
Points of Attack: Skin.
Medical Surveillance: Preliminary medical exam to detect chronic diseases of central nervous system, liver, heart, kidneys, lung and skin, as well as endocrinological or immunological disturbances, should protect susceptible individuals. Periodical medical exams of internal organs, skin and eyes are important to avoid chronic occupational intoxications. They should include lab and patch tests when necessary[83]. Evaluation by a qualified allergist, including exposure history and testing, may help diagnose allergy.
First Aid: Never give anything by mouth to an unconscious person. If breathing is irregular or stopped, administer artificial respiration. *Inhalation*: Move to fresh air. Consult a physician. *Dermal contact*: Wash off immediately with soap and plenty of water. If skin irritation persists, call a physician. *Eye contact*: Rinse thoroughly with plenty of water, also under the eyelids. Keep eye wide open while rinsing. If eye irritation persists call a doctor. Ingestion: Drink 1 or 2 glasses of water. Do not induce vomiting without medical advice. Consult a physician.
Personal Protective Methods: Wear protective gloves and clothing to prevent any reasonable probability of dermal and/or eye contact. Safety equipment suppliers/manufacturers can provide recommendations on the most protective glove/clothing material for your operation. All protective clothing (suits, gloves, footwear, headgear) should be clean, available each day, and put on before work. Contact lenses should not be worn when working with this chemical. Wear splash- or dust-proof chemical goggles (depending on physical state of material) and face shield unless full facepiece respiratory protection is worn. Employees should wash immediately with soap when skin is wet or contaminated. Provide emergency showers and eyewash.
Respirator Selection: Wherever and whenever workplace conditions warrant respirator use, a respiratory protection program must be followed that meets one or more of the following government standards: OSHA's 29 CFR 1910.134, ANSI Z88.2, or European Standard EN 149.
Storage: Color Code-Green: General storage may be used. Prior to working with this chemical you should be trained on its proper handling and storage. Store in a refrigerator or a cool, dry place. Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.
Shipping: Environmentally hazardous substances, solid or liquid, usually fall in Hazard Class 9.
Spill Handling: This material may not be readily biodegradable. Wear personal protective equipment. Environmental precautions: Do not flush into surface water or sanitary sewer system. Do not allow material to contaminate ground water system. Methods for cleaning up: Sweep up or vacuum up spillage and collect in suitable container for disposal. Use approved industrial vacuum cleaner for removal. If spill area is on ground near valuable plants or trees, remove 5 cm of top soil after initial clean up.
Fire Extinguishing: Hazardous decomposition products formed under fire conditions including toxic oxides of nitrogen and carbon. As an immediate precautionary measure, isolate spill or leak area in all directions for at least 50 meters/150 feet for liquids and at least 25 meters/75 feet for solids. *Fire involving storage or vehicular tanks:* isolate for 800 meters/0.5 mile in all directions; also, consider initial evacuation for 800 meters/0.5 mile in all directions. *On a small fire:* use dry chemical, CO_2, water spray or regular foam. *On a large fire:* use water spray, fog or regular foam. Do not scatter spilled material with high-pressure streams

of water. Move containers from fire area if you can do it without risk. Dike fire-control water for later disposal. *Fire involving tanks:* from a secure, explosion-proof location, use water spray to cool exposed containers. If cooling streams are ineffective (venting sound increases in volume and pitch, tank discolors, or shows any signs of deforming), withdraw immediately to a secure position. Always stay away from tanks engulfed in fire. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode.

Disposal Method Suggested: Do not discharge into drains or sewers. Dispose of waste material as hazardous waste using a licensed disposal contractor to an approved landfill. Consult with environmental regulatory agencies for guidance on acceptable disposal practices. If allowed, incineration with effluent gas scrubbing is recommended. Containers must be disposed of properly by following package label directions or by contacting your local or federal environmental control agency, or by contacting your regional EPA office.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- United States National Library of Medicine, ChemIDplus Advanced, Bethesda, MD. http://chem.sis.nlm.nih.gov/chemidplus/rn/2164-08-1

Lindane L:0260

Use Type: Insecticide, Rodenticide

CAS Number: 58-89-9; 608-73-1 (technical grade HCH); *(alt)* 8007-42-9; *(alt)* 55963-79-6

Formula: $C_6H_6Cl_6$

Synonyms: BBH; Benzene hexachloride; γ-Benzene hexachloride; Bexol; BHC; γ-BHC; Benzene hexachloride-gamma isomer; 2,5-Cyclohexane,1,2,3,4,5,6-hexachloro-, (1α,2α,3β,4 α,5α,6β)-; DBH; ENT 7,796; Gammabenzene hexachlorocyclohexane (gamma isomer); gamma-BHC; Gamma-HCH; Gammahexa; Gammahexane; HCCH; HCH; γ-HCH; HCH BHC; Hexachlorocyclohexane (gamma isomer); Hexachloran; γ-Hexachloran; γ-Hexachloran; Hexachlorane; γ-Hexachlorane; gamma-Hexachlorane; γ-Hexachlorobenzene; 1α,2α,3β,4α,5α,6β-Hexachlorocyclohexane; γ-Hexachlorocyclohexane; Hexachlorocyclohexane, gamma isomer; 1,2,3,4,5,6-Hexachlor-cyclohexane; γ-1,2,3,4,5,6-Hexachlorocyclohexane; 1,2,3,4,5,6-Hexachlorocyclohexane, gamma isomer; gamma-Hexaclorobenzene; HGI; γ-Lindane; NCI-C00204

Trade Names: AALINDAN®; AFICIDE®; AGRISOL G-20®; AGROCIDE®; AGRONEXIT®; AMEISENATOD®; AMEISENMITTEL (MERCK)®; APARASIN®; APHTIRIA®; APLIDAL®; ARBITEX®; BEN-HEX®; BENTOX 10®; CELANEX®; CHLORESENE®; CODECHINE®; DELSANEX DAIRY FLY SPRAY®; DETMOL-EXTRAKT®; DETOX 25®; DEVORAN®; DOL GRANULE®; DRILL TOX-SPEZIAL AGLUKON®; DUAL MURGANIC RPB SEED TREATMENT®; ENTOMOXAN®; EXAGAMA®; FORLIN®; GALLOGAMA®; GAMACID®; GAMAPHEX®; GAMENE®; GAMMA-COL®; GAMMALIN®; GAMMALIN 20; GAMMALEX®; GAMMASAN 30®; GAMMATERR®; GAMMAPHEX®; GAMMEX®; GAMMEXANE®; GAMMEXENE®; GAMMOPAZ®; GEXANE®; HECLOTOX®; HEXA®; HEXAFLOW®; HEXATOX®; HEXAVERM®; HEXICIDE®; HEXYCLAN®; HORTEX®; INEXIT®; ISOTOX®; JACUTIN®; KOKOTINE®; KWELL®; LENTOX®; LINDAGRAM®; LIDENAL®; LINDAFOR®; LINDAGAM®; LINDAGRAIN®; LINDAGRANOX®; LINDAPOUDRE®; LINDATOX®; LINDOSEP®; LINTOX®; LOREXANE®; MARSTAN FLY SPRAY®; MERGAMMA 30®; MILBOL 49®; MIST-O-MATIC LINDEX®; MSZYCOL®; NEXEN FB®; NEXIT®; NEXIT-STARK®; NEXOL-E®; NICOCHLORAN®; NOVIGAM®; OMNITOX®; OVADZIAK®; OWADZIAK®; PEDRACZAK®; PFLANZOL®; QUELLADA®; RODESCO INSECT POWDER®; SANG GAMMA®; SILVANO®; SPRITZ-RAPIDIN®; SPRUEHPFLANZOL®; STREUNEX®; TAP 85®; TRI-6®; VITON®

Chemical class: Organochlorine

EPA/OPP PC Code: 009001

California DPR Chemical Code: 359

HSDB Number: 646

UN/NA & ERG Number: UN2761 (solid)/151

RTECS® Number: GV4900000

EC Number: 200-401-2 [*Annex I Index No.:* 602-043-00-6]; 210-168-9 (technical)

Uses: Lindane has been used against insects in a wide range of applications including treatment of animals, buildings, man for ectoparasites, clothes, water for mosquitoes, living plants, seeds and soils. Most applications have been canceled due to excessive residues, e.g., stored foodstuffs, that may cause cancer. Formulators, distributors and users of lindane represent a special risk group. The major use of lindane in recent years has been to pretreat seeds. Other uses include sunflowers, peas, wheat, barley and oats. Lindane is currently also used in lotions, creams and shampoos for the control of lice and mites in humans. Not approved for use in EU countries[115]. A U.S. EPA restricted Use Pesticide (RUP). Lindane should be handled as a carcinogen, with extreme caution. Most applications have been canceled. It has not been produced in the U.S. since 1977; however, it is still imported into the U.S. and formulated to treat head lice, body lice and scabies.

U.S. Maximum Allowable Residue Levels for Lindane (40 CFR 180.133): in or on cattle, fat 7.0 ppm; goat, fat 7.0 ppm; hog, fat 4.0 ppm; horse, fat 7.0 ppm; sheep, fat 7.0 ppm. All other allowable residues in or on raw agricultural commodities expired or were revoked on 4/26/2007.

Human toxicity (long-term)[101]: Extra high–0.20 ppb, MCL (Maximum Contaminant Level)

Fish toxicity (threshold)[101]: Extra high–0.11310 ppb, MATC (Maximum Acceptable Toxicant Concentration)

Regulatory Authority and Advisory Information: Carcinogenicity[83]: EPA, suggestive evidence of carcinogenicity, but not sufficient to assess human carcinogenic potential; NTP: 12th Report on Carcinogens, 2011: Reasonably anticipated to be a human carcinogen; ACGIH A3 Confirmed animal carcinogen with unknown relevance to humans.

California Proposition 65 Chemical: *(Lindane and other hexachlorocyclohexane isomers*) Cancer 1/1/89

Acute Oral Category: 2, WARNING

Health Advisory: Mutagen, Developmental/Reproductive Toxin, Endocrine disruptor (S!)

Clean Air Act: Hazardous Air Pollutants (Title I, Part A, Section 112)

Clean Water Act: Section 311 Hazardous Substances/RQ 40CFR117.3 (same as CERCLA, see below); 40CFR423, Appendix A, Priority Pollutants; Section 313 Water Priority Chemicals (57FR41331, 9/9/92); 40CFR401.15 Section 307 Toxic Pollutants, as hexachlorocyclohexane

EPA Hazardous Waste Number (RCRA No.): U129

RCRA Toxicity Characteristic (Section 261.24), Maximum Concentration of Contaminants, regulatory level, 0.4 mg/L

Safe Drinking Water Act: MCL, 0.0002 mg/L; MCLG, 0.0002 mg/L; Regulated chemical (47 FR 9352)

RCRA 40CFR264, Appendix 9; TSD Facilities Ground Water Monitoring List. Suggested test method(s) (PQL μg/L): 8080(0.05)

RCRA 40CFR268.48; 61FR15654, Universal Treatment Standards: Wastewater (mg/L), 0.0017; Non-wastewater (mg/kg), 0.066

Superfund/EPCRA 302 Extremely Hazardous Substances: TPQ = 1000/10,000 lb (454/4,540 kg)

Superfund/EPCRA 40CFR302.4 RQ: CERCLA, 1 lb (0.454 kg)

EPCRA Section 313 Form R *de minimis* concentration reporting level: 0.1%

U.S. DOT Regulated Marine Pollutant (49CFR172.101, Appendix B)

Rotterdam Convention Severe Marine Pollutant (Class II)

Rotterdam Convention Annex III [Chemicals Subject to the Prior Informed Consent Procedure (PIC)] (as lindane)

See also HCH (mixed isomers) 608-73-1

List of Stockholm Convention POPs: Annex A (Elimination)

European/International Regulations: Hazard Symbol: T, N; risk phrases: R20/21; R25; R48/22; R64; R50/53; safety phrases: S1/2; S13; S36/37; S45; S60; S61 (see Appendix 1)

WGK (German Aquatic Hazard Class): 3-Severe hazard to waters

Description: Lindane is a white to yellow crystalline powder. Slight, musty odor (pure material is odorless). Molecular weight = 290.83; Specific gravity (H_2O:1) = 1.85 (no temperature); Boiling point = (decomposes) 323.3 °C @ 760 mmHg; Freezing/Melting point = 112.5 °C; Vapor pressure = 0.00001 mmHg. Hazard Identification (based on NFPA-704 M Rating System): Health 3, Flammability 0, Reactivity 0. Low solubility in water; solubility = <1 mg/mL @ 24 °C. Noncombustible solid, but may be dissolved in flammable liquids. Physical and toxicological properties may be affected by carrier solvents in commercial formulations.

Incompatibilities: Lindane decomposes on contact with powdered iron, aluminum, and zinc and with alkalis, producing trichlorobenzene. Incompatible with strong oxidizers and alkaline materials (undergoes dehydrochlorination). Corrosive to metals[9].

Permissible Exposure Limits in Air: NIOSH IDLH: 50 mg/m^3

OSHA PEL: 0.5 mg/m^3 TWA [skin]

NIOSH REL: 0.5 mg/m^3 TWA [skin]

ACGIH TLV®[1]: 0.5 mg/m^3 TWA [skin]; confirmed animal carcinogen with unknown relevance to humans.

Protective Action Criteria (PAC) Ver. 27[89]

PAC-1: 9.1 mg/m^3
PAC-2: 100 mg/m^3
PAC-3: 100 mg/m^3

DFG MAK: 0.1 mg/m3, inhalable fraction; [skin]; Carcinogen Category 4; Pregnancy Risk Group C

Determination in Air: Collection on a filter, workup with isooctane, analysis by gas chromatography/flame ionization.

Permissible Concentration in Water: Federal Drinking Water Standards: 0.03 ppb[80]; EPA 0.2 μg/L; State Drinking Water Guidelines: Arizona 0.2 μg/L; Maine 0.2 μg/L. To protect freshwater aquatic life–0.080 μg/L as a 24 hour average, never to exceed 2.0 μg/L. To protect saltwater aquatic life–never to exceed 0.16 μg/L. To protect human health-preferably zero. An additional lifetime cancer risk of 1 in 100,000 is posed by a concentration of 0.186 μg/L[6]. Acceptable Daily Intake (ADI): EPA, 10-day health advisory (10 kg child) who consumes 1 L/water/day = 1.2 mg/L; Long-term health advisory (10 kg child) who consumes 1 L/water/day = 0.033 mg/L; Long-term health advisory (70 kg adult) who consumes 2 L/water/day = 0.12 mg/L; Lifetime health advisory (70 kg adult) who consumes 2 L/water/day = 10 μg/L.

Determination in Water: EPA Method D3086. GC method with ECD for the determination of organochlorine pesticides in water and wastewater. Methylene chloride extraction followed by gas chromatography with electron capture or halogen-specific detection (EPA Method 608) or gas chromatography plus mass spectrometry (EPA Method 625). Log K_{ow} => 3.7. Values at or above 3.0 are likely to bioaccumulate in marine organisms.

Routes of Entry: Inhalation, skin absorption, ingestion, eye and/or dermal contact.

Harmful Effects and Symptoms

Lindane is a stimulant of the nervous system, causing violent convulsions that are rapid in onset and generally followed by death or recovery within 24 hours.

Short Term Exposure: Lindane irritates the eyes and the respiratory tract and may affect the central nervous system. Symptoms of exposure include vomiting, faintness, tremor, restlessness, muscle spasms, unsteady gait, and convulsions may occur as a result of exposure. Elevated body temperature and pulmonary edema have been reported in children. Coma, respiratory failure and death can result. Exposure to vapors of this compound or its thermal decomposition products may lead to headache, nausea, vomiting, and irritation of the eyes, nose, and throat. Lindane is a stimulant of the nervous system, causing violent convulsions that are rapid in onset and generally followed by death or recovery within 24 hours. The probable human oral lethal dose is 50–500 mg/kg, or between 1 teaspoon and 1 ounce for a 150 lb (70 kg) person[83]. LD_{50} (oral, rat) = 75–165 mg/kg.

Long Term Exposure: May cause tumors. Organochlorine pesticides are highly toxic to mammals and will accumulate in the tissues of living organisms. Repeated or prolonged contact with skin may cause dermatitis. May damage the liver and kidneys. May damage the nerves in the arms and legs, possibly with weakness and poor coordination. May cause a serious drop in the blood cell count (aplastic anemia) or in the white blood cell count (agranulocytopenia). The Department of Health and Human Services has determined that HCH (hexachlorocyclohexanes) may reasonably be anticipated to be carcinogenic. Liver cancer has been seen in laboratory rodents that ate HCH for long periods of time. In animals, there is evidence that oral exposure to lindane during pregnancy results in an increased incidence of fetuses with extra ribs. However, ATSDR reports that animal studies have not shown birth defects in the babies of animals fed HCH during pregnancy. HCH has been detected in human breast milk.

Points of Attack: Eyes, central nervous system, blood, liver, kidneys and skin, brain.

Medical Surveillance: Consider the points of attack in preplacement and periodic physical examinations. Examination of the nervous system. Complete blood count. Blood test for lindane (may not be accurate longer than 1 week following last exposure). Liver and kidney function tests.

First Aid: If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least 15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately. If this chemical contacts the skin, remove contaminated clothing and wash immediately with soap and water. Seek medical attention immediately. If this chemical has been inhaled, remove from exposure, begin rescue breathing (using universal precautions) if breathing has stopped, and CPR if heart action has stopped. Transfer promptly to a medical facility. When this chemical has been swallowed, get medical attention. Give large quantities of water and induce vomiting. Do not make an unconscious person vomit.

Personal Protective Methods: Wear protective gloves and clothing to prevent any reasonable probability of dermal and/or eye contact. Safety equipment suppliers/manufacturers can provide recommendations on the most protective glove/clothing material for your operation. All protective clothing (suits, gloves, footwear, headgear) should be clean, available each day, and put on before work. Contact lenses should not be worn when working with this chemical. Wear dust-proof chemical goggles and face shield unless full facepiece respiratory protection is worn. Employees should wash immediately with soap when skin is wet or contaminated. Provide emergency showers and eyewash.

Respirator Selection: SCBA >9.1 mg/m^3. At any detectable concentration: SCBAF: Pd,Pp (APF = 10,000) (any NIOSH/MSHA- or European Standard EN 149-approved self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode); or SaF: Pd,Pp: ASCBA (APF = 10,000) (any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary, self-contained breathing apparatus operated in a pressure-demand or other positive-pressure mode). *Escape:* 100 F (APF = 50) (any air-purifying, full facepiece respirator with an N100, R100, or P100 filter k-mounted organic vapor canister having a high-efficiency particulate filter); or SCBAE (any appropriate escape-type, self-contained breathing apparatus).

Storage: Color Code-Blue: Health Hazard/Poison: Store in a secure poison location. Prior to working with this chemical you should be trained on its proper handling and storage. Store in tightly sealed containers in a cool, dry place away from light and incompatible materials. Protect containers against physical damage. A regulated, marked area should be established where this chemical is handled, used, or stored in compliance with OSHA Standard 1910.1045. Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: Organochlorine pesticides, liquid or solid require a "poisonous materials" label. They fall in Hazard Class 6.1.

Spill Handling: For solids, isolate spill or leak area in all directions for at least 25 meters/75 feet. Increase, in the downwind direction, as necessary. Do not touch damaged containers or spilled material unless wearing appropriate protective clothing. Stop leak if you can do it without risk. Prevent entry into waterways, sewers, basements or confined areas. Cover with plastic sheet to prevent spreading. Absorb or cover with dry earth, sand or other non-combustible material and transfer to containers. Do not allow water to get inside containers.

Fire Extinguishing: Hazardous decomposition includes toxic hydrogen chloride gas, phosgene, and oxides of carbon. *On a small fire:* use dry chemical, carbon dioxide or water spray. *On a large fire:* use water spray, fog or regular foam. Move containers from fire area if you can do it without risk. Dike fire-control water for later disposal. Use water spray or fog; do not scatter material using straight water jet streams. *Fire involving storage or vehicular tanks:* isolate for 800 meters/0.5 mile in all directions; also, consider initial evacuation for 800 meters/0.5 mile in all directions. fight fire from maximum distance or use unmanned hose holders or monitor nozzles. Do not allow water to get inside containers. Cool containers with flooding quantities of water until well after fire is out. Withdraw immediately in the case of rising sound from venting safety devices or discoloration of tank. *Always* stay away from tanks engulfed in fire. For massive fire, use unmanned hose holders or monitor nozzles; if this is impossible, withdraw from area and let fire burn.

Disposal Method Suggested: Do not discharge into drains or sewers. Dispose of waste material as hazardous waste using a licensed disposal contractor to an approved landfill. Consult with environmental regulatory agencies for guidance on acceptable disposal practices. Generators of waste containing this contaminant (≥100 kg/mo) must conform with EPA regulations governing storage, transportation, treatment, and waste disposal. Incineration with effluent gas scrubbing is recommended. Containers must be disposed of properly by following package label directions or by contacting your local or federal environmental control agency, or by contacting your regional EPA office.

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- USEPA, "Chemical Profile: Lindane," Washington, DC, Chemical Emergency Preparedness Program (Nov.30, 1987)
- New York State Department of Health, "Chemical Fact Sheet: Gamma-BHC," Albany, NY, Bureau of Toxic Substance Assessment (May 1986)

Linuron L:0265

Use Type: Herbicide
CAS Number: 330-55-2
Formula: $C_9H_{10}Cl_2N_2O_2$
Synonyms: Caswell No. 528; 3-(3,4-Dichlorophenyl)-1-metoxy-1-methylurea; *N*'-(3,4-Dichlorophenyl)-*N*-methoxy-*N*-methylurea; 3-(3,4-Dichlorophenyl)-1-methoxymethylurea; 3-(3,4-Dichlorophenyl)-1-methoxy-1-methylurea; *N*-(3,4-Dichlorophenyl)-*N*'-methyl-*N*'-methoxyurea; 3-(4,5-Dichlorphenyl)-1-methoxy-1-methylharnstoff (German); Methoxydiuron; 1-Methoxy-1-methyl-3-(3,4-dichlorophenyl)urea; Urea, *N*'-(3,4-dichlorophenyl)-*N*-methoxy-*N*-methyl-; Urea, 3-(3,4-dichlorophenyl)-1-methoxy-1-methyl-
Trade Names: AFALON®; ALIBI®; ALISTELL®; BROADCIDE 20EC®; BRONOX®; CERTOLLIN ONIONS®; CLOVACORN EXTRA®; CROP WEEDSTOP®; DU PONT 326®[C]; FF6135' HERBICIDE 326®; GARNITAN®; H 326®; GEMINI®[C]; HERBICIDE 326®; HOE 2810®; JANUS®; LANDSIDE®; LINNET®; LINEX®; LINOROX®; LINUREX®; LOREX®; LOROX®[C]; MARKSMAN 1®; NEMINFEST®; ONSLAUGHT®; PRE-EMPT®; PREMALIN®; PROFALON®; ROTILIN®; SARCLEX®; SCARCLEX®; SINURON®; STAY KLEEN®; TEMPO®; TRIFARMON FL®; TRIFLURON®; TRILIN®; URANUS® (trifluralin + linuron); WARRIOR®
Chemical class: Urea
EPA/OPP PC Code: 035506
California DPR Chemical Code: 361
HSDB Number: 1733
UN/NA & ERG Number: UN3077 (solid)/171; UN3082 (liquid)/171
RTECS® Number: YS9100000
EC Number: 206-356-5 [*Annex I Index No.:* 006-021-00-1]

Uses: Inhibits photosynthesis. Linuron is a selective, pre-emergence herbicide used to control grasses and broadleaf weeds in carrots, beans, peas, asparagus, maize, potatoes, soybeans, sorghum, wheat, bananas, coffee, cotton and ornamentals. It is also used for control of annual weeds in storehouses, roadsides, fence rows and other non-crop lands. Linuron is frequently used in formulations with other herbicides, insecticides and fungicides.

U.S. Maximum Allowable Residue Levels for Linuron [40 CFR 180.184 (a)]: in or on the following food commodities: asparagus 7 ppm; carrots 1 ppm; cattle, fat 1 ppm; cattle, meat byproducts 1 ppm; cattle, meat 1 ppm; celery 0.5 ppm; corn, field, fodder 1 ppm; corn, field, forage 1 ppm; corn, fresh (inc. sweet k + cwhr) 0.25 ppm; corn, grain (inc. pop) 0.25 ppm; corn, sweet, fodder 1 ppm; corn, sweet, forage 1 ppm; cottonseed 0.25 ppm; goats, fat 1 ppm; goats, meat byproducts 1 ppm; goats, meat 1 ppm; hogs, fat 1 ppm; hogs, meat byproducts 1 ppm; hogs, meat 1 ppm; horses, fat 1 ppm; horses, meat byproducts 1 ppm; horses, meat 1 ppm; parsnips (with or without tops) 0.5 ppm; potatoes 1 ppm; sheep, fat 1 ppm; sheep, meat byproducts 1 ppm; sheep, meat 1 ppm; sorghum, fodder 1 ppm; sorghum, forage 1 ppm; sorghum, grain (milo) 0.25 ppm; soybeans (dry and succulent) 1 ppm; soybeans, forage 1 ppm; soybeans, hay 1 ppm; wheat, forage 0.5 ppm; wheat, grain 0.25 ppm; wheat, hay 0.5 ppm; and wheat, straw 0.5 ppm. ***Regional registration* [*40 CFR 180.184 (b)*]**: parsley 0.25 ppm.

Human toxicity (long-term)[101]: High–5.60 ppb, Health Advisory

Fish toxicity (threshold)[101]: Intermediate–42.00007 ppb, MATC (Maximum Acceptable Toxicant Concentration)

Regulatory Authority and Advisory Information: Carcinogenicity[83]: EPA Group C, Possible human carcinogen; Carcinogenicity: GHS Category 2: Suspected human carcinogen

California Proposition 65 Chemical: Developmental/Reproductive toxin (3/19/1999)

Health Advisory: Mutagen, Reproductive and developmental toxin (TRI), Endocrine disruptor (S!)

Acute Oral Category: 4, Caution, not acutely toxic

Marine Pollutant, IMDG

Potential Ground Water Pollutant [California FAC Section 13145(d)/12811, active]

EPCRA Section 313 Form R *de minimis* concentration reporting level: 1.0%

European/International Regulations: Hazard Symbol: T, N; risk phrases: R22; R40; R48/22; R50/53; R61; R62; safety phrases: S2; S45; S60; S61 (see Appendix 1)

WGK (German Aquatic Hazard Class): 3-Severe hazard to waters.

Description: White crystalline solid or powder. Odorless. Commercial product may be available as a water soluble or emulsifiable concentrate. Molecular weight = 249.11; Specific gravity (H_2O:1) = 1.492 @ 20 °C; Freezing/Melting point = 93–94 °C; Vapor pressure = 1.43×10^{-6} mmHg @ 25 °C[83,USDA]. Slightly soluble in water; solubility = 75 mg/L @ 25 °C.

Determination in Air: Filter; none; Gravimetric; NIOSH IV [Particulates NOR; #0500 (total), #0600 (respirable)].[18].

Permissible Concentration in Water: State Drinking Water Standards: Florida 14 μg/L; Minnesota 1.0 μg/L

Determination in Water: Log K_{ow} = >3.0. Values above 3.0 are likely to bioaccumulate in marine organisms.

Routes of Entry: Dermal contact, ingestion, inhalation.

Harmful Effects and Symptoms

Short Term Exposure: Contact with eyes or skin may cause irritation or burns. Inhalation should be avoided; use NIOSH- or CEN (UK)-approved air-purifying respirators for pesticides. Ingestion may cause nausea, vomiting, and diarrhea. LD_{50} (oral, rat) = 1146 mg/kg; LD_{50} (dermal, rat) = >2.5 g/kg.

Long Term Exposure: Developmental problems; mutagen.

Points of Attack: Skin; reproductive system.

Medical Surveillance: Preliminary medical exam to detect chronic diseases of central nervous system, liver, heart, kidneys, lung and skin, as well as endocrinological or immunological disturbances, should protect susceptible individuals. Periodical medical exams of internal organs, skin and eyes are important to avoid chronic occupational intoxications. They should include lab and patch tests when necessary[83]. This chemical is a suspected or known human carcinogen. Exposed persons should contact a physician for advice regarding the possible long term health effects and advice for medical monitoring. Comprehensive physical examination with emphasis on the genito-urinary tract analysis to include sperm count, motility and morphology. Other tests, such as serum testosterone, serum follicle stimulating hormone (FSH), and serum lutenizing hormone (LH), may be carried out if, in the opinion of a physician, they are indicated.

First Aid: If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least 15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately. If this chemical contacts the skin, remove contaminated clothing and wash immediately with soap and water. Seek medical attention immediately. If this chemical has been inhaled, remove from exposure, begin rescue breathing (using universal precautions) if breathing has stopped, and CPR if heart action has stopped. Transfer promptly to a medical facility. When this chemical has been swallowed, get medical attention. Give large quantities of water. Do not induce vomiting when formulations containing petroleum solvents are ingested. Do not make an unconscious person vomit.

Personal Protective Methods: Wear protective gloves and clothing to prevent any reasonable probability of dermal and/or eye contact. Safety equipment suppliers/manufacturers can provide recommendations on the most protective glove/clothing material for your operation. All protective clothing (suits, gloves, footwear, headgear) should be clean, available each day, and put on before work. Contact lenses should not be worn when working with this chemical. Wear dust-proof chemical goggles and face shield unless full facepiece respiratory protection is worn. Employees should wash immediately with soap when skin is wet or contaminated. Provide emergency showers and eyewash.

Respirator Selection: Where the neat (undiluted) test chemical is weighed and diluted, wear a NIOSH-approved half face respirator equipped with a combination filter cartridge, i. e. organic vapor/acid gas/HEPA (specific for organic vapors, HCl, acid gas, SO_2 and a high-efficiency particulate filter)[88]

Storage: Color Code-Blue: Health Hazard/Poison. Store in a tightly closed container in a dry, well-ventilated and secure poison location. Prior to working with this chemical you should be trained on its proper handling and storage. Where possible, automatically transfer material from other storage containers to process containers. Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: Environmentally hazardous substances, solid or liquid, usually fall in Hazard Class 9.

Spill Handling: First remove all sources of ignition. Evacuate persons not wearing protective equipment from area of spill or leak until clean up is complete. Do not touch spilled material; stop leak if you can do it without risk. Use water spray to reduce vapors. Collect powdered material in the most convenient and safe manner and deposit in sealed containers. *Large spills:* dike far ahead of spill for later disposal. Ventilate area after clean up is complete. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable.

Fire Extinguishing: Hazardous decomposition includes oxides of nitrogen and carbon, and corrosive fumes of chlorides. As an immediate precautionary measure, isolate spill or leak area in all directions for at least 50 meters/150 feet for liquids and at least 25 meters/75 feet for solids. *Fire involving storage or vehicular tanks:* isolate for 800 meters/0.5 mile in all directions; also, consider initial evacuation for 800 meters/0.5 mile in all directions. *On a small fire:* use dry chemical, CO_2, water spray or regular foam. *On a large fire:* use water spray, fog or regular foam. Do not scatter spilled material with high-pressure streams of water. Move containers from fire area if you can do it without risk. Dike fire-control water for later disposal. *Fire involving tanks:* from a secure, explosion-proof location, use water spray to cool exposed containers. If cooling streams are ineffective (venting sound increases in volume and pitch, tank discolors, or shows any signs of deforming), withdraw immediately to a secure position. Always stay away from tanks engulfed in fire. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode.

Disposal Method Suggested: Incinerate in a unit operating at 850 °C equipped with off-gas scrubbing equipment. Containers must be disposed of properly by following package label directions or by contacting your local or federal environmental control agency, or by contacting your regional EPA office.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- EXTOXNET, Extension Toxicology Network, "Pesticide Information Profile, Linuron," Oregon State University, Corvallis, OR (June 1996). http://extoxnet.orst.edu/pips/linuron.htm
- USEPA, Office of Pesticide Programs, Pesticide Residue Limits, "Linuron", ***40 CFR 180.184***. http://www.epa.gov/pesticides/food/viewtols.htm

M

Malathion M:0190

Use Type: Insecticide
CAS Number: 121-75-5
Formula: $C_{10}H_{19}O_6PS_2$
Synonyms: *S*-[1,2-Bis(carbethoxy)ethyl] *O,O*-dimethyldithiophosphate; *S*-[1,2-Bis(ethoxycarbonyl) ethyl] *O,O*-dimethyl phosphorodithioate; *S*-1,2-Bis(ethoxycarbonyl)ethyl-*O,O*-dimethylthiophosphate; Butanedioic acid, [(dimethoxyphosphinothioyl) thio]-, diethyl ester; *S*-(1,2-Dicarbethoxyethyl) *O,O*-dimethylphosphorodithioate; Dicarboethoxyethyl *O,O*-dimethyl phosphorodithioate; Diethyl [(dimethoxyphosphinothioyl)thio]butanedioate; Diethyl (dimethoxyphosphinothioylthio)succinate; Diethyl (dimethoxythiophosphorylthio)succinate; Diethyl mercaptosuccinate, *O,O*-dimethyl phosphorodithioate; Diethyl mercaptosuccinate, *O,O*-dimethyl dithiophosphate, *S*-ester; Diethyl mercaptosuccinate, *O,O*-dimethyl thiophosphate; Diethyl mercaptosuccinate, *S*-ester with *O,O*-dimethyl phosphorodithioate; [(Dimethoxyphosphinothioyl) thio] butanedioic acid diethyl ester; *O,O*-Dimethyl *S*-(1,2-dicarbethoxyethyl) dithiophosphate; *O,O*-Dimethyl *S*-(1,2-dicarbethoxyethyl)phosphorodithioate; *O,O*-Dimethyl *S*-1,2-di(ethoxycarbamyl)ethyl phosphorodithioate; *O,O*-Dimethyldithiophosphate diethylmercaptosuccinate; *O,O*-Dimethyl dithiophosphate of diethyl mercaptosuccinate; Carbophos; ENT 17,034; Malathon; Malathyl; Malmed; Malphos; Mercaptosuccinic acid diethyl ester; Mercaptothion; NCI-C00215; Oleophosphothion; Phosphothion; Succinic acid, mercapto-, Diethyl ester, *S*-ester with *O,O*-dimethyl phosphorodithioate
Trade Names: AI3-17034®; AGRICHEM GREENFLY SPRAY®; ALCO® Malathion; ALL PURPOSE GARDEN INSECTICIDE®; AMERICAN CYANAMID 4,049®; ATRAPA 5E®; BAN-MITE®; CALMATHION®; CARBETOVUR®; CARBETOX®; CELTHION®; CHEMATHION®; CIMEXAN®; COMPOUND 4049®; CROMOCIDE®; CYTHION®; SPRAY CONCENTRATE®; CYTHION®; DETMOL MA®; DETMOL® 96%; DETMOL MALATHION®; DURAMITEX®; EMMATOS EXTRA®; EL 4049®; EMMATON®; EMMATOS®; ETIOL®; EVESHIELD CAPTAN/MALATHION®; EXATHIOS®; EXTERMATHION®; FYAFANON®; FISONS GREENFLY AND BLACKFLY KILLER®; FOG® 3; FORMAL®; FORTHION®; FOSFOTHION®; FOSFOTION®; FYFANON®; ETHIOLACAR®; GREEN DEVIL®; GREENFLY AEROSOL SPRAY®; HILTHION®; KARBOFOS®; KOPTHION®; KYPFOS®; MALACIDE®; MALAFOR®; MALAGRAN®; MALAKILL®; MALAMAR®; MALASOL®; MALASPRAY®; MALATAF®; MALATHION 60®; MALATHION E50®; MALATOL®; MALTOX®; MOSCARDA®; ORTHO MALATHION®; PBI CROP SAVER®; PRENTOX®; PRIODERM®; PROKIL® Malathion; SADOFOS®; SADOPHOS®; SF® 60; SIPTOX I®; SUMITOX®; TAK®; TM-4049®; VETIOL®; ZITHIOL®
Chemical class: Organophosphate
EPA/OPP PC Code: 057701
California DPR Chemical Code: 367
HSDB Number: 665
UN/NA & ERG Number: UN2783 (solid)/152; UN3018 (liquid)/152
RTECS® Number: WM8400000
EC Number: 204-497-7 [*Annex I Index No.:* 015-041-00-X]
Uses: Not approved for use in EU countries[115]. Malathion is a non-systemic, wide-spectrum organophosphate insecticide. It was one of the earliest organophosphate insecticides developed (introduced in 1950). Malathion is suited for the control of sucking and chewing insects on fruits, vegetables, citrus, cotton, corn, sorghum, ornamentals and stored products, and is also used to control mosquitoes, flies, household insects, farm and livestock parasites (ectoparasites), and head and body lice. Malathion may also be found in formulations with many other pesticides; the U.S. EPA lists 2,283 current and canceled labels of products containing malathion. Malathion is marketed as 99.6% technical grade liquid. Available formulations include wettable powders (25% and 50%), emulsifiable concentrates, dusts and aerosols.
U.S. Maximum Allowable Residue Levels for Malathion (40 CFR 180.111): [40 CFR 180.111(a) (1)]: alfalfa, forage 135 ppm; alfalfa, hay 135 ppm; almond, hulls 50 ppm; almond, postharvest 8 ppm; apple 8 ppm; apricot 8 ppm; asparagus 8 ppm; avocado 8 ppm; barley, grain, postharvest 8 ppm; bean, dry, seed 8 ppm; bean, succulent 8 ppm; beet, garden, roots 8 ppm; beet, garden, tops 8 ppm; beet, sugar, roots 1 ppm; beet, sugar, tops 8 ppm; blackberry 8 ppm; blueberry 8 ppm; boysenberry 8 ppm; carrot, roots 8 ppm; chayote, fruit 8 ppm; chayote, roots 8 ppm; cherry 8 ppm; chestnut 1 ppm; clover, forage 135 ppm; clover, hay 135 ppm; corn, field, forage 8 ppm; corn, field, grain, postharvest 8 ppm; corn, pop, grain, postharvest 8 ppm; corn, sweet, forage 8 ppm; corn, sweet, kernel plus cob with husks removed 2 ppm; cowpea, forage 135 ppm; cowpea, hay 135 ppm; cranberry 8 ppm; cucumber 8 ppm; currant 8 ppm; date, dried fruit 8 ppm; dewberry 8 ppm; eggplant 8 ppm; fig 8 ppm; flax, seed 0.1 ppm; garlic, bulb 8 ppm; gooseberry 8 ppm; grape 8 ppm; grapefruit 8 ppm; guava 8 ppm; hazelnut 1 ppm; hop, dried cones 1 ppm; horseradish 8 ppm; kumquat 8 ppm; leek 8 ppm; lemon 8 ppm; lentil, seed 8 ppm; lespedeza, hay 135 ppm; lime 8 ppm; loganberry 8 ppm; lupin, seed 8 ppm; mango

8 ppm; melon 8 ppm; mushroom 8 ppm; nectarine 8 ppm; nut, macadamia 1 ppm; oat, grain, postharvest 8 ppm; okra 8 ppm; onion, bulb 8 ppm; onion, green 8 ppm; orange 8 ppm; papaya 1 ppm; parsnip 8 ppm; passionfruit 8 ppm; pea 8 ppm; pea, field, hay 8 ppm; pea, field, vines 8 ppm; peach 8 ppm; peanut, hay 135 ppm; peanut, postharvest 8 ppm; pear 8 ppm; pecan 8 ppm; pepper 8 ppm; peppermint, tops 8 ppm; pineapple 8 ppm; plum 8 ppm; plum, prune 8 ppm; potato 8 ppm; pumpkin 8 ppm; quince 8 ppm; radish 8 ppm; raspberry 8 ppm; rice, grain, postharvest 8 ppm; rice, wild 8 ppm; rutabaga 8 ppm; rye, grain, postharvest 8 ppm; safflower, seed 0.2 ppm; salsify, roots 8 ppm; salsify, tops 8 ppm; shallot, bulb 8 ppm; sorghum, grain, forage 8 ppm; sorghum, grain, grain, postharvest 8 ppm; soybean, forage 135 ppm; soybean, hay 135 ppm; soybean, seed 8 ppm; soybean, vegetable, succulent 8 ppm; spearmint, tops 8 ppm; squash, summer 8 ppm; squash, winter 8 ppm; strawberry 8 ppm; sunflower, seed, postharvest 8 ppm; sweet potato, roots 1 ppm; tangerine 8 ppm; tomato 8 ppm; trefoil, forage 135 ppm; trefoil, hay 135 ppm; turnip, greens 8 ppm; turnip, roots 8 ppm; vegetable, brassica, leafy, group 5, 8 ppm; vegetable, leafy, except brassica, group 4, 8 ppm; vetch, hay 135 ppm; walnut 8 ppm; wheat, grain, postharvest 8 ppm***; malathion and its metabolite, malaoxon [40 CFR 180.111(a) (2)]:*** barley, straw 50 ppm; corn, field, stover 30.0 ppm; cotton, undelinted seed 20.0 ppm; grass, forage 200 ppm; grass, hay 270 ppm; oat, forage 4.0 ppm; oat, straw 50 ppm; rye, forage 4.0 ppm; rye, straw 50 ppm; watercress 0.2 ppm; wheat, forage 4.0 ppm; wheat, straw 5 0 ppm***; residues of malathion [40 CFR 180.111(a) (3)]:*** cattle, fat 4 ppm; cattle, meat (The tolerance level shall not be exceeded in any cut of meat or in any meat byproducts from cattle, goat, hog, horse, poultry, or sheep) 4 ppm; cattle, meat byproducts (the tolerance level shall not be exceeded in any cut of meat or in any meat byproducts from cattle, goat, hog, horse, poultry, or sheep) 4 ppm; egg 0.1 ppm; goat, fat 4 ppm; goat, meat (the tolerance level shall not be exceeded in any cut of meat or in any meat byproducts from cattle, goat, hog, horse, poultry, or sheep) 4 ppm; Goat, meat byproducts (the tolerance level shall not be exceeded in any cut of meat or in any meat byproducts from cattle, goat, hog, horse, poultry, or sheep) 4 ppm; hog, fat 4 ppm; hog, meat (the tolerance level shall not be exceeded in any cut of meat or in any meat byproducts from cattle, goat, hog, horse, poultry, or sheep) 4 ppm; hog, meat byproducts (the tolerance level shall not be exceeded in any cut of meat or in any meat byproducts from cattle, goat, hog, horse, poultry, or sheep) 4 ppm; horse, fat 4 ppm; horse, meat (the tolerance level shall not be exceeded in any cut of meat or in any meat byproducts from cattle, goat, hog, horse, poultry, or sheep) 4 ppm; horse, meat byproducts (the tolerance level shall not be exceeded in any cut of meat or in any meat byproducts from cattle, goat, hog, horse, poultry, or sheep) 4 ppm; milk, fat 0.5 ppm; poultry, fat 4 ppm; poultry, meat (the tolerance level shall not be exceeded in any cut of meat or in any meat byproducts from cattle, goat, hog, horse, poultry, or sheep) 4 ppm; Poultry, meat byproducts (the tolerance level shall not be exceeded in any cut of meat or in any meat byproducts from cattle, goat, hog, horse, poultry, or sheep) 4 ppm; sheep, fat 4 ppm; sheep, meat (the tolerance level shall not be exceeded in any cut of meat or in any meat byproducts from cattle, goat, hog, horse, poultry, or sheep) 4 ppm; sheep, meat byproducts (the tolerance level shall not be exceeded in any cut of meat or in any meat byproducts from cattle, goat, hog, horse, poultry, or sheep) ***[40 CFR 180.111(a)(4)]:*** may be safely used in accordance with the following conditions: (i) It is incorporated into paper trays in amounts not exceeding 100 milligrams per square foot. (ii) Treated paper trays are intended for use only in the drying of grape (raisins). (iii) Total residues of malathion resulting from drying of grape on treated trays and from application to grape before harvest shall not exceed 12 parts per million on processed ready-to-eat raisins. ***[40 CFR 180.111(a)(5)]:*** Residues of malathion in safflower, refined oil from application to the growing safflower plant shall not exceed 0.6 ppm. ***[40 CFR 180.111(a)(6)]:*** Malathion may be safely used for the control of insects during the drying of grape (raisins) in compliance with paragraph (a)(4) of this section by incorporation into paper trays in amounts not exceeding 100 mg/ft^2. ***[40 CFR 180.111(a)(7)]:*** Malathion may be safely used in feed in accordance with the following conditions. (i) A tolerance of 50 ppm is established for residues of malathion in citrus, dried pulp for cattle feed, when present as the result of the application of the pesticide to bagged citrus pulp during storage. Whether or not tolerances for residues of malathion on the fresh fruit have been established under section 408 of the Act, the total residue of malathion in the citrus, dried pulp shall not exceed 50 ppm. (ii) A tolerance of 10 ppm is established for malathion in nonmedicated cattle feed concentrate blocks resulting from its application as a pesticide to paper used in packaging the nonmedicated cattle feed concentrate blocks.

Human toxicity (long-term)[101]: Very low–100.00 ppb, Health Advisory

Fish toxicity (threshold)[101]: Extra high–0.28991 ppb, MATC (Maximum Acceptable Toxicant Concentration)

Regulatory Authority and Advisory Information:

Carcinogenicity[83]: EPA, Suggestive evidence of carcinogenicity, but not sufficient to assess human carcinogenic potential; IARC, Group 3 not classifiable as to its carcinogenicity in humans.

Acute Oral Category: 2, WARNING; Category: 3, CAUTION (depending on formulation and carrier solvent)

Health Advisory: Nerve Toxin, Mutagen, Developmental/Reproductive Toxin, Endocrine disruptor (S!)

EPA Acute reference dose (RfD) 0.14 mg/kg/day

Potential Ground Water Pollutant [California FAC Section 13145(d)/12811, active]

Clean Water Act: Section 311 Hazardous Substances/RQ 40CFR117.3 (same as CERCLA, see below)

Superfund/EPCRA 40CFR302.4 RQ: CERCLA, 100 lb (45.4 kg)

EPCRA Section 313 Form R *de minimus* concentration reporting level: 1.0%

U.S. DOT 49CFR172.101, Inhalation Hazard Chemical as organophosphates

U.S. DOT Regulated Marine Pollutant (49CFR172.101, Appendix B)

European/International Regulations: Hazard Symbol: Xn, Xi; N; risk phrases: R22; R43; R50/53; safety phrases: S2; 24; S37; S46; S60; S61 (see Appendix 1)

WGK (German Aquatic Hazard Class): 3-Severe hazard to waters

Description: At room temperature, malathion is a yellow to deep brown liquid. Clear and colorless when pure. It is a solid below 2.8 °C. It is often dissolved in a hydrocarbon solvent before use. *Warning properties*: Garlic odor at 13.5 mg/m^3; inadequate warning for acute and chronic exposures. Molecular weight = 330.36; Specific gravity (H_2O:1) =1.2076 @ 20 °C; Boiling point = (decomposes); Freezing/Melting point = 1.4–2.9 °C; Boiling point = 156–157 °C; Vapor pressure = 8×10^6 mmHg @ 20 °C; Flash point ≥163 °C (may be lower depending on carrier solvent used). Hazard Identification (based on NFPA-704 M Rating System): Health 2, Flammability 1, Reactivity 0. Slightly soluble in water; solubility = 145 ppm @ 20 °C. Physical and toxicological properties may be affected by carrier solvents in commercial formulations.

Incompatibilities: May react violently with antimony(V) pentafluoride. Incompatible with lead diacetate, magnesium, silver nitrate. In the presence of strong reducing agents such as hydrides, organophosphates form highly toxic and flammable phosphine gas. Contact with oxidizers can cause the release of toxic oxides of phosphorus. Reacts violently with alkaline pesticides. Attacks metals including iron, steel, tin plate, lead, copper, and some plastics, coatings, and rubbers.

Permissible Exposure Limits in Air: OSHA PEL: 15 mg/m^3 (*total dust*) TWA[skin]

NIOSH REL: 10 mg/m^3 TWA[skin]

ACGIH TLV®[1]: 1 mg/m^3 TWA measured as inhalable fraction and vapor; [skin]; not classifiable as a human carcinogen; TLV-BEI$_A$ issued as Acetylcholinesterase inhibiting pesticides.

NIOSH IDLH: 250 mg/m^3

Protective Action Criteria (PAC) Ver. 27[89]

PAC-1: **15**$_A$ mg/m^3

PAC-2: **120**$_A$ mg/m^3

PAC-3: **390**$_A$ mg/m^3

*AEGLs (Acute Emergency Guideline Levels) are in **bold face**. Subscript "**A**" is a 60-minute value.

DFG MAK: 15 mg/m^3 inhalable fraction TWA; Peak Limitation Category II(4); Pregnancy Risk Group D

Determination in Air: OSHA versatile sampler-2; Toluene/Acetone; Gas chromatography/Flame photometric detection for sulfur, nitrogen, or phosphorus; NIOSH IV, Method #5600, Organophosphorus pesticides.[18]. See also OSHA Method #62[58].

Permissible Concentration in Water: Federal Drinking Water Guidelines: 100 ppb[80]; EPA Health Advisory: 500 μg/L; State Drinking Water Guidelines: Arizona 140 μg/L; Maine 140 μg/L; Florida 140 μg/L; California 160 μg/L. Canadian Drinking Water Standards: MAC 0.19 mg/L.

Determination in Water: Log K_{ow} = >2.5–3.0. Values above 3.0 are likely to bioaccumulate in marine organisms.

Routes of Entry: Inhalation of vapor, skin absorption, ingestion and skin and/or eye contact.

Harmful Effects and Symptoms

Short Term Exposure: Systemic malathion toxicity due to excess cholinergic stimulation may result from all routes of exposure. Symptoms include abdominal cramps, vomiting, diarrhea, pinpoint pupils and blurred vision, excessive sweating, salivation and lacrimation, wheezing, excessive tracheobronchial secretions, agitation, seizures, bradycardia or tachycardia, muscle twitching and weakness, and urinary and fecal incontinence. Seizures are much more common in children than in adults. Death results from loss of consciousness, coma, excessive bronchial secretions, respiratory depression and cardiac irregularity. Commercial malathion products often contain impurities and hydrocarbon solvents, such as xylene or toluene, which themselves can cause toxicity. Toxicity of malathion depends on metabolic activation; thus, symptoms may appear from a few minutes to a few hours after exposure. The effects caused by many short term exposures during a week's time can be accumulated and felt as one intense response. Sometimes effects are not felt until hours or days after exposure. *Inhalation:* No effects were reported from exposures of up to 86 mg/m^3 for 42 days. The only effect reported due to inhalation was the reduction in activity of an important nervous system enzyme. Delayed pulmonary edema may occur following inhalation. *Skin:* Important route of exposure during formulation and usage. Prolonged contact (hours) along with poor hygiene has resulted in irritation, as well as symptoms listed under ingestion. *Eyes:* Direct contact can lead to irritation and discomfort. *Ingestion:* Swallowing of malathion has caused severe poisoning and death. Swallowing of 1-1/2 to 3 ounces of a moisture (50% malathion) has caused severe poisoning with symptoms which include nausea, vomiting, headache, abdominal pain, diarrhea, difficulty in breathing, fall in blood pressure, muscle spasms, paralysis, loss of reflexes, convulsions and coma. Between 3-1/2 and 5 ounces of a mixture (50% malathion) has caused death. LD_{50} (oral, rat) = 1000–>5000 mg/kg; LD_{50} (dermal, rat) = >2000 mg/kg.

Long Term Exposure: May cause tumors. High or repeated exposure may damage the nerves, causing weakness, dizziness, and poor coordination in arms and legs. Repeated exposures may cause personality changes, depression, anxiety or irritability. Persistent weakness and impaired memory have been reported to occur from low-level exposures to some organophosphates in the absence of acute cholinergic effects, but there is no reliable information on adverse health effects of chronic exposure to malathion.(ATSDR) *Carcinogenicity[83]:* The International Agency for Research on Cancer has determined that malathion is unclassifiable as to its carcinogenicity to humans. In animals, malathion induced liver carcinogenicity at doses that were considered excessive. *Reproductive and developmental effects:* Studies have been reported in which malathion induced transient testicular effects in rodents. Results from studies addressing reproductive or developmental effects in humans are inconclusive. Prolonged, daily contact with exposed areas of skin has led to skin irritation and sensitization. May cause genetic changes (mutations). Birth defects have not been observed in humans exposed to malathion, but developmental effects have been seen in the offspring of animals that ingested enough malathion while pregnant to cause health effects in the mother. Animal studies have shown that malathion can be transferred from a pregnant mother to the developing fetus and from a nursing mother to the newborns through the mother's milk. A neurotoxin.

Points of Attack: Eyes, skin, respiratory system, liver, blood cholinesterase, central nervous system, cardiovascular system and gastrointestinal tract.

Medical Surveillance: Medical observation is recommended for 24 to 48 hours following breathing overexposure, as pulmonary edema may be delayed. Routine biological monitoring of pesticide applicators and field workers includes testing of plasma and red blood cell acetylcholinesterase levels (for enzyme poisoned by this chemical). These tests are normally accurate only if done within about two hours of exposure. If exposure stops, plasma levels return to normal in 1–2 weeks while red blood cell levels may be reduced for 1–3 months. When acetylcholinesterase enzyme levels are reduced by 25% or more below preemployment levels, risk of poisoning is increased, even if results are in lower ranges of "normal." Reassignment to work not involving organophosphate pesticides is recommended until enzyme levels recover. Do not drink any alcoholic beverages before or during use as it promotes absorption of organophosphates. Erythrocyte cholinesterase levels should be checked as noted above and as described in detail by NIOSH Criteria Document No. 76-205. Evaluation by a qualified allergist, including exposure history and testing, may help diagnose allergy.

First Aid: **Treatment for organophosphate poisoning consists of thorough decontamination, cardiorespiratory support, and administration of the antidotes atropine and pralidoxime. In cases of severe poisoning, diazepam, an anticonvulsant, should also be administered. Antidotes should be administered as prevention even if the diagnosis is in doubt**. Speed in removing material from eyes and skin is of extreme importance. *Eyes:* Eye contact can cause dangerous amounts of these chemicals to be quickly absorbed through the mucous membrane into the bloodstream. Immediately and gently flush eyes with plenty of warm or cold water (NO hot water) for at least 15 minutes, occasionally lifting the upper and lower eyelids. Get medical aid immediately. *Skin:* Get medical aid. Dermal contact can cause dangerous amounts of these chemicals to be absorbed into the bloodstream. Wearing the appropriate PPE equipment and respirator for organophosphate pesticides, immediately flush skin with plenty of soap and water for at least 15 minutes while removing contaminated clothing and shoes. Shampoo hair promptly if contaminated. The removed, contaminated clothing and shoes should be double-bagged and left in Hot Zone for later disposal by hazardous materials experts. Skin may also be decontaminated with diluted hypochlorite solution. *Inhalation:* Get medical aid. Do not contaminate yourself. Wearing the appropriate PPE equipment and respirator for organophosphate pesticides, immediately remove the victim from the contaminated area to fresh air. If the victim is not breathing, administer artificial respiration. Do not use mouth-to-mouth method if victim ingested or inhaled the substance; give artificial respiration with the aid of a pocket mask equipped with a one-way valve or other proper respiratory medical device. If breathing is difficult, administer oxygen through bag/mask apparatus until medical help arrives. Do not leave victim unattended. *Ingestion:* Call poison control. Loosen all clothing. Never give anything by mouth to an unconscious person. If victim is *unconscious or having convulsions,* do nothing except keep victim warm. Get medical aid. Transfer promptly to a medical facility. In cases of ingestion, **do not induce vomiting**. If the victim is alert and asymptomatic, administer a slurry of activated charcoal at a dose of 1 g/kg (infant, child, and adult dose). A soda can and straw may be of assistance when offering charcoal to a child. *In some cases you may be specifically instructed by poison control to induce vomiting by way of 2 tablespoons of syrup of ipecac (adult) washed down with a cup of water*. Do NOT give activated charcoal before or with ipecac syrup. *Note to physician or authorized medical personnel:* Treat cases of respiratory compromise, coma, or excessive pulmonary secretions with respiratory support using protocols and techniques available and within the scope of training. Some cases may necessitate procedures such as endotracheal intubation or cricothyrotomy by properly trained and equipped personnel. When possible, atropine (see *Antidotes*, below) should be given under medical supervision. Patients who are comatose, hypotensive, or having seizures or cardiac arrhythmias should be treated according to advanced life support protocols. *Antidotes:* Two antidotes are administered to treat organophosphate poisoning. Atropine is a competitive antagonist of acetylcholine at muscarinic receptors and is used to control the excessive bronchial secretions which are often responsible for death. Pralidoxime relieves both the nicotinic and muscarine effects of organophosphate poisoning by regenerating acetylcholinesterase and can reduce both the bronchial secretions and the muscle weakness associated with poisoning. The initial intravenous dose of atropine in adults should be determined by the severity of symptoms: An initial adult dose of 1.0 to 2.0 mg or pediatric dose of 0.01 mg/kg (minimum 0.01 mg) should be administered intravenously. If intravenous access cannot be established, atropine may also be given intramuscularly, subcutaneously or via endotracheal tube. Doses should be repeated every 15 minutes until excessive secretions and sweating have been controlled. Once bronchial secretion has been controlled, atropine administration should be repeated whenever the secretions begin to recur. In seriously poisoned patients, very large doses may be required. Alterations of pulse rate and pupillary size should not be used as indicators of treatment adequacy. Pralidoxime should be administered as early in poisoning as possible as its efficacy may diminish when given more than 24 to 36 hours after exposure. Doses are as follows: adult 1.0 g; pediatric 25 to 50 mg/kg. The drug should be administered intravenously over 30 to 60 minutes, but in a life-threatening situation one-half of the total dose can be given per minute for a total administration time of 2 minutes. Treatment should begin to take effect within 40 minutes with a reduction in symptoms and the amount of atropine necessary to control bronchial secretion. The initial dose can be repeated in 1 hour and then every 8 to 12 hours until the patient is clinically well and no longer requires atropine. If intravenous access cannot be established, pralidoxime may also be given intramuscularly. Early administration of diazepam in addition to the combined atropine and pralidoxime treatment may help prevent the onset of seizures and potential brain and cardiac morphologic damage following high-level organophosphate poisoning. As first aid for pulmonary edema, a doctor or authorized paramedic may consider administering a corticosteroid spray.

Personal Protective Methods: Wear protective gloves and clothing to prevent any reasonable probability of dermal and/or eye contact. Safety equipment suppliers/manufacturers can provide recommendations on the most protective glove/clothing material for your operation. One recommendation is the use of DuPont™ Tychem® suit fabrics[88]. All protective clothing (suits, gloves, footwear, headgear) should be clean, available each day, and put on before work. Contact lenses should not be worn when working with this chemical. Wear splash-proof chemical goggles and face shield unless full facepiece respiratory protection is worn. Employees should wash immediately with soap when skin is wet or contaminated. Provide emergency showers and eyewash.

Respirator Selection: SCBA >$\mathbf{15}_{\mathbf{A}}$ mg/m^3 Subscript "**A**" is a 60-minute value. Engineering controls should be used wherever feasible to maintain airborne concentrations of this chemical below the prescribed exposure limit. Respirators and protective equipment are less effective than engineering controls, and should be used only in non-routine or emergency situations which may result in exposure concentrations in excess of the TWA environmental limit. *At any concentrations above the NIOSH REL, or where there is no REL, at any detectable concentration:* SCBAF: Pd,Pp (APF = 10,000) (any NIOSH/MSHA- or European Standard EN 149-approved self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode); or SaF: Pd,Pp: ASCBA (APF = 10,000) (any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary, self-contained breathing apparatus operated in a pressure-demand or other positive-pressure mode).

Storage: Color Code-Blue: Health Hazard/Poison. The premium grade can maintain its biological activity unchanged for approximately 2 years if stored unopened in a cool, shaded, and well-aired place at 20–30 °C. Store in a secure poison location. Prior to working with this chemical you should be trained on its proper handling and storage. Where possible, automatically transfer material from other storage containers to process containers. Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: Organophosphorus pesticides, solid or liquid (nonflammable), require a "poisonous materials" label. This chemical falls in Hazard Class 6.1.

Spill Handling: First remove all sources of ignition. Evacuate persons not wearing protective equipment from area of spill or leak until clean up is complete. Stay upwind; keep out of low areas. Ventilate area of spill or leak. Remove and isolate contaminated clothing at the site. Do not touch spilled material; stop leak if you can do so without risk. Use water spray to reduce vapors. *Small spills:* absorb with sand or other noncombustible absorbent material and place into containers for later disposal. *Large spills:* dike far ahead of spill for later disposal. Collect powdered material in the most convenient and safe manner and deposit in sealed containers. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable. Seek professional environmental engineering assistance from the U.S. EPA Environmental Response Team at (908) 548-8730 (24-hour response line).

Fire Extinguishing: Decomposes in temperatures >170 °C. Hazardous decomposition includes nitrogen oxides, sulfur oxides and phosphorus oxides. May be fatal if inhaled, ingested or absorbed through skin. Inhalation or contact with some of these materials will irritate or burn skin and eyes. Vapors may cause dizziness or suffocation. *Small fires:* dry chemical, carbon dioxide; water spray; or foam. *Large fires:* water spray, fog, or foam. Stay upwind; keep out of low areas. Ventilate closed spaces before entering them. Firefighting gear (including SCBA) may not provide adequate protection. If exposure occurs, remove and isolate gear immediately and thoroughly decontaminate personnel. Wear positive-pressure breathing apparatus and special protective clothing. Remove and isolate contaminated clothing at the site. Move container from fire area if you can do so without risk. Fight fire from maximum distance. Dike fire-control water for later disposal; do not scatter the material. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies. From a secure, explosion-proof location, use water spray to cool exposed containers. If cooling streams are ineffective (venting sound increases in volume and pitch, tank discolors, or shows any signs of deforming), withdraw immediately to a secure position. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode.

Disposal Method Suggested: Destruction by alkali hydrolysis or incineration. Containers must be disposed of properly by following package label directions or by contacting your local or federal environmental control agency, or by contacting your regional EPA office.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- EXTOXNET, Extension Toxicology Network, "Pesticide Information Profile, Malathion," Oregon State University, Corvallis, OR (June 1996). http://extoxnet.orst.edu/pips/malathio.htm
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- New York State Department of Health, "Chemical Fact Sheet: Malathion, " Albany, NY, Bureau of Toxic Substance Assessment (Version 2-March 1986)
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Maleic hydrazide M:0220

Use Type: Herbicide, Plant growth regulator, Fungicide

CAS Number: 123-33-1

Formula: $C_4H_4N_2O_2$

Synonyms: 1,2-Dihydropyridazine-3,6-dione; 1,2-Dihydro-3,6-pyradazinedione; 1,2-Dihydro-3,6-pyridazinedione; ENT 18,870; Hydrazid hydrazida maleica (Spanish); 6-Hydroxy-3(2*H*)-pyridazinone; KMH; MAH; Maleic acid hydrazide; Maleic hydrazide acid; Maleic hydrazine; Maleic hydrazide fungicide; Mazide; *N,N*-maleoylhydrazine; Malzid; 1,2,3-tetrahydro-3,6-dioxopyridazine; MH

Trade Names: BH DOCK KILLER®; BOS MH®; BURTOLIN®; CHEMFORM®; DE-CUT®; DESPROUT D REXEL-SUPER P®; EC 300®; FAIR 30®; FAIR PLUS®; FAIR PS®; MAINTAIN 3®; MALEIN 30®; MALAZIDE®; MH 30®; MH 40®; MH 36 BAYER®; PO-SAN® (with 9*H*-Fluorene-9-carboxylic acid, 2-chloro-9-hydroxy-, methyl ester)®; REGULOX®; REGULOX W®; REGULOX 50W®; RETARD®; ROYAL MH 30®; ROYAL SLO-GRO®; SLO-GRO®; SPROUT-STOP®; STUNTMAN®; SUCKER-STUFF®; SUPER DE-SPROUT®; SUPER SPROUT STOP®; VONDALDHYDE®; VONDRAX®

Chemical class: Pyridazine; Pyridazinone

EPA/OPP PC Code: 051501

California DPR Chemical Code: 368

HSDB Number: 1162

UN/NA & ERG Number: UN3077(solid)/171

RTECS® Number: UR5950000

EC Number: 204-619-9

Uses: Banned for use in EU countries[115]. Actively registered for use in the U.S. Maleic hydrazide is a plant growth regulator (sprout inhibitor) and herbicide that is registered for use on tobacco, potatoes, onions, non-bearing citrus, turf, utility and highway rights-of-way, airports, industrial land, lawns, recreational areas, ornamental/shade trees and ornamental plants. Most of the use of maleic hydrazide in the U.S. is on tobacco.

U.S. Maximum Allowable Residue Levels for Maleic Hydrazide [40 CFR 180.175(a)(1)]: in or on the following raw agricultural commodities: onion, dry bulb 15.0 ppm and potato 50.0 ppm. ***[40 CFR 180.175(a)(2)]:*** may be present in potato chips when used in accordance with the following conditions: (i) The food additive is present as a result of the application of a pesticide formulation containing maleic hydrazide to the growing potato plant in accordance with directions registered by the U.S. EPA. (ii) The label of the pesticide formulation containing the food additive conforms to labeling registered by the U.S. EPA. (iii) The food additive is present in an amount not to exceed 160 ppm by weight of the finished food.

Human toxicity (long-term)[101]: Very low–4000.00 ppb, Health Advisory

Fish toxicity (threshold)[101]: Very low–19952.62315 ppb, MATC (Maximum Acceptable Toxicant Concentration)

Regulatory Authority and Advisory Information:

Carcinogenicity[83]: EPA Group E, evidence of non-carcinogenicity for humans; IARC: Animal Inadequate Evidence; Human No Adequate Data, *not classifiable as carcinogenic to humans*, Group 3, 1987

Acute Oral Category: 4, Caution

Health Advisory: Mutagen

U.S. EPA Hazardous Waste Number (RCRA No.): U148

CERCLA Reportable Quantity (RQ): 5000 lb (2270 kg)

Description: Maleic hydrazide is a colorless crystalline solid. Odorless. Molecular weight = 112.10; Specific gravity (H_2O:1) = 1.62 @ 25°C; Freezing/Melting point = 292°C (decomposes @ 260°C); also reported at >300°C. Hazard Identification (based on NFPA-704 M Rating System): Health 2, Flammability 1, Reactivity 0. Highly soluble in water.

Incompatibilities: Contact with flammable material may cause fire and explosions. Contact with combustible or oxidizable materials may form heat-, shock-, and friction-sensitive explosive mixtures. Static electricity may also cause explosions. Keep away from all acids, especially dibasic organic acids, ammonium compounds, antimony sulfide, arsenic trioxide, metal sulfides, powdered metals, calcium aluminum hydride, cyanides, manganese dioxide, phosphorus, selenium, sulfur, thiocyanates, zinc. May be corrosive to brass and its alloys.

Permissible Exposure Limits in Air: Protective Action Criteria (PAC) Ver. 27[89]

PAC-1: 11 mg/m^3
PAC-2: 130 mg/m^3
PAC-3: 750 mg/m^3

Determination in Air: Filter; none; Gravimetric; NIOSH IV [Particulates NOR; #0500 (total), #0600 (respirable)].[18].

Permissible Concentration in Water: Federal Drinking Water Guidelines: 4000 μg/L; State Drinking Water Guidelines: Maine 3500 μg/L. Runoff from spills or fire control may cause water pollution.

Determination in Water: A lowest-observed-adverse-effect-level (LOAEL) of 500 mg/kg/day has been calculated. On the basis of this, the USEPA has calculated a lifetime health advisory for an adult of 3.5 mg/L. Log K_{ow} = <1.0. Unlikely to bioaccumulate in marine organisms.

Routes of Entry: Inhalation, ingestion, skin and/eye contact. Absorbed through the intact skin

Harmful Effects and Symptoms

Short Term Exposure: Irritation of eyes, skin and mucous membranes. Ingestion can cause tremors and muscle spasms. Sin contact may cause sensitization. LD_{50} (oral, rat) = >3500 mg/kg; LD_{50} (dermal, rat) = >4000 mg/kg.

Long Term Exposure: May cause tumors. May cause liver damage and acute central nervous system effects. May cause mutations (genetic changes).

Points of Attack: Central nervous system, liver, skin.

Medical Surveillance: Preliminary medical exam to detect chronic diseases of central nervous system, liver, heart, kidneys, lung and skin, as well as endocrinological or immunological disturbances, should protect susceptible individuals. Periodical medical exams of internal organs, skin and eyes are important to avoid chronic occupational intoxications. They should include lab and patch tests when necessary[83]. Liver function tests. Examination by a qualified allergist. Tests of the nervous system. Evaluation by a qualified allergist, including exposure history and testing, may help diagnose allergy.

First Aid: *Skin:* Flood all areas of body that have contacted the substance with water. Don't wait to remove contaminated clothing; do it under the water stream. Use soap to help assure removal. Isolate contaminated clothing when removed to prevent contact by others. *Eyes:* Remove any contact lenses at once. Flush eyes well with copious quantities of water or normal saline for at least 20–23 minutes. Seek medical attention. *Inhalation:* Leave contaminated area immediately; breathe fresh air. Proper respiratory protection must be supplied to any rescuers. If coughing, difficult breathing or any other symptoms develop, seek medical attention at once, even if symptoms develop many hours after exposure. *Ingestion:* If convulsions are not present, give a glass or two of water or milk to dilute the substance. Ensure that the person's airway is unobstructed and contact a hospital or poison center immediately for advice on whether or not to induce vomiting

Personal Protective Methods: Wear protective gloves and clothing to prevent any reasonable probability of dermal and/or eye contact. Safety equipment suppliers/manufacturers can provide recommendations on the most protective glove/clothing material for your operation. All protective clothing (suits, gloves, footwear, headgear) should be clean, available each day, and put on before work. Contact lenses should not be worn when working with this chemical. Wear dust-proof chemical goggles and face shield unless full facepiece respiratory protection is worn. Employees should wash immediately with soap when skin is wet or contaminated. Provide emergency showers and eyewash.

Respirator Selection: SCBA >11 mg/m^3. Follow regulations in OSHA 29CFR1910.134 or European Standard EN149. Use a NIOSH/MSHA- or European Standard EN149-approved respirator; or use an approved supplied-air respirator with a full facepiece operated in the positive-pressure mode, or with a full facepiece, hood, or helmet in the continuous-flow mode; or use a NIOSH/MSHA- or European Standard EN149-approved self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive-pressure mode.

Storage: Color Code-Green: General storage may be used. Prior to working with this chemical you should be trained on its proper handling and storage. Store in a refrigerator or a cool, dry place. Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: Environmentally hazardous substances, solid or liquid, usually fall in Hazard Class 9.

Spill Handling: First remove all sources of ignition. Evacuate persons not wearing protective equipment from area of spill or leak until clean up is complete. Dampen spilled material with acetone to avoid dust. Collect powdered material in the most convenient and safe manner and deposit in sealed containers. Ventilate area after clean up is complete. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable.

Fire Extinguishing: Hazardous decomposition includes oxides of nitrogen and carbon. As an immediate precautionary measure, isolate spill or leak area in all directions for at least 50 meters/150 feet for liquids and at least 25 meters/75 feet for solids. *Fire involving storage or vehicular tanks:* isolate for 800 meters/0.5 mile in all directions; also, consider initial evacuation for 800 meters/0.5 mile in all directions. *On a small fire:* use dry chemical, CO_2, water spray or regular foam. *On a large fire:* use water spray, fog or regular foam. Do not scatter spilled material with high-pressure streams of water. Move containers from fire area if you can do it without risk. Dike fire-control water for later disposal. *Fire involving tanks:* from a secure, explosion-proof location, use water spray to cool exposed containers. If cooling streams are ineffective (venting sound increases in volume and pitch, tank discolors, or shows any signs of deforming), withdraw immediately to a secure position. Always stay away from tanks engulfed in fire. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode.

Disposal Method Suggested: Consult with environmental regulatory agencies for guidance on acceptable disposal practices. Generators of waste containing this contaminant (≥100 kg/mo) must conform with EPA regulations governing storage, transportation, treatment, and waste disposal. In accordance with 40CFR165, follow recommendations for the disposal of pesticides and pesticide containers. Containers must be disposed of properly by following package label directions or by contacting your local or federal environmental control agency, or by contacting your regional EPA office.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- USEPA, "Reregistration Eligibility Decision (RED), Maleic Hydrazide," Office of Prevention, Pesticides and Toxic Substances, Washington DC (June 1994). http://www.epa.gov/REDs/0381.pdf
- USEPA, "Health Advisory: Maleic Hydrazide," Washington DC, Office of Drinking Water (August 1987)
- USEPA, Office of Pesticide Programs, Pesticide Residue Limits, "Maleic Hydrazide", 40 CFR 180.175. http://www.epa.gov/pesticides/food/viewtols.htm

Mancozeb M:0235

Use Type: Fungicide

CAS Number: 8018-01-7

Formula: $C_4H_6MnN_2S_4 \cdot C_4H_6N_2S_4Zn$

Synonyms: Carbamodithioic acid, 1,2-ethanediylbis-, manganous zinc salt; Ethylenebis(dithiocarbamic acid manganese zinc complex (8CI); Maneb-zinc; Manganese ethylene-bis(dithiocarbamate)(polymeric) complex with zinc salt; Zinc ion and manganese ethylenebisdithiocarbamate 80%; A coordination product of manganese 16%, zinc 2%, and ethylenebisdithiocarbamate 62%

Trade Names: ACROBAT® (mancozeb+dimethomorph); ASHLAND SOLACE® (cymoxanil+mancozeb); CARMAZINE®; CUPROFIX®; DITHANE®; EMCARB® (mancozeb+carbendez); EMTHANE M-15®; EVOLVE®; F 2966®; FORE®; FORMEC®; GAUCHO® (imidacloprid+mancozeb); GAVEL® (mancozeb+zoxamide); GREEN-DAISEN M®; KARAMATE®; KENCOZEB®; MANCOFOL®; MANOSEB®; MANTOX®; MANZATE 200®; MANZEB®; MANZIN 80®; MARZIN®; MAXIM®; MILOR®; NEMISPOR®; PACE® fungicide (mixture of mancozeb and metalaxyl); PENNCOZEB®; POLICAR®; TRIZIMAN®; TRIZIMAN-D®; VONDOZEB PLUS®; ZIMANAT®; ZIMMAN-DITHANE®; ZIMANEB®

Chemical class: Dithiocarbamate

EPA/OPP PC Code: 014504

California DPR Chemical Code: 211

HSDB Number: 6792

UN/NA & ERG Number: UN2771(solid)/151; UN3077 (solid)/171

RTECS® Number: ZB3200000

EC Number: [*Annex I Index No.:* 006-076-00-1]

Uses: Mancozeb is used to control a wide variety of fungal diseases, including potato blight, leaf spot, scab (on apples and pears), and rust (on roses). It is used on fruits, vegetables, nuts and field crops, and many more. It is also used as a seed treatment of cotton, potatoes, corn, safflower, sorghum, peanuts, tomatoes, flax, and cereal grains.

U.S. Maximum Allowable Residue Levels for Mancozeb (40 CFR 180.176): apples 7 ppm; asparagus 0.1 ppm; banana 4 ppm; banana, pulp 0.5 ppm; barley, grain 5 ppm; barley, milled fractions 20 ppm; barley, straw 25 ppm; beet, sugar 2 ppm; beet, sugar, tops 65 ppm; carrots 2 ppm; celery 5 ppm; corn, fodder 5 ppm; corn, forage 5 ppm; corn, grain, except popcorn 0.1 ppm; corn, fresh, including sweet ppm; corn, kernels plus cob with ppm; husk removed 0.5 ppm; corn, pop, grain 0.5 ppm; cotton, undelinted seed 0.5 ppm; crabapples 10 ppm; cranberry 7 ppm; cucumber 4 ppm; fennel 10 ppm; grape 7 ppm; kidney 0.5 ppm; liver 0.5 ppm; melon 4 ppm; oat, bran 20 ppm; oat, grain 5 ppm; oat, milled fractions 20 ppm; oat, straw 25 ppm; onion, dry bulb 0.5 ppm; papaya 10 ppm; peanut 0.5 ppm; peanut, hay 65 ppm; pear 10 ppm; potato 1 ppm; quince 10 ppm; rye, grain 5 ppm; rye, milled fractions 20 ppm; rye, straw 25 ppm; tomato 4 ppm; wheat, grain 5 ppm; wheat, milled byproducts 20 ppm; wheat, straw 25 ppm.

Human toxicity (long-term)[101]***:*** High–5.82363 ppb, CHCL (Chronic Human Carcinogen Level)

Fish toxicity (threshold)[101]***:*** High–3.16731 ppb, MATC (Maximum Acceptable Toxicant Concentration)

Regulatory Authority and Advisory Information:

Carcinogenicity[83]: EPA Group B2, probable human carcinogen

California Proposition 65 Chemical: Carcinogen (1/1/1990)
Acute Oral Category: 4, Caution, not acutely toxic
Health Advisory: Mutagen, Developmental/Reproductive Toxin (TRI); Endocrine disruptor (probable)
AB 2588-Air Toxics "Hot Spots" Chemicals (CAL) as manganese or zinc compounds
The "Director's List" (CAL/OSHA) as manganese or zinc compounds
Clean Air Act: Hazardous Air Pollutants (Title I, Part A, Section 112) as manganese compounds
EPCRA Section 313: Form R *de minimis* concentration reporting level: 1.0% as manganese compounds
Clean Water Act: Section 307 Toxic Pollutants as zinc compounds
Safe Drinking Water Act: SMCL, 0.05 mg/L as manganese
Safe Drinking Water Act: SMCL, 5 mg/L; Priority List (55 FR 1470) as zinc
European/International Regulations: Hazard Symbol: Xi, N; risk phrases: R43; R50; R63; safety phrases: S2; S36/37, S46; S61 (see Appendix 1)

Description: Grayish-yellow powder. Molecular weight = 266.31; Specific gravity (H_2O:1) = 1.99; Boiling point = (decomposes); Freezing/Melting point = (decomposes). Vapor pressure = very low/negligible. Flash point = >135 °C. Low solubility in water.

Incompatibilities: Combustible material. Dust may form explosive mixture in air. Decomposes in temperatures above 170 °C. Keep away from water, acid, oxidizing materials. Heat, or contact with moisture or acids causes rapid decomposition and the generation of toxic and flammable hydrogen sulfide and carbon disulfide gases. Flammable gases are also generated by reaction with aldehydes, nitrides, and hydrides. Incompatible with oxidizers including peroxides, acids, acid halides, mercury[88]. Corrosive to iron, copper brass and zinc metals, especially in the presence of moisture. Contact with lime, moisture can cause decomposition. Decomposes on prolonged storage. Degradation produces ethylene thiourea.

Permissible Exposure Limits in Air: ACGIH(1) TLV 0.2 mg/m^3 as manganese; OSHA(2) PEL ceiling limit 5 mg/m^3 as manganese; NIOSH(2) 1 mg/m^3 as manganese.

Protective Action Criteria (PAC) Ver. 27[89]
PAC-1: 3 mg/m^3
PAC-2: 2 mg/m^3
PAC-3: 990 mg/m^3

Determination in Air: *Manganese:* Use NIOSH Analytical Method, Elements by ICP, #7300; #7301; #7303; #9102; Elements in blood or tissue, #8005; Metals in urine, #8310; OSHA Analytical Method, ID-125G or ID.

Permissible Concentration in Water: Federal Drinking Water Guidelines: 6 ppb[14]. State Drinking Water Guidelines: Arizona 21 μg/L; Maine 6 μg/L. Canadian Drinking Water Standards: AO $\leq$ 5.0 mg[Zn]/L.

Determination in Water: EPA EMSLC Method 630. The Determination of Dithiocarbamate Pesticides in Municipal and Industrial Wastewater by UV-VIS Spectrophotometry. Log K_{ow} = <1.5. Unlikely to bioaccumulate in marine organisms.

Harmful Effects and Symptoms

Short Term Exposure: Low levels of toxicity but may be a thyroid toxin. Concentrated solutions are slightly corrosive to eyes and mucous membranes. Dust inhalation can cause irritation of the respiratory system with sneezing. Eye contact can cause irritation, watering, pain, and inflammation of the eyelids. Dermal contact can cause irritation and minor ulceration. Ingestion can cause nausea, vomiting, fever, muscle twitching, seizure, rapid respiration, slow heart beat. Severe exposure may result in death. Unlike carbamates the dithiocarbamates are not cholinesterase inhibitors, but some of them may react with recently ingested alcohol or alcohol-containing products including wine, medications, and cold remedies such as cough-syrups. LD_{50} (oral, rat) = >5 g/kg; LD_{50} (dermal, rat) = >5 g/kg.

Long Term Exposure: May cause tumors. May cause thyroid problems. A reproductive toxin (may enlarge ovarian cells). Skin sensitizer.

Points of Attack: Respiratory system, central nervous system, cardiovascular system, skin, eyes.

Medical Surveillance: This chemical is a suspected or known human carcinogen. Exposed persons should contact a physician for advice regarding the possible long term health effects and advice for medical monitoring. There are tests available to measure zinc in your blood, urine, hair, saliva, and feces. High levels of zinc in the feces can mean high recent zinc exposure. High levels of zinc in the blood can mean high zinc consumption and/or high exposure. Tests to measure zinc in hair may provide information on long-term zinc exposure; however, the relationship between levels in your hair and the amount of zinc you were exposed to is not clear. Medical observation is recommended for 24 to 48 hours following breathing overexposure, as pulmonary edema may be delayed. Before employment and at regular times after that, the following are recommended: If symptoms develop or overexposure occurs, repeat the above tests as soon as possible and get an exam of the nervous system. Also consider complete blood count and chest x-ray following acute overexposure. Evaluation by a qualified allergist, including exposure history and testing, may help diagnose allergy.

First Aid: If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least 15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately. If this chemical contacts the skin, remove contaminated clothing and wash immediately with soap and water. Seek medical attention immediately. If this chemical has been inhaled, remove from exposure, begin rescue breathing (using universal precautions) if breathing has stopped, and CPR if heart action has stopped. Transfer promptly to a medical facility. When this chemical has been swallowed, get medical attention. If victim is conscious and able to swallow, have victim drink 4 to 8 ounces of water. Do not induce vomiting. *Note to physician or authorized medical personnel*: Medical observation is recommended for 24 to 48 hours following breathing overexposure, as pulmonary edema may be delayed. As first aid for pulmonary edema, a doctor or authorized paramedic might consider administering a corticosteroid spray. Cigarette smoking may exacerbate pulmonary injury and should be discouraged for at least 72 hours following exposure.

Personal Protective Methods: Reacts with the following absorbent materials: Cellulose-Based; Mineral- and Clay-Based; Dirt/Earth[88]. Wear protective gloves and clothing to prevent any reasonable probability of dermal and/or eye contact. Safety equipment suppliers/manufacturers can provide recommendations on the most protective glove/clothing material for your operation. All protective clothing (suits, gloves, footwear, headgear) should be clean, available each day, and put on before work. Contact lenses should not be worn when working with this chemical. Wear splash-proof chemical goggles and face shield unless full facepiece respiratory protection is worn. Employees should wash immediately with soap when skin is wet or contaminated. Provide emergency showers and eyewash.

Respirator Selection: SCBA >3 mg/m^3. NIOSH: *At any detectable concentration*: SCBAF: Pd,Pp (APF = 10,000) (any NIOSH/MSHA- or European Standard EN 149-approved self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode); or SaF: Pd,Pp: ASCBA (APF = 10,000) (any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary, self-contained breathing apparatus operated in a pressure-demand or other positive-pressure mode). *Escape:* 100 F (APF = 50) (any air-purifying, full facepiece respirator with an N100, R100, or P100 filter k-mounted organic vapor canister having a high-efficiency particulate filter); or SCBAE (any appropriate escape-type, self-contained breathing apparatus).

Storage: Color Code-Blue: Health Hazard/Poison. Store in a secure poison location. Prior to working with this chemical you should be trained on its proper handling and storage. Store in tightly closed containers in a cool, well-ventilated area away from oxidizers. Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: Thiocarbamate and dithiocarbamate pesticides, solid, toxic require a label of "poisonous materials." They usually fall in Hazard Class 6.1.

Spill Handling: First remove all sources of ignition. Evacuate persons not wearing protective equipment from area of spill or leak until clean up is complete. Collect powdered material in the most convenient and safe manner and deposit in sealed containers. Ventilate area after clean up is complete. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable.

Fire Extinguishing: Hazardous decomposition includes oxides of nitrogen and sulfur. Combustible. Extinguish fire using an agent suitable for type of surrounding fire. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies. From a secure, explosion-proof location, use water spray to cool exposed containers. If cooling streams are ineffective (venting sound increases in volume and pitch, tank discolors, or shows any signs of deforming), withdraw immediately to a secure position. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode.

Disposal Method Suggested: Do not discharge into drains or sewers. Dispose of waste material as hazardous waste using a licensed disposal contractor to an approved landfill. Consult with environmental regulatory agencies for guidance on acceptable disposal practices. A potential candidate for liquid injection incineration at a temperature range of 650 to 1,600°C and a residence time 0.1 to 2 seconds. Also, a potential candidate for rotary kiln incineration at a temperature range of 820 to 1,600°C and residence times of seconds for liquids and gases, and hours for solids[83]. Containers must be disposed of properly by following package label directions or by contacting your local or federal environmental control agency, or by contacting your regional EPA office.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- EXTOXNET, Extension Toxicology Network, "Pesticide Information Profile, Mancozeb," Oregon State University, Corvallis, OR (June 1996). http://extoxnet.orst.edu/pips/mancozeb.htm
- USEPA, Office of Pesticide Programs, "Pesticide Residue Limits, Mancozeb," 40 CFR 180.176. http://www.epa.gov/pesticides/food/viewtols.htm

Maneb M:0240

Use Type: Fungicide

CAS Number: 12427-38-2

Formula: $C_4H_6MnN_2S_4$

Synonyms: Carbamic acid, ethylenebis(dithio-), manganese salt; Carbamodithioic acid, 1,2-ethanediylbis-, manganese salt; EBDC; ENT 14,875; 1,2-Ethanediylbis (carbamodithioato)(2-)-manganese; 1,2-Ethanediylbiscarbamodithioic acid, manganese complex; 1,2-Ethanediylbiscarbamodithioic acid, manganese(2+) salt(1:1); 1,2-Ethanediylbismaneb, manganese (2+) salt (1:1); Ethylenebisdithiocarbamate manganese; Ethylenebis(dithiocarbamato), manganese;

Ethylenebis(dithiocarbamic acid), manganese salt; Ethylenebis(dithiocarbamic acid) manganous salt; 1,2-Ethylenediylbis(carbamodithioato)manganese; Manganese ethylene-1,2-bisdithiocarbamate; Manganese(II) ethylene di(dithiocarbamate); Manganous ethylenebis(dithiocarbamate); MEB; MNEBD

Trade Names: (The U.S. EPA lists more than 460 active and/or canceled products containing maneb) AAMANGAN®; AKZO CHEMIE MANEB®; BASF-MANEB SPRITZPULVER®; BAVISTIN M®; COSMIC®; CHEM NEB®; CHLOROBLE M®; CLEANACRES®; CR 3029®; DELSENE M FLOWABLE®; DITHANE-22®; F 10®; FARMANEB®; IDA MANEB®; KASCADE®; KYPMAN 80®; LONOCOL M®; MANAM®; MANEB 80®; MANEBA®; MANEBE®; MANEBGAN®; MANESAN®; MANESAN®; MANEX®; MANOC®; MANZATE®; MANZATE D®; MANZATE MANEB FUNGICIDE®; MANZEB®; MANZI®; M-DIPHAR®; MULTI-W®; NEREB®; NESPOR®; NEWSPOR®; PLANTIFOG 160M®; POLYRAM M®; REMASAN CHLOROBLE M®; RHODIANEHE®; SOPRANEBE®; SQUADRON AND QUADRANGLE MANEX®; SUPERMAN MANEB F®; SUP'R FLO®; TERSAN-LSR®; TRIMANGOL®; TRIMANOC®; TRITHAC®; TUBOTHANE®; UNICROP MANEB®; VANCIDE®; VANCIDE MANEB 80®; VASSGRO MANEX®; VITAVAX® Maneb

Chemical class: Dithiocarbamate

EPA/OPP PC Code: 014505

California DPR Chemical Code: 369

HSDB Number: 4063

UN/NA & ERG Number: UN2210 (Maneb preparation, with not <60% maneb)/135; UN2968 (Maneb, stabilized against self-heating)/135

RTECS® Number: OP0700000

EC Number: 235-654-8 [*Annex I Index No.:* 006-077-00-7]

Uses: Maneb is an ethylene(bis)dithiocarbamate fungicide used in the control of early and late blights on potatoes and tomatoes and many other diseases of fruits, vegetables, field crops, and ornamentals. Maneb controls a wider range of diseases than other fungicides. It is available as granular, wettable powder, flowable concentrate, and ready-to-use formulations. Maneb is widely used by itself and in combination with other pesticides on a variety of crops. Principal uses in California are for head and leaf lettuce, walnuts, almonds, onions, potatoes and broccoli.

U.S. Maximum Allowable Residue Levels for Maneb [40 CFR 180.110 (a)]: almond 0.1 ppm; apple 2 ppm; apricot 10 ppm; banana 4 ppm; banana, pulp 0.5 ppm; bean, dry 7 ppm; bean, succulent 10 ppm; beet, sugar, tops 45 ppm; broccoli 10 ppm; Brussels sprouts 10 ppm; cabbage 10 ppm; cabbage, chinese, bok choy 10 ppm; carrot, roots 7 ppm; cauliflower 10 ppm; celery 5 ppm; collards 10 ppm; corn, sweet, kernel plus ppm; cob with husks removed 5 ppm; cranberry 7 ppm; cucumber 4 ppm; eggplant 7 ppm; endive 10 ppm; fig 7 ppm; grape 7 ppm; kale 10 ppm; kohlrabi 10 ppm; lettuce 10 ppm; melon 4 ppm; mustard greens 10 ppm; nectarine 10 ppm; onion 7 ppm; papaya 10 ppm; peach 10 ppm; pepper 7 ppm; potato 0.1 ppm; pumpkin 7 ppm; squash, summer 4 ppm; squash, winter 4 ppm; tomato 4 ppm; turnip, greens 10 ppm; turnip, roots 7 ppm; walnut 0.05 ppm.

Human toxicity (long-term)[101]: High–5.73770 ppb, CHCL (Chronic Human Carcinogen Level)

Fish toxicity (threshold)[101]: Extra high–0.00193 ppb, MATC (Maximum Acceptable Toxicant Concentration)

Regulatory Authority and Advisory Information:

Carcinogenicity[83]: EPA Group B2, probable human carcinogen.

California Proposition 65 Chemical: Cancer (1/1/1990)

Health Advisory: Mutagen, Developmental/Reproductive Toxin, Endocrine disruptor (S!), Increased Thyroid Weight

Acute Oral Category: 3, CAUTION

EPCRA Section 313 Form R *de minimus* concentration reporting level: 1.0%

U.S. DOT Regulated Marine Pollutant (49CFR172.101, Appendix B)

Safe Drinking Water Act: SMCL, 0.05 mg/L as manganese

European/International Regulations: Hazard Symbol: Xi, Xn, N; risk phrases: R20; R36; R43; R63; R50/53; safety phrases: S2; S36/37; S46; S60; S61 (see Appendix 1)

Description: Maneb is a yellow powder or crystalline solid. Faint odor. Molecular weight = 265.30; Specific gravity (H_2O:1) = 1.97 @ 25 °C; Boiling point = (decomposes); Freezing/Melting point = (decomposes) <195 °C; Vapor pressure = 7.5×10^{8} mmHg @ 25 °C[83,USDA]. Hazard Identification (based on NFPA-704 M Rating System): Health 3, Flammability 3, Reactivity 1. Moderately soluble in water. This material is spontaneously combustible and can be dangerous when wet.

Incompatibilities: Combustible material. Contact with air or water may generate heat spontaneously; heat may be sufficient to ignite the material. Decomposes in temperatures >195 °C. Dust may form explosive mixture in air. Water, acid, oxidizing materials. Heat, or contact with moisture or acids causes rapid decomposition and the generation of toxic and flammable hydrogen sulfide and carbon disulfide. Flammable gases are generated by reaction with aldehydes, nitrides, and hydrides. Incompatible with oxidizers including peroxides, acids, acid halides, mercury[88]. Decomposition products in fire include oxides of nitrogen and sulfur. Corrosive to iron, copper brass and zinc metals, especially in the presence of moisture. Heat alkalies (lime), moisture can cause decomposition. Decomposes on prolonged storage. Degradation produces ethylene thiourea.

Permissible Exposure Limits in Air: OSHA PEL: 5 mg[Mn]/m^3 Ceiling Concentration

NIOSH REL: 1 mg[Mn]/m^3 TWA; 3 mg[Mn]/m^3 STEL

ACGIH TLV: 5 mg[Mn]/m^3 TWA

DFG MAK: Danger of skin sensitization.

Permissible Concentration in Water: Federal Drinking Water Guidelines: 6 ppb[14]. State Drinking Water Guidelines: Arizona 35 μg/L; Maine 6 μg/L; Florida 75 μg/L. Runoff from spills or fire control may cause water pollution.

Determination in Water: EPA EMSLC Method 630. The Determination of Dithiocarbamate Pesticides in Municipal and Industrial Wastewater by UV-VIS Spectrophotometry. Log K_{ow} = 0.62[83]. Unlikely to bioaccumulate in marine organisms.

Routes of Entry: Inhalation, ingestion, eye and/or dermal contact.

Harmful Effects and Symptoms

Short Term Exposure: Maneb irritates the eyes, skin, and respiratory tract. Maneb is low in acute toxicity and does not present alarming properties during long-term administration to experimental animals, except at very high dosages. However, it is a material of concern because of evidence of mutagenic and teratogenic effects as well as the possibility of nitrosation to carcinogenic nitrosamines. Unlike carbamates the dithiocarbamates are not cholinesterase inhibitors, but some of them may react with recently ingested alcohol or alcohol-containing products including wine, medications, and cold remedies such as cough-syrups. LD_{50} (oral, rat) = 3 g/kg; LD_{50} (dermal, rat) = >5 g/kg[9].

Long Term Exposure: May cause tumors. Repeated dermal contact can cause skin sensitization and rash. High or repeated exposures may interfere with thyroid function (causing goiter), damage the central nervous system, affect liver function, or cause kidney damage. May cause reproductive and fetal effects.

Points of Attack: Skin, thyroid, liver, kidneys, central nervous system, reproductive system. Reproductive cells.

Medical Surveillance: This chemical is a suspected or known human carcinogen. Exposed persons should contact a physician for advice regarding the possible long term health effects and advice for medical monitoring. If symptoms develop or overexposure is suspected, the following may be useful: Exam of the nervous system. Thyroid function tests. Consider kidney and liver function tests with higher or repeated exposures. Evaluation by a qualified allergist, including exposure history and testing, may help diagnose allergy. In addition to comprehensive initial medical and work histories emphasizing reproductive experience and menstrual history, patient should have physical examination and testing of genito-urinary tract, sperm count, motility and morphology. If required, other tests, such as serum testosterone, serum follicle stimulating hormone (FSH), and serum lutenizing hormone (LH), may be indicated.

First Aid: If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least 15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately. If this chemical contacts the skin, remove contaminated clothing and wash immediately with soap and water. Seek medical attention immediately. If this chemical has been inhaled, remove from exposure, begin rescue breathing (using universal precautions) if breathing has stopped, and CPR if heart action has stopped. Transfer promptly to a medical facility. When this chemical has been swallowed, get medical attention. Give large quantities of water and induce vomiting. Do not make an unconscious person vomit.

Personal Protective Methods: Reacts with the following absorbent materials: Cellulose-Based; Mineral- and Clay-Based; Dirt/Earth[88]. Wear protective gloves and clothing to prevent any reasonable probability of dermal and/or eye contact. Safety equipment suppliers/manufacturers can provide recommendations on the most protective glove/clothing material for your operation. All protective clothing (suits, gloves, footwear, headgear) should be clean, available each day, and put on before work. Contact lenses should not be worn when working with this chemical. Wear dust-proof chemical goggles and face shield unless full facepiece respiratory protection is worn. Employees should wash immediately with soap when skin is wet or contaminated. Provide emergency showers and eyewash.

Respirator Selection: Where potential exists for exposure to maneb, use a NIOSH/MSHA- or European Standard EN149-approved supplied-air respirator with a full facepiece operated in the positive-pressure mode, or with a full facepiece, hood, or helmet in the continuous-flow mode; or use a NIOSH/MSHA- or European Standard EN149-approved self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive-pressure mode.

Storage: Color Code (liquid)-Red: Flammability Hazard: Store in a flammable liquid storage area or approved cabinet away from ignition sources and corrosive and reactive materials. Prior to working with this chemical you should be trained on its proper handling and storage. Maneb must be stored to avoid contact with water, since violent reactions occur. Store in tightly closed containers in a cool, well-ventilated area away from acids, moisture, heat, and oxidizing materials. Where possible, automatically transfer material from drums or other storage containers to process containers. A regulated, marked area should be established where this chemical is handled, used, or stored in compliance with OSHA Standard 1910.1045. Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: Maneb or maneb preparations with not <60 % maneb require labels of 4.2–Spontaneously combustible material & 4.3 Dangerous when wet. Maneb falls in Hazard Class 4.2.

Spill Handling: First remove all sources of ignition. Evacuate persons not wearing protective equipment from area of spill or leak until clean up is complete. Use HEPA vacuum or wet method to reduce dust during clean up . Do not dry sweep. Collect powdered material in the most convenient and safe manner and deposit in sealed containers. Ventilate area after clean up is complete. Keep maneb out of a confined space, such as a sewer, because of the possibility of an explosion, unless the sewer is designed to prevent the build-up of explosive concentrations. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable.

Fire Extinguishing: *Highly flammable and dangerous when wet.* Hazardous decomposition includes nitrogen oxides, hydrogen sulfide; sulfur oxides, and carbon disulfide. Use dry chemical, soda ash; *dry* sand, or lime extinguishers. *Do not use water or* foam. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies. From a secure, explosion-proof location, use water spray to cool exposed containers. If cooling streams are ineffective (venting sound increases in volume and pitch, tank discolors, or shows any signs of deforming), withdraw immediately to a secure position. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode.

Disposal Method Suggested: Maneb is unstable to moisture and is hydrolyzed by acids and hot water. It decomposes at about 100 °C but may spontaneously decompose vigorously when stored in bulk. Incineration is the preferred disposal means. Containers must be disposed of properly by following package label directions or by contacting your local or federal environmental control agency, or by contacting your regional EPA office.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- EXTOXNET, Extension Toxicology Network, "Pesticide Information Profile," Oregon State University, Corvallis, OR (June 1996). http://extoxnet.orst.edu/pips/maneb.htm
- USEPA, Office of Pesticide Programs, Pesticide Residue Limits, "Maneb," ***40 CFR 180.110***, http://www.epa.gov/pesticides/food/viewtols.htm
- New Jersey Department of Health and Senior Services, "Hazardous Substance Fact Sheet: Maneb," Trenton, NJ (November 1999). http://www.state.nj.us/health/eoh/rtkweb/1154.pdf

MCPA M:0290

Use Type: Herbicide

CAS Number: 94-74-6; 25319-90-8 (-thioethyl)

Formula: $C_9H_9ClO_3$; $C_{11}H_{13}ClO_2S$ (-thioethyl)

Synonyms: Acetic acid (4-chloro-2-methylphenoxy)-; Acetic acid [(4-chloro-*o*-tolyl)-oxy]-; BH MCPA; (4-Chloro-*o*-cresoxy)acetic acid; 4-Chloro-*o*-cresoxyacetic acid; (4-Chloro-2-methylphenoxy)acetic acid; 4-Chloro-2-methylphenoxyacetic acid; 4-Chloro-*o*-toloxyacetic acid; (4-Chloro-*o*-toloxy)acetic acid; [(4-Chloro-*o*-tolyl)oxy] acetic acid; MCP; Methoxone; Methylchlorophenoxyacetic acid; 2-Methyl-4-chlorophenoxyacetic acid; (2-Methyl-4-chlorophenoxy)acetic acid

Trade Names: ACME MCPA AMINE 4®; AGRITOX®; AGROXONE®; AGROZONE®; AGSCO®; ANICON KOMBI®; ANICON M®; BANLENE®; BLESEL MC®; BORDERMASTER®; BROMINAL M & PLUS®; CAMBILENE®; CHEYENNE®; CHIMAC OXY®; CHIPTOX®; CHWASTOX®; CORNOX M®; DAKOTA®; DED WEED®; DICOPUR-M®; DICOTEX®; DOW MCP AMINE WEED KILLER®; DYVEL®; EH1356 HERBICIDE®; EMCEPAN®; EMPAL®; ENVOY®; HEDAPUR M 52®; HEDAREX M®; HEDONAL M®; HERBICIDE M®; HORMOTUHO®; HORNOTUHO®; KILSEM®; 4 K-2 M®; KVK®; LEGUMEX DB®; LEUNA M®; LEYSPRAY®; LINORMONE®; M 40®; 2 M-4C®; 2 M-4KH®; MALERBANE®; MAYCLENE®; MEPHANAC®; MIDOX®; MXL®; OKULTIN®; PHENOXYLENE 50®; PHENOXYLENE PLUS®; PHENOXYLENE SUPER®; RAZOL DOCK KILLER®; RHOMENE®; RHONOX®; SHAMOX®; B-SELEKTONON M®; SEPPIC MMD®; TILLER®; TRIMEC®; U 46®; VACATE®; VESAKONTUHO®; WEEDAR®; WEEDAR MCPA CONCENTRATE®; WEEDONE MCPA ESTER®; WEED RHAP®; ZELAN®

Chemical class: Chlorophenoxy; Phenoxyacetic acid; Aryloxyalkanoic

EPA/OPP PC Code: 030501; 431500 (-thioethyl)

California DPR Chemical Code: 2326

HSDB Number: 1127

UN/NA & ERG Number: UN3345 (solid)/153; UN3348 (liquid)/153

RTECS® Number: AG1575000

EC Number: 202-360-6 [*Annex I Index No.:* 607-051-00-3]

Uses: A U.S. EPA restricted Use Pesticide (RUP) as MCPA, sodium salt. MCPA is a systemic post-emergence phenoxy herbicide used to control broadleaf annual and perennial weeds (including thistle and dock) in cereals, flax, rice, vines, peas, potatoes, grasslands, forestry applications, and on rights-of-way. It is very compatible with many other compounds and may be used in formulation with many other products, including bentazone, bromoxynil, 2,4-D, dicamba, fenoxaprop, MCPB, mecoprop, thifensulfuron, and tribenuron.

U.S. Maximum Allowable Residue Levels for Tolerances are established for residues of the herbicide 2-methyl-4-chlorophenoxyacetic acid from application of the herbicide in the acid form or in the form of its sodium, ethanolamine, diethanolamine, triethanolamine, isopropanolamine, diisopropanolamine, triisopropanolamine, or dimethylamine salts or its isooctyl or butoxyethyl esters [40 CFR 180.339(a)]: in or on raw agricultural commodities as follows: alfalfa 0.1 ppm; alfalfa, hay 0.1 ppm; barley, grain 0.1 ppm (N); barley straw 2 ppm; clovers 0.1 ppm; clover, hay 0.1 ppm; flax, straw 2 ppm; flaxseed 0.1 ppm (N); grasses, pasture 300 ppm; grasses, rangeland 300 ppm; grass, canary, annual seed 0.1 ppm; grass, canary, annual, straw 0.1 ppm; grass, hay 20 ppm; lespedeza 0.1 ppm; lespedeza, hay 0.1 ppm; oats, forage 20 ppm; oats, grain 0.1 ppm; oats, straw 2 ppm; peas 0.1 ppm (N); peavines 0.1 ppm (N); peavines, hay 0.1 ppm (N); rice, grain 0.1 ppm (N); rice, straw 2 ppm; rye, forage 20 ppm; rye, grain 0.1 ppm (N); rye, straw 2 ppm; sorghum, fodder 20 ppm; sorghum, forage 20 ppm; sorghum, grain 0.1 ppm; trefoils 0.1 ppm; trefoil, hay 0.1 ppm; vegetables, seed and pod 0.1 ppm; vetches 0.1 ppm; vetch, hay 0.1 ppm; wheat, forage 20 ppm; wheat, grain 0.1 ppm (N); wheat, straw 2 ppm. *For combined negligible residues (***N***) of the herbicide 2-methyl-4-chlorophenoxyacetic acid and its metabolite 2-methyl-4-chlorophenol* ***[40 CFR 180.339(b)]:*** in or on the following raw agicultural commodities: cattle, fat 0.1 ppm (N); cattle, meat byproducts 0.1 ppm (N); cattle, meat 0.1 ppm (N); goats, fat 0.1 ppm (N); goats, meat byproducts 0.1 ppm (N); goats, meat 0.1 ppm (N); hogs, fat 0.1 ppm (N); hogs, meat byproducts 0.1 ppm (N); hogs, meat 0.1 ppm (N); horses, fat 0.1 ppm (N); horses, meat byproducts 0.1 ppm (N); horses, meat 0.1 ppm (N); milk 0.1 ppm (N); sheep, fat 0.1 ppm (N); sheep, meat byproducts 0.1 ppm (N); and sheep, meat 0.1 ppm (N). (N) = negligible amount of residue.

Human toxicity (long-term)[101]: High–4.00 ppb, Health Advisory

Fish toxicity (threshold)[101]: Very low–17986.45312 ppb, MATC (Maximum Acceptable Toxicant Concentration)

Regulatory Authority and Advisory Information:

Carcinogenicity[83]: EPA, Not likely to be carcinogenic to humans.

Acute Oral Category: 2, WARNING

Health Advisory: Mutagen, Developmental/Reproductive Toxin (S!), Skin irritant/sensitizer.

EPCRA Section 313 Form R *de minimus* concentration reporting level: 0.1%

AB 2588-Air Toxics "Hot Spots" Chemicals (CAL) as chlorophenoxy pesticides

European/International Regulations: Hazard Symbol: Xi; Xn; risk phrases: R22; R38/R41; R50/53; safety phrases: S2; S26; S37; S39; S60; S61 (see Appendix 1)

WGK (German Aquatic Hazard Class): 2-Hazard to waters

Description: MCPA is a white to tan crystalline solid. Available commercially in various forms including emulsifiable concentrates and as amines, salts, and esters. Molecular weight = 200.63; Specific gravity (H_2O:1) = 1.41; 1.56; Boiling point = (decomposes); Freezing/Melting point = 118–119 °C; Vapor pressure = 1.5×10^6 mmHg @ 20 °C; 200 mmHg @ 21 °C. The acid is very slightly soluble in water; solubility = 725 ppm. Solubility of the salt and amine are high. An Arizona State University data base (Aquasol) lists solubility at 630 mg/L. Physical and toxicological properties may be affected by carrier solvents in commercial formulations.

Incompatibilities: A weak acid. Incompatible with alkalies. Decomposes in temperatures above 290 °C. The ester reacts with acids to liberate heat along with alcohols and acids. Strong oxidizing acids may cause a vigorous reaction that is sufficiently exothermic to ignite the reaction products. Heat is also generated by the interaction of esters with caustic solutions. Flammable hydrogen is generated by mixing esters with alkali metals and hydrides.

Permissible Exposure Limits in Air: No standards set. Poland: MAC (TWA) 1 mg/m^3, MAC (STEL) 3 mg/m^3, 1999.

Permissible Concentration in Water: Federal Drinking Water Guidelines: 4 ppb[93]; EPA Health Advisory 30 μg/L; State Drinking Water Guidelines: Minnesota 3 μg/L; Maine 4 μg/L; Florida 1000 μg/L. Runoff from spills or fire control may cause water pollution.

Determination in Water: Log K_{ow} = 2.6. Unlikely to bioaccumulate in marine organisms.

Routes of Entry: Inhalation, ingestion, skin and/or eye contact.

Harmful Effects and Symptoms

Short Term Exposure: Irritates the eyes, skin, and respiratory tract. Can cause nausea, vomiting, diarrhea and abdominal pain. The approximate lethal dose to a 150 lb man is 3.3 tablespoonfuls. LD_{50} (oral, human) = 800 mg/kg; LD_{50} (dermal, rat) = >1 g/kg.

Long Term Exposure: May cause tumors. Animal tests show that this substance possibly causes toxic effects upon human reproduction. May cause hypotension; decreased blood pressure. May be a neurotoxin and a skin sensitizer.

Points of Attack: Central nervous system. Liver and kidneys and central nervous system. Reproductive cells.

Medical Surveillance: Preliminary medical exam to detect chronic diseases of central nervous system, liver, heart, kidneys, lung and skin, as well as endocrinological or immunological disturbances, should protect susceptible individuals. Periodical medical exams of internal organs, skin and eyes are important to avoid chronic occupational intoxications. They should include lab and patch tests when necessary[83]. Monitor blood pressure. Liver function tests. In addition to comprehensive initial medical and work histories emphasizing reproductive experience and menstrual history, patient should have physical examination and testing of genito-urinary tract, sperm count, motility and morphology. If required, other tests, such as serum testosterone, serum follicle stimulating hormone (FSH), and serum lutenizing hormone (LH), may be indicated. Evaluation by a qualified allergist, including exposure history and testing, may help diagnose allergy.

First Aid: If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least 15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately. If this chemical contacts the skin, remove contaminated clothing and wash immediately with soap and water. Seek medical attention immediately. If this chemical has been inhaled, remove from exposure, begin rescue breathing (using universal precautions) if breathing has stopped, and CPR if heart action has stopped. Transfer promptly to a medical facility. When this chemical has been swallowed, get medical attention. Give large quantities of water and induce vomiting. Do not make an unconscious person vomit.

Personal Protective Methods: Wear protective gloves and clothing to prevent any reasonable probability of dermal and/or eye contact. Safety equipment suppliers/manufacturers can provide recommendations on the most protective glove/clothing material for your operation. All protective clothing (suits, gloves, footwear, headgear) should be clean, available each day, and put on before work. Contact lenses should not be worn when working with this chemical. Wear dust-proof chemical goggles and face shield unless full facepiece respiratory protection is worn. Employees should wash immediately with soap when skin is wet or contaminated. Provide emergency showers and eyewash.

Respirator Selection: Follow regulations in OSHA 29CFR1910.134 or European Standard EN149. Use a NIOSH/MSHA- or European Standard EN149-approved respirator; or use an approved supplied-air respirator with a full facepiece operated in the positive-pressure mode, or with a full facepiece, hood, or helmet in the continuous flow mode; or use a NIOSH/MSHA- or European Standard EN149-approved self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive-pressure mode.

Storage: Color Code-Blue: Health Hazard/Poison: Store in a secure poison location. Prior to working with this chemical you should be trained on its proper handling and storage. Store in tightly closed containers in a cool, well-ventilated area. A regulated, marked area should be established where this chemical is handled, used, or stored in compliance with OSHA Standard 1910.1045. Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: Phenoxyacetic acid derivative pesticide, solid or liquid, toxic require a shipping label of "poisonous materials" and fall in Hazard Class 6.1.

Spill Handling: First remove all sources of ignition. Evacuate persons not wearing protective equipment from area of spill or leak until clean up is complete. Collect powdered material in the most convenient and safe manner and deposit in sealed containers. Ventilate area after clean up is complete. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable. Also, can be precipitated with divalent cations. Carbon or peat can be used as sorbents.

Fire Extinguishing: Hazardous decomposition includes hydrogen chloride and oxides of nitrogen and carbon. Solid material not combustible. Liquid formulations containing organic solvents may be flammable. Use dry chemical, carbon dioxide; water spray; or alcohol foam extinguishers. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies. From a secure, explosion-proof location, use water spray to cool exposed containers. If cooling streams are ineffective (venting sound increases in volume and pitch, tank discolors, or shows any signs of deforming), withdraw immediately to a secure position. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode.

Disposal Method Suggested: Incineration with added flammable solvent; incinerator equipped with fume scrubber. Containers must be disposed of properly by following package label directions or by contacting your local or federal environmental control agency, or by contacting your regional EPA office.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- EXTOXNET, Extension Toxicology Network, "Pesticide Information Profile, MCPA," Oregon State University, Corvallis, OR (June 1996). http://extoxnet.orst.edu/pips/MCPA.htm
- USEPA, Office of Pesticide Programs, Pesticide Residue Limits, "MCPA Salts and Esters," ***40 CFR 180.339***. http://www.epa.gov/pesticides/food/viewtols.htm
- New Jersey Department of Health and Senior Services, "Hazardous Substance Fact Sheet 4-Chloro-2-methylphenoxyacetic acid," Trenton, NJ (August 2000). http://www.state.nj.us/health/eoh/rtkweb/3094.pdf
- USEPA, Initial Scientific and Minieconomic Review No. 21: MCPA, Washington DC, Office of Pesticide Programs (1975)
- USEPA, "Health Advisory: MCPA," Washington DC, Office of Drinking Water (August 1987)
- Sax, N. I., Ed., "Dangerous Properties of Industrial Materials Report," 8, No. 6, 35-41 (1988)

MCPB M:0292

Use Type: Herbicide

CAS Number: 94-81-5

Formula: $C_{11}H_{13}ClO_2$

Synonyms: Butanoic acid, 4-(4-chloro-2-methylphenoxy)-; Butyric acid, 4-[(4-chloro-o-tolyl)oxy]-; 4-(4-Chloro-2-methylphenoxy)butanoic acid; gamma-(4-Chloro-2-methylphenoxy)butyric acid; 4-Chloro-2-methylphenoxy butyric acid; 4-(4-Chloro-2-methylphenoxy)butyric acid; (4-Chloro-o-tolyloxy)butyric acid; 4-[4-Chloro-o-tolyl)oxy]butyric acid; *S*-Ethyl(4-chloro-2-methylphenoxy)ethanethioate; 4-(MCB); *gamma*-MCPB; 2,4-MCPB; MCP-butyric; *gamma*-2-Methyl-4-chlorophenoxybutyric acid; 2-Methyl-4-chlorophenoxybutyric acid; 4-(2-Methyl-4-chlorophenoxy)butyric acid

Trade Names: 2M-4Kh-M; 2M4KhM; 2M-4XM; 4MCPB; BEXANE; BEXONE; U46 MCPB; LEGUMEX; PDQ; THITROL; TRIFOLEX; TRITROL; TROTOX

Chemical class: Chlorophenoxy; Aryloxyalkanoic acid; Phenoxybutyric

EPA/OPP PC Code: 019201

California DPR Chemical Code: 5055

HSDB Number: 1737

UN/NA&ERG Number: UN3345 (solid)/153; UN3348 (liquid)/153

RTECS® Number: ES8575000

EC Number: 202-365-3 [*Annex I Index No.:*607-053-00-4]

Uses: A metabolite of MCPA (see above). MCPB is a phenoxy herbicide produced as a sodium salt and an acid. Herbicide registered for use on peas prior to flowering. There are no residential uses of MCBP. Target organisms: post-emergence control of Canadian thistle, buttercup, mustard, purslane, ragweed, common lambsquarters, pigweed, smartweed, sowthistle, morning glory and other broad leaf weeds[83].

U.S. Maximum Allowable Residue Levels for MCPA [40 CFR 180.318]: pea (green and dry) 0.1 (N) ppm. (N) = negligible amount of residue.

Regulatory Authority and Advisory Information:

Carcinogenicity[83]: EPA, Not likely to be carcinogenic to humans

Health Advisory: Nerve Toxin (?), Mutagen (S!)

Acute Oral Category: 3, CAUTION

European/International Regulations: Hazard Symbol: N; risk phrases: R50/53; safety phrases: S2; S60; S61 (see Appendix 1)

Description: White crystalline solid; Commercial product is available as an emulsifiable concentrate. Molecular weight = 228.68; Specific gravity (H_2O:1) = 1.23 @ 25 °C; Boiling point = >350 °C; Freezing/Melting point = 98–100 °C; Vapor pressure = 4×10^7 mmHg @ 20 °C; Flash point = 192 °C. Solubile in water; solubility = >40 mg/L.

Incompatibilities: Strong oxidizers.

Determination in Water: Log K_{ow} = <2. Unlikely to bioaccumulate in marine organisms.

Routes of Entry: Dermal, eyes, ingestion, inhalation.

Harmful Effects and Symptoms

Short Term Exposure: Irritates the eyes, skin, and respiratory tract. May cause eye pain and is capable of causing irreversible eye damage. LD_{50} (oral, rat) = <1000[9]–4000 mg/kg[83]; (dermal, rat) > 2 g/kg[83].

Long Term Exposure: May cause reproductive and fetal effects.

Points of Attack: Eyes. Reproductive cells.

Medical Surveillance: In addition to comprehensive initial medical and work histories emphasizing reproductive experience and menstrual history, patient should have physical examination and testing of genito-urinary tract, sperm count, motility and morphology. If required, other tests, such as serum testosterone, serum follicle stimulating hormone (FSH), and serum lutenizing hormone (LH), may be indicated. Preliminary medical exam to detect chronic diseases of central nervous system, liver, heart, kidneys, lung and skin, as well as endocrinological or immunological disturbances, should protect susceptible individuals. Periodical medical exams of internal organs, skin and eyes are important to avoid chronic occupational intoxications. They should include lab and patch tests when necessary[83]. Monitor blood pressure. Liver function tests.

First Aid: If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least 15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately. If this chemical contacts the skin, remove contaminated clothing and wash immediately with soap and water. Seek medical attention immediately. If this chemical has been inhaled, remove from exposure, begin rescue breathing (using universal precautions) if breathing has stopped, and CPR if heart action has stopped. Transfer promptly to a medical facility. When this chemical has been swallowed, get medical attention. Give large quantities of water and induce vomiting. Do not make an unconscious person vomit.

Personal Protective Methods: Wear protective gloves and clothing to prevent any reasonable probability of dermal and/or eye contact. Safety equipment suppliers/manufacturers can provide recommendations on the most protective glove/clothing material for your operation. All protective clothing (suits, gloves, footwear, headgear) should be clean, available each day, and put on before work. Contact lenses should not be worn when working with this chemical. Wear dust-proof chemical goggles and face shield unless full facepiece respiratory protection is worn. Employees should wash immediately with soap when skin is wet or contaminated. Provide emergency showers and eyewash.

Respirator Selection: Follow regulations in OSHA 29CFR1910.134 or European Standard EN149. Use a NIOSH/MSHA- or European Standard EN149-approved respirator; or use an approved supplied-air respirator with a full facepiece operated in the positive-pressure mode, or with a full facepiece, hood, or helmet in the continuous flow mode; or use a NIOSH/MSHA- or European Standard EN149-approved self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive-pressure mode.

Storage: Color Code-Blue: Health Hazard/Poison: Store in a secure poison location. Prior to working with this chemical you should be trained on its proper handling and storage. Store in tightly closed containers in a cool, well-ventilated area. A regulated, marked area should be established where this chemical is handled, used, or stored in compliance with OSHA Standard 1910.1045. Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: Phenoxyacetic acid derivative pesticides, solid or liquid, toxic, require a shipping label of "poisonous materials" and fall in Hazard Class 6.1.

Spill Handling: First remove all sources of ignition. Evacuate persons not wearing protective equipment from area of spill or leak until clean up is complete. Collect powdered material in the most convenient and safe manner and deposit in sealed containers. Ventilate area after clean up is complete. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable. Also, can be precipitated with divalent cations. Carbon or peat can be used as sorbents.

Fire Extinguishing: Hazardous decomposition includes hydrogen chloride and oxides of nitrogen and carbon. Solid material not combustible. Liquid formulations containing organic solvents may be flammable. Use dry chemical, carbon dioxide; water spray; or alcohol foam extinguishers.If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies. From a secure, explosion-proof location, use water spray to cool exposed containers. If cooling streams are ineffective (venting sound increases in volume and pitch, tank discolors, or shows any signs of deforming), withdraw immediately to a secure position. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode.

Disposal Method Suggested: Incineration with added flammable solvent; incinerator equipped with fume scrubber. Containers must be disposed of properly by following package label directions or by contacting your local or federal environmental control agency, or by contacting your regional EPA office.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov.
- USEPA, *R.E.D. FACTS, MCPB*, EPA 738-R-06-001, Washington DC (March 2006)

(MCPP) Mecoprop M:0295

Use Type: Herbicide

CAS Number: 93-65-2; 7085-19-0 (EPA and state of California, primary usage); 16484-77-8 (mecoprop-P)

Formula: $C_{10}H_{11}ClO_3$

Synonyms: 4-Chloro-2-methylphenoxy-α-propionic acid; 2-(4-Chloro-2-methylphenoxy)propanoic acid; (+)-α-(4-Chloro-2-methylphenoxy) propionic acid; (4-Chloro-2-methylphenoxy)propionic acid; 2-(4-Chloro-2-methylphenoxy)propionic acid; α-(4-Chloro-2-methylphenoxy)propionic acid; 2-(4-Chlorophenoxy-2-methyl) propionic acid; 2-(4-Chloro-*o*-tolyl)oxylpropionic acid; 2-(*p*-chloro-*o*-tolyloxy)propionic acid; CMPP; 2 M-4CP; MCPP; 2-MCPP; MCPP; MCPP 2,4-D; MCPP-D-4; MCPP K-4; 2-Methyl-4-chlorophenoxy-α-propionic acid; 2-(2-Ethyl-4-chlorophenoxy)propanoic acid; α(2-Methyl-4-chlorophenoxy)propionic acid; 2-(2'-Methyl-4'-chlorophenoxy)propionic acid; 2M4KHP; NSC 60282; Propanoic acid, 2-(4-chloro-2-methylphenoxy)-; Propionic acid, 2-(4-chloro-2-methylphenoxy); Propionic acid, 2-[(4-chloro-*o*-tolyl)oxy]-; Propionic acid, 2-(2-methyl-4-chlorophenoxy)-

Trade Names: ASSASSIN®; BANVEL P®; BH MECOPROP®; CERIDOR®; CHIPCO®; CHIPCO TURF HERBICIDE MCPP®; CLEAVAL®; CLENECORN®; CLOVOTOX®; COMPITOX EXTRA®; CORNOX PLUS®; CR 205®; CRUSADER®; DOCKLENE®; EXP 419®; GRASLAM®; HARNESS®; HARRIER®; HEDONAL MCPP®; HERRISOL®; HYMEC®; IOTOX®; ISO-CORNOX®; KILPROP®; LIRANOX®; MECOBROM®; MECOMIN D®; MECOPEOP®; MECOPAR®; MECOPEX®; MECOTURF®; MEPRO®; MECHLORPROP®; MECOPROP®; MYLONE®; MUSKETEET®; POST-KITE®; PROPAL®; PROPONEX-PLUS®; RANKOTEX®; RD 4593®; RUNCATEX®; SELOXONE®; SCOTLENE®; SEL-OXONE®; SUPER GREEN AND WEED®; SUPOERTOX®; SWIPE 560 EC®; TARGET®; TERSET®; TETRALEN-PLUS®; TRIESTER II®; TRIMEC 1144 40% SP®; TRIPLET®; U 46®; U 46 KV-ESTER®; VERDONE®; VI-PAR®; VI-PEX®; VIPEX®

Chemical class: Chlorophenoxy; Aryloxyalkanoic acid

EPA/OPP PC Code: 031501. Not assigned for (-p)

California DPR Chemical Code: 374

HSDB Number: 1738

UN/NA & ERG Number: UN3345 (solid)/153; UN3348 (liquid)/153

RTECS® Number: UE9750000

EC Number: 202-264-4 [*Annex I Index No.:* 607-049-00-2]

Uses: A General Use Pesticide, postemergent herbicide, most often used in combination with other pesticides. Most of the production is used on turf, including lawns, sport turf and commercial sod production for control of creeping broadleaf weeds such as clovers, chickweed, ivy, plantain and similar plants. It is also used on wheat, barley and oats. A small percentage is used in noncrop areas such as rights-of-way, drainage ditch banks and forest site preparation.

Human toxicity (long-term)[101]: High–7.00 ppb, Health Advisory

Fish toxicity (threshold)[101]: Very low–25458.68925 ppb, MATC (Maximum Acceptable Toxicant Concentration)

Regulatory Authority and Advisory Information:

Carcinogenicity[83]: IARC: Group 2b, Possible human carcinogen

Acute Oral Category: 2, WARNING

Health Advisory: Mutagen, Developmental/Reproductive Toxin (S!)

AB 2588-Air Toxics “Hot Spots” Chemicals (CAL) as chlorophenoxy pesticides

EPCRA Section 313 Form R *de minimus* concentration reporting level: 0.1%

European/International Regulations: Hazard Symbol: Xi, Xn, N; risk Phrases: R22; R38; R41; R50/53; safety phrases: S2; S13; S26; S37/39; S60; S61 (see Appendix 1)

Description: Mecoprop is a white to tan crystalline solid. Odorless. Molecular weight = 214.64; Freezing/Melting point = 9395 °C; Vapor pressure = 1.2×10^{5} mmHg @ 20 °C. Henry's Law constant = 3.8×10^{9} atm-m^3/mol @ 25 °C (est)[83]. Highly soluble in water; solubility = >2000 ppm @ 20 °C.

Determination in Water: Log K_{ow} = >3.0. Values above 3.0 are likely to bioaccumulate in aquatic organisms.

Incompatibilities: A weak acid. Incompatible with strong bases and oxidizers.

Routes of Entry: Inhalation, dermal absorption.

Harmful Effects and Symptoms

Short Term Exposure: This chemical can be absorbed through the skin, thereby increasing exposure. Contact irritates the eyes and skin. Irritates the respiratory tract. Exposure can cause headache, weakness, convulsions, muscle cramps, loss of coordination, unconsciousness, and death. Moderately toxic: probable oral lethal dose (human) 0.5–5 g/kg, between 1 oz and 1 pint (or 1 lb) for a 70 kg person (150 lb)[83]. LD_{50} (oral, rat) = 650 to >1000 mg/kg; LD_{50} (dermal, rat) = 700 mg/kg.

Long Term Exposure: May cause tumors. May cause cancer. May affect human reproduction. Exposure may damage blood cells, causing anemia, and damage to the kidneys. May be a neurotoxin and a skin sensitizer.

Points of Attack: Blood, kidney, skin, central nervous system.

Medical Surveillance: Preliminary medical exam to detect chronic diseases of central nervous system, liver, heart, kidneys, lung and skin, as well as endocrinological or immunological disturbances, should protect susceptible individuals. Periodical medical exams of internal organs, skin and eyes are important to avoid chronic occupational intoxications. They should include lab and patch tests when necessary[83]. Examination of the nervous system. Complete blood count. Kidney function tests. Evaluation by a qualified allergist, including exposure history and testing, may help diagnose allergy.

First Aid: If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least 15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately. If this chemical contacts the skin, remove contaminated clothing and wash immediately with soap and water. Seek medical attention immediately. If this chemical has been inhaled, remove from exposure, begin rescue breathing (using universal precautions) if breathing has stopped, and CPR if heart action has stopped. Transfer promptly to a medical facility. When this chemical has been swallowed, get medical attention. Give large quantities of water and induce vomiting. Do not make an unconscious person vomit.

Personal Protective Methods: Wear protective gloves and clothing to prevent any reasonable probability of dermal and/or eye contact. Safety equipment suppliers/manufacturers can provide recommendations on the most protective glove/clothing material for your operation. All protective clothing (suits, gloves, footwear, headgear) should be clean, available each day, and put on before work. Contact lenses should not be worn when working with this chemical. Wear dust-proof chemical goggles and face shield unless full facepiece respiratory protection is worn. Employees should wash immediately with soap when skin is wet or contaminated. Provide emergency showers and eyewash.

Respirator Selection: Where there is a potential for overexposure: SCBAF: Pd,Pp (APF = 10,000) (any NIOSH/MSHA- or European Standard EN 149-approved self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode); or SaF: Pd,Pp: ASCBA (APF = 10,000) (any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary, self-contained breathing apparatus operated in a pressure-demand or other positive-pressure mode).

Storage: Color Code-Blue: Health Hazard/Poison: Store in a secure poison location. Prior to working with this chemical you should be trained on its proper handling and storage. Store in tightly closed containers in a cool, well-ventilated area away from oxidizers and strong bases. Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: Phenoxyacetic acid derivative pesticides, solid or liquid, toxic, require a shipping label of "poisonous materials" and fall in Hazard Class 6.1.

Spill Handling: First remove all sources of ignition. Evacuate persons not wearing protective equipment from area of spill or leak until clean up is complete. Collect powdered material in the most convenient and safe manner and deposit in sealed containers. Ventilate area after clean up is complete. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable.

Fire Extinguishing: Hazardous decomposition includes phosgene, hydrogen chloride, and carbon monoxide. Mecoprop is a noncombustible solid. Use dry chemical, carbon dioxide; alcohol or polymer foam extinguishers. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies. From a secure, explosion-proof location, use water spray to cool exposed containers. If cooling streams are ineffective (venting sound increases in volume and pitch, tank discolors, or shows any signs of deforming), withdraw immediately to a secure position. If employees are expected to fight fires, they must be trained and equipped in OSHA

1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode.

Disposal Method Suggested: In accordance with 40CFR165, follow recommendations for the disposal of pesticides and pesticide containers. Containers must be disposed of properly by following package label directions or by contacting your local or federal environmental control agency, or by contacting your regional EPA office.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- EXTOXNET, Extension Toxicology Network, "Pesticide Information Profile, Mecoprop," Oregon State University, Corvallis, OR (September 1995). http://extoxnet.orst.edu/pips/mecoprop.htm
- New Jersey Department of Health and Senior Services, Hazardous Substance Fact Sheet, "2-(4-chloro-2-methylphenoxy) Propionic Acid," Trenton, NJ (April 1999). http://www.state.nj.us/health/eoh/rtkweb/3093.pdf

Mefluidide M:0307

Use Type: Herbicide; plant growth regulator

CAS Number: 53780-34-0

Formula: $C_{11}H_{13}F_3N_2O_3S$

Synonyms: Acetamide, *N*-(2,4-dimethyl-5-[((trifluoromethyl)sulfonyl)amimo)phenyl]-; 5-Acetamido-2,4-dimethyltrifluoromethanesulfonanilide; *N*-[(2,4-Dimethyl-5-((trifluoromethyl)sulfonyl)amino) phenyl] acetamide; 2',4'-Dimethyl-5-[(trifluoromethyl) sulfonamido] acetanilide

Trade Names: EMmHgK®; MBR 12325®; MBR 12325®; METHAFLUORIDAMID®; S 15733®; VEL 3973®; VISTAR® Herbicide

Chemical class: Anilide

EPA/OPP PC Code: 114001; 114002 (diethanolamine salt); 114003 (potassium salt)

California DPR Chemical Code: 5082

HSDB Number: 6698

UN/NA & ERG Number: UN3077 (solid)/171; UN3082 (liquid)/171

RTECS® Number: AE2460000

EC Number: 258-767-4

Uses: Not approved for use in EU countries[115]. Mefluidide is used to control ornamental and non-ornamental woody plants, ground cover, hedges, trees, turfgrass and broadleaf weeds. Both the diethanolamine and potassium salts are actively used in the U.S.

Human toxicity (long-term)[101]: Very low–2100.00 ppb, Health Advisory

Fish toxicity (threshold)[101]: Very low–19076.48500 ppb, MATC (Maximum Acceptable Toxicant Concentration)

Regulatory Authority and Advisory Information

Acute Oral Category: 3, CAUTION

This product is considered hazardous under the criteria of the Federal OSHA Hazard Communication Standard 29 CFR 1910.1200.

SARA Title III, Section 311/312 Hazard Category: Immediate Health Hazard

Description: White crystalline solid. Some formulations are a dark brown liquid. Molecular weight = 310.29; Freezing/Melting point = 184 °C. Vapor pressure = 2.40×10^{8} mmHg @ 25 °C (est)[83]; Henry's Law constant = 1.28×10^{11} atm-m^3/mol @ 25 °C (est)[83]; Flash point = >212 °C. Slightly soluble in water. Physical and toxicological properties may be affected by carrier solvents in commercial formulations.

Incompatibilities: May react with strong oxidizers such as chlorates, peroxides, nitrates, etc.

Determination in Air: Filter; none; Gravimetric; NIOSH IV [Particulates NOR; #0500 (total), #0600 (respirable)][18].

Permissible Concentration in Water: Runoff from spills or fire control may cause water pollution.

Determination in Water: Log K_{ow} = >3.0. Values above 3.0 are likely to bioaccumulate in aquatic organisms.

Routes of Entry: Eyes; dermal contact, inhalation, ingestion.

Harmful Effects and Symptoms

Short Term Exposure: May cause eye, skin, and respiratory tract irritation. May be absorbed through the unbroken skin. Harmful if swallowed, with gastrointestinal irritation. LD_{50} (oral, rat) = >3.5 g/kg; LD_{50} (dermal, rabbit) = >2 g/kg.

Long Term Exposure: Fluorides may cause bone disease (pain and tenderness of the bones); mottled teeth in children.

Points of Attack: Bones.

Medical Surveillance: Preliminary medical exam to detect chronic diseases of central nervous system, liver, heart, kidneys, lung and skin, as well as endocrinological or immunological disturbances, should protect susceptible individuals. Periodical medical exams of internal organs, skin and eyes are important to avoid chronic occupational intoxications. They should include lab and patch tests when necessary[83].

First Aid: If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least 15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately. If this chemical contacts the skin, remove contaminated clothing and wash immediately with soap and water. Seek medical attention immediately. If this chemical has been inhaled, remove from exposure, begin rescue breathing (using universal precautions) if breathing has stopped, and CPR if heart action has stopped. Transfer promptly to a medical facility. When this chemical has been swallowed, get medical attention. Give large quantities of water and induce vomiting. Do not make an unconscious person vomit. Do not induce vomiting when formulations containing petroleum solvents are ingested

Personal Protective Methods: Wear protective gloves and clothing to prevent any reasonable probability of dermal and/or eye contact. Safety equipment suppliers/manufacturers can provide recommendations on the most protective glove/clothing material for your operation. All protective clothing (suits, gloves, footwear, headgear) should be clean, available each day, and put on before work. Contact lenses should not be worn when working with this chemical. Wear dust-proof chemical goggles and face shield unless full facepiece respiratory protection is worn. Employees should wash immediately with soap when skin is wet or contaminated. Provide emergency showers and eyewash.

Respirator Selection: Engineering controls should be used wherever feasible to maintain airborne concentrations of this chemical below the prescribed exposure limit. Respirators and protective equipment are less effective than engineering controls, and should be used only in non-routine or emergency situations which may result in exposure concentrations in excess of the TWA environmental limit. *At any concentrations above the NIOSH REL, or where there is no REL, at any detectable concentration:* SCBAF: Pd,Pp (APF = 10,000) (any NIOSH/MSHA- or European Standard EN 149-approved self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode); or SaF: Pd,Pp: ASCBA (APF = 10,000) (any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary, self-contained breathing apparatus operated in a pressure-demand or other positive-pressure mode).

Storage: Color Code-Blue: Health Hazard/Poison. Store in a secure poison location. Prior to working with this chemical you should be trained on its proper handling and storage. Store in tightly closed containers in a cool, well-ventilated area. Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: Environmentally hazardous substances, solid or liquid, usually fall in Hazard Class 9.

Spill Handling: First remove all sources of ignition. Evacuate persons not wearing protective equipment from area of spill or leak until clean up is complete. Collect powdered material in the most convenient and safe manner and deposit in sealed containers. Ventilate area after clean up is complete. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable.

Fire Extinguishing: Hazardous decomposition includes oxides of nitrogen, sulfur and carbon and hydrogen fluoride gas. As an immediate precautionary measure, isolate spill or leak area in all directions for at least 50 meters/150 feet for liquids and at least 25 meters/75 feet for solids. *Fire involving storage or vehicular tanks:* isolate for 800 meters/0.5 mile in all directions; also, consider initial evacuation for 800 meters/0.5 mile in all directions. *On a small fire:* use dry chemical, CO_2, water spray or regular foam. *On a large fire:* use water spray, fog or regular foam. Do not scatter spilled material with high-pressure streams of water. Move containers from fire area if you can do it without risk. Dike fire-control water for later disposal. *Fire involving tanks:* from a secure, explosion-proof location, use water spray to cool exposed containers. If cooling streams are ineffective (venting sound increases in volume and pitch, tank discolors, or shows any signs of deforming), withdraw immediately to a secure position. Always stay away from tanks engulfed in fire. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode.

Disposal Method Suggested: Dissolve or mix the material with a combustible solvent and burn in a chemical incinerator equipped with an afterburner and scrubber. All federal, state, and local environmental regulations must be observed.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- United States National Library of Medicine, *ChemIDplus Advanced*, Bethesda MD. http://chem.sis.nlm.nih.gov/chemidplus/rn/53780-34-0

Mepiquat chloride M:0336

Use Type: Herbicide, Plant growth regulator

CAS Number: 24307-26-4

Formula: $C_7H_{16}ClN$

Synonyms: *N,N*-Dimethylpiperidinium chloride; 1,1-Dimethylpiperidinium chloride; *N,N*-Dimethylpiperidium chloride; 1,1-Dimethylpiperidin-1-ium chloride

Trade Names: BAS 083 01W®; BAS 85559X®; MEPEX®; MEPICHLOR®; MEPPLUS®; PIX®; PONNAX®; ROQUAT®; TERPAL® (with Ethephon)

Chemical Class: Quarternary ammonium salt

EPA/OPP PC Code: 109101

California DPR Chemical Code: 2075

HSDB Number: 7059

UN/NA & ERG Number: Not a regulated material.

RTECS® Number: TN4939200

EC Number: 246-247-6 [*Annex I Index No.:* 613-127-00-7]

Uses: Registered solely for cotton, to control the growth and yield.

U.S. Maximum Allowable Residue Levels for Mepiquat Chloride [40 CFR 180.384 (a)(1)]: in or on the following commodities: cattle, meat byproducts 0.1 ppm; cotton, gin byproducts 6.0 ppm; cottonseed 2.0 ppm; goat, meat byproducts 0.1 ppm; hog, meat byproducts 0.1 ppm; horse, meat byproducts 0.1 ppm; sheep, meat byproducts 0.1 ppm. ***[40 CFR 180.384 (a)(2)]:*** in or on the following commodities: cattle, fat 0.1 ppm; cattle, meat 0.1 ppm; goat, fat 0.1 ppm; goat, meat 0.1 ppm; grape 1.0 ppm; hog, fat 0.1 ppm; hog, meat 0.1 ppm; horse, fat 0.1 ppm; horse, meat 0.1 ppm; rasisins 5.0 ppm; sheep, fat 0.1 ppm; sheep, meat 0.1 ppm.

Human toxicity (long-term)[101]: Very low–4200.00 ppb, Health Advisory

Fish toxicity (threshold)[101]: Very low–100000.00 ppb, MATC (Maximum Acceptable Toxicant Concentration)

Regulatory Authority and Advisory Information:

Carcinogenicity[83]: EPA Group E, evidence of non-carcinogenicity for humans.

Acute Oral Category: 2, WARNING

European/International Regulations: Hazard Symbol: Xn; risk phrases: R22; R52/53; safety phrases: S2; S61 (see Appendix 1)

Description: White crystalline solid, off-white powder, or pinkish liquid. Slightly sweet, musty odor; Molecular weight = 149.63; Specific gravity (H_2O:1) = 1.17; Boiling point = (decomposes) >100 °C; Freezing/Melting point = >300 °C with discoloration ~ 296 °C[83]. Hazard Identification (based on NFPA-704 M Rating System): Health 1, Flammability 0, Reactivity 0. Highly soluble in water; solubility = 52.9 g/100 ml[83].

Incompatibilities: Decomposes in temperatures above 320 °C.

Permissible Concentration in Water: Runoff from spills or fire control may cause water pollution.

Determination in Water: Log K_{ow} = <– 3. Unlikely to bioaccumulate in marine organisms.

Routes of Entry: Ingestion, inhalation, dermal contact.

Harmful Effects and Symptoms

Short Term Exposure: This material may cause irritation to the skin, eyes, and respiratory tract. LD_{50} (oral, rat) = <500 mg/kg; LD_{50} (dermal, rabbit) = >2 g/kg.

Medical Surveillance: Preliminary medical exam to detect chronic diseases of central nervous system, liver, heart, kidneys, lung and skin, as well as endocrinological or immunological disturbances, should protect susceptible individuals. Periodical medical exams of internal organs, skin and eyes are important to avoid chronic occupational intoxications. They should include lab and patch tests when necessary[83].

First Aid: If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least 15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately. If this chemical contacts the skin, remove contaminated clothing and wash immediately with soap and water. Seek medical attention immediately. If this chemical has been inhaled, remove from exposure, begin rescue breathing (using universal precautions) if breathing has stopped, and CPR if heart action has stopped. Transfer promptly to a medical facility. When this chemical has been swallowed, get medical attention. Give large quantities of water and induce vomiting. Do not make an unconscious person vomit.

Personal Protective Methods: Applicators and other handlers must wear: Coveralls worn over long-sleeved shirt and long pants; Chemical-resistant gloves such as DuPont™ Tychem® suit fabrics, barrier laminate, or Viton®; Chemical-resistant footwear plus socks; Protective eye wear; Chemical-resistant headgear for overhead exposure; Chemical-resistant apron when cleaning equipment, mixing, or loading[83]. Agricultural Use/Engineering Controls: When handlers use closed systems, enclosed cabs, or aircraft in a manner that meets the requirements listed in the Worker Protection Standard (WPS) for agricultural pesticides, ***40 CFR 170.240(d)(4-6)***, the handler PPE requirements may be reduced or modified as specified in the Worker Protection Standard. Firefighters should wear NIOSH-approved self-contained breathing apparatus and full protective clothing.

Respirator Selection: Wherever and whenever workplace conditions warrant respirator use, a respiratory protection program must be followed that meets one or more of the following government standards: OSHA's 29 CFR 1910.134, ANSI Z88.2, or European Standard EN 149.

Storage: Color Code-Green: General storage may be used. Prior to working with this chemical you should be trained on its proper handling and storage. Store in tightly closed containers in a cool, well-ventilated area away from oxidizers, acids, water, or combustible materials.

Shipping: Not a regulated material.

Spill Handling: Eliminate all ignition sources (no smoking, flares, sparks or flames in immediate area). Do not touch damaged containers or spilled material unless wearing appropriate protective clothing. Stop leak if you can do it without risk. Prevent entry into waterways, sewers, basements or confined areas. Absorb or cover with dry earth, sand or other non-combustible material and transfer to containers. Do not get water inside containers.

Fire Extinguishing: Hazardous decomposition includes oxides of nitrogen, carbon and hydrogen chloride gas. *Fire involving storage or vehicular tanks:* isolate for 800 meters/0.5 mile in all directions; also, consider initial evacuation for 800 meters/0.5 mile in all directions. *Small fire:* dry chemical, carbon dioxide or water spray. *Large fire:* dry chemical, carbon dioxide, alcohol-resistant foam or water spray. Move containers from fire area if you can do it without risk. Dike fire-control water for later disposal; do not scatter the material. *Fire involving tanks or car/trailer loads:* fight fire from maximum distance or use unmanned hose holders or monitor nozzles. Do not get water inside containers. Cool containers with flooding quantities of water until well after fire is out. Withdraw immediately in the case of rising sound from venting safety devices or discoloration of tank. Always stay away from tanks engulfed in fire. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies.

Disposal Method Suggested: Do not discharge into drains or sewers. Dispose of waste material as hazardous waste using a licensed disposal contractor to an approved landfill. Consult with environmental regulatory agencies for guidance on acceptable disposal practices. Incineration with effluent gas scrubbing is recommended[22]. In accordance with 40CFR165, follow recommendations for the disposal of pesticides and pesticide containers. Noncombustible containers should be compacted and buried under more than 16 inches/40 cm. of soil[83]. Must be disposed properly by following package label directions or by contacting your local or federal environmental control agency, or by contacting your regional EPA office.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- USEPA, "Reregistration Eligibility Decision (RED), Mepiquat Chloride," Office of Prevention, Pesticides and Toxic Substances, Washington DC (March 1997). http://www.epa.gov/REDs/2375red.pdf
- USEPA, Office of Pesticide Programs, Pesticide Residue Limits, "Mepiquat Chloride" ***40 CFR 180.384***. http://www.epa.gov/pesticides/food/viewtols.htm

Metalaxyl M:0475

Use Type: Fungicide

CAS Number: 57837-19-1; 70630-17-0 (M-)

Formula: $C_{15}H_{21}NO_4$

Synonyms: *dl*-Alanine, *N*-(2,6-dimethylphenyl)-*N*-(methoxyacetyl)-, methyl ester; *N*-(2,6-Dimethylphenyl)-*N*-(methoxyacetyl)alanine, methyl ester; *N*-(2,6-Dimethylphenyl)-*N*-(methoxyacetyl)-*dl*-alanine methyl ester

Trade Names: AGROX® PREMIERE; ALLEGIENCE®; APRON®; CG 117®; CGA-48988®; CHLORAXYL®; COTGUARD®; EPERON®; DELTA-COAT; FOLIO® GOLD; GAUCHO®; KODIAK®; METALAXIL®; METAXANIN®; PACE®; PREVAIL®; RAXIL® (tebuconazole+metalaxyl); RIDOMIL® GOLD/BRAVO®; RIDOMIL®; RIDOMIL 2E®; SUBDUE®

Chemical class: Phenylamide

EPA/OPP PC Code: 113501

California DPR Chemical Code: 2132

HSDB Number: 7061

UN/NA & ERG Number: UN3077(solid)/171

RTECS® Number: AY691000

EC Number: 260-979-7 [*Annex I Index No.:* 607-425-00-6]

Uses: Metalaxyl is used as a systemic fungicide on a variety of food and non-food crops including tobacco, turf and conifers, and ornamentals. Used in combination with fungicides of different mode of action as a foliar spray on tropical and subtropical crops; as a seed treatment to control downy mildew; and as a soil fumigant to control soilborne pathogens.

U.S. Maximum Allowable Residue Levels for Metalaxyl [40 CFR 180.408 (a)]: Tolerances are established for the combined residues of the fungicide metalaxyl (*N*-(2,6-dimethylphenyl)-*N*-(methoxyacetyl)alanine methylester) and its metabolites containing the 2,6-dimethylaniline moiety, and *N*-(2-hydroxymethyl-6-methylphenyl)-*N*-(methoxyacetyl)-alanine methyl ester, each expressed as metalaxyl equivalents, in or on the following food commodities: alfalfa, forge 6.0 ppm; alfalfa, hay 20.0 ppm; almond 0.5 ppm; almond, hulls 10.0 ppm; apple 0.2 ppm; apple, wet pomace 0.4 ppm; apricot, dried 4.0 ppm; asparagus 7.0 ppm; avocado 4.0 ppm; beet 0.1 ppm; beet, sugar 0.1 ppm; beet, sugar, molasses 1.0 ppm; beet, sugar, roots 0.5 ppm; beet, sugar, tops 10.0 ppm; beet, tops 0.1 ppm; blueberry 2.0 ppm; broccoli 2.0 ppm; Brussels sprouts 2.0 ppm; cabbage 1.0 ppm; cattle, fat 0.4 ppm; cattle, kidney 0.4 ppm; cattle, liver 0.4 ppm; cattle, meat 0.05 ppm; cattle, meat byproducts, except kidney and liver 0.05 ppm; cauliflower 1.0 ppm; citrus, oil 7.0 ppm; citrus, pulp 7.0 ppm; clover, forage 1.0 ppm; clover, hay 2.5 ppm; cottonseed 0.1 ppm; cranberry 4.0 ppm; egg 0.05 ppm; fruit, citrus 1.0 ppm; fruit, stone, group, 1.0 pmm; ginseng 3.0 ppm; goat, fat 0.4 ppm; goat, kidney 0.4 ppm; goat, liver 0.4 ppm; goat, meat 0.05 ppm; goat, meat byproducts, except kidney and liver 0.05 ppm; grain, ceral (except wheat, barley, and oats) 0.1 ppm; grain, crop 0.1 ppm; grape 2.0 ppm; grass, forage 10.0 ppm; grass, hay 25.0 ppm; hog, fat 0.4 ppm; hog, kidney 0.4 ppm; hog, liver 0.4 ppm; hog, meat 0.05 ppm; hog, meat byproducts, except kidney and liver 0.05 ppm; hop, dried cone 20.0 ppm; hop, green 2.0 ppm; horse, fat 0.4 ppm; horse, kidney 0.4 ppm; horse, liver 0.4 ppm; horse, meat 0.05 ppm; horse, meat byproducts, except kidney and liver 0.05 ppm; leafy vegetables (except brassica) group (except spinach) 5.0 ppm; leaves of root and tuber vegetables (human food or animal feed) group, 15.0 ppm; legume vegetable group (dry or succulent) 0.2 ppm; lettuce, head 5.0 ppm; milk 0.02 ppm; mustard greens 5.0 ppm; onion, dry bulb 3.0 ppm; onion, green 10.0 ppm; peanut, hay 20.0 pmm; peanut, meal 1.0 ppm; peanut, nut 0.2 ppm; peanut, shells 2.0 ppm; peanut, vines 20.0 ppm; pineapple 0.1 ppm; pineapple, fodder 0.1 ppm; pineapple, forage 0.1 ppm; plum, prune, dried 4.0 ppm; potato waste, dried, processed 4.0 ppm; potato, processed (including potato, chips) 4.0 ppm; poultry, fat 0.4 ppm; poultry, kidney 0.4 ppm; poultry, liver 0.4 ppm; poultry, meat 0.05 ppm; poultry, meat byproducts, except kidney and liver 0.05 ppm; potato 0.5 ppm; raisins 6.0 ppm; raspberry 0.5 ppm; sheep, fat 0.4 ppm; sheep, kidney 0.4 ppm; sheep, liver 0.4 ppm; sheep, meat 0.05 ppm; sheep, meat byproducts, except kidney and liver 0.05 ppm; soybean, grain 1.0 ppm; soybean, hulls 2.0 ppm; soybean, meal 2.0 ppm; spinach 10.0 ppm; strawberry 10.0 ppm; sunflowers 0.1 ppm; sunflower, forage 0.1 ppm; tomato, processed 3.0 ppm; vegetables, brassica, leafy, group (except broccoli, cabbage, cauliflower, Brussels sprouts, and mustard greens) 0.1 ppm; vegetable, cucurbit, group, 1.0 ppm; vegetable, fruiting (except cucurbits) group, 1.0 ppm; vegetable, legume, cannery waste 5.0 ppm; vegetable, legume, foliage 8.0 ppm; vegetable, root and tuber group, 0.5 ppm; walnut 0.5 ppm. ***Regional registration, as defined in section 180.1(n) are established for the combined residues of the fungicide metalaxyl and its metabolites containing the 2,6-dimethylaniline moiety, and N-(2-hydroxymethyl-6-methyl)-N-(methoxyacetyl)-alanine methylester, each expressed as metalaxyl [40 CFR 180.408 (c)]:*** in or on the following raw agricultural commodity: papaya, 0.1 ppm. ***[40 CFR 180.408 (d)]:*** in or on the food commodities when present therein as a result of the appliсatiion of metalaxyl to growing crops listed in paragraph (a) of this section and other non-food crops to read as follows: barley, grain 0.2 ppm; barley, fodder 2.0 ppm; barley, milling fractions 1.0 ppm; barley, straw 2.0 ppm; grain, cereal group (except wheat, barley and oats), fodder 1.0 ppm; grain, cereal group (except wheat, barley and oats), forage 1.0 ppm; grain, cereal group (except wheat, barley and oats), straw 1.0 ppm; oat, fodder 2.0 ppm; oat, forage 2.0 ppm; oat, grain 0.2 ppm; oat milling fractions 1.0 ppm; oat, straw 2.0 ppm; wheat, fodder 2.0 ppm; wheat, forage 2.0 ppm; wheat, grain 0.2 ppm; wheat, milling fractions 1.0 ppm; wheat, straw 2.0 ppm.

Human toxicity (long-term)[101]: Very low–518.00 ppb, Health Advisory

Fish toxicity (threshold)[101]: Very low–9099.97083 ppb, MATC (Maximum Acceptable Toxicant Concentration)

Regulatory Authority and Advisory Information:

Carcinogenicity[83]: EPA Group E, evidence of non-carcinogenicity for humans

Health Advisory: Mutagen

Acute Oral Category: 3, CAUTION

European/International Regulations: Hazard Symbol: Xi, Xn, N; risk Phrases: R22; R43; R52/53; safety phrases: S2; S13; S24; S37; S46; S61 (see Appendix 1)

WGK (German Aquatic Hazard Class): No value assigned.

Description: Flammable, white crystalline solid or powder. Odorless. Molecular weight = 297.34; Specific gravity (H_2O:1) = 1.22; Boiling point = 294 °C; Freezing/Melting point = 67–68 °C; 69–72 °C; Vapor pressure = 6×10^{6} mmHg @ 20 °C; Flash point = 100 °C (cc). Hazard Identification (based on NFPA-704 M Rating System): Health 2, Flammability 2, Reactivity 0. Highly soluble in water; solubility = 7.0 g/L @ 20 °C.

Incompatibilities: Incompatible with alkaline materials, strong acids, oxidizers (chlorates, nitrates, peroxides, permanganates, perchlorates, chlorine, bromine, fluorine, etc.); contact may cause fires or explosions.

Permissible Concentration in Water: Federal Drinking Water Guidelines: 400 ppb[93]. State Drinking Water Guidelines: Maine 420 μg/L. Runoff from spills or fire control may cause water pollution.

Determination in Water: Log K_{ow} = <2.0. Unlikely to bioaccumulate in marine organisms.

Routes of Entry: Ingestion, inhalation, dermal contact.

Harmful Effects and Symptoms

Short Term Exposure: Contact may burn eyes, skin, and respiratory tract. Eye contact may cause permanent damage. May cause skin allergy. Toxic if ingested. LD_{50} (oral, rat) = 600–700 mg/kg; LD_{50} (dermal, rat) = >2000 mg/kg.

Long Term Exposure: Prolonged or frequent exposure may cause liver damage; skin allergy.

Points of Attack: Skin, eyes, liver.

Medical Surveillance: Check liver function. Consult a physician if poisoning is suspected or if redness, itching, or burning of the eyes or skin develop. Evaluation by a qualified allergist, including exposure history and testing, may help diagnose allergy.

First Aid: If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least 15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately. If this chemical contacts the skin, remove contaminated clothing and wash immediately with soap and water. Seek medical attention immediately. If this chemical has been inhaled, remove from exposure, begin rescue breathing (using universal precautions) if breathing has stopped, and CPR if heart action has stopped. Transfer promptly to a medical facility. When this chemical has been swallowed, get medical attention. *Do not induce vomiting when formulations containing petroleum solvents are ingested*. Otherwise, give large quantities of water and induce vomiting. Do not make an unconscious person vomit.

Personal Protective Methods: Wear protective gloves and clothing to prevent any reasonable probability of dermal and/or eye contact. Safety equipment suppliers/manufacturers can provide recommendations on the most protective glove/clothing material for your operation. All protective clothing (suits, gloves, footwear, headgear) should be clean, available each day, and put on before work. Contact lenses should not be worn when working with this chemical. Wear dust-proof chemical goggles and face shield unless full facepiece respiratory protection is worn. Employees should wash immediately with soap when skin is wet or contaminated. Provide emergency showers and eyewash.

Respirator Selection: Where potential for exposure exists, use a NIOSH/MSHA- or European Standard EN149-approved supplied-air respirator with a full facepiece operated in the positive-pressure mode, or with a full facepiece, hood, or helmet in the continuous-flow mode; or use a NIOSH/MSHA- or European Standard EN149-approved self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive-pressure mode.

Storage: Color Code-Blue: Health Hazard/Poison. Store in a secure poison location. Color Code-White: Corrosive or Contact Hazard; Store separately in a corrosion-resistant location. Prior to working with this chemical you should be trained on its proper handling and storage. Store in tightly closed containers in a cool, well-ventilated area away from strong oxidizers; strong acids; strong alkalies. Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: Environmentally hazardous substances, solid or liquid, usually fall in Hazard Class 9.

Spill Handling: First remove all sources of ignition. Evacuate persons not wearing protective equipment from area of spill or leak until clean up is complete. Collect powdered material in the most convenient and safe manner and deposit in sealed containers. Ventilate area after clean up is complete. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable.

Fire Extinguishing: Hazardous decomposition includes oxides of nitrogen and carbon. As an immediate precautionary measure, isolate spill or leak area in all directions for at least 50 meters/150 feet for liquids and at least 25 meters/75 feet for solids. *Fire involving storage or vehicular tanks:* isolate for 800 meters/0.5 mile in all directions; also, consider initial evacuation for 800 meters/0.5 mile in all directions. *On a small fire:* use dry chemical, CO_2, water spray or regular foam. *On a large fire:* use water spray, fog or regular foam. Do not scatter spilled material with high-pressure streams of water. Move containers from fire area if you can do it without risk. Dike fire-control water for later disposal. *Fire involving tanks:* from a secure, explosion-proof location, use water spray to cool exposed containers. If cooling streams are ineffective (venting sound increases in volume and pitch, tank discolors, or shows any signs of deforming), withdraw immediately to a secure position. Always stay away from tanks engulfed in fire. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode.

Disposal Method Suggested: Small amounts may be destroyed by alkaline hydrolysis. Admixture with alkali can be followed by soil burial. Larger quantities can be disposed of by incineration in admixture with acetone or xylene and using effluent gas scrubbing. Do not reuse empty container; proper disposal required.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- EXTOXNET, Extension Toxicology Network, "Pesticide Information Profile, Metalaxyl," Oregon State University, Corvallis, OR (June 1996). http://extoxnet.orst.edu/pips/metalaxy.htm
- USEPA, Office of Pesticide Programs, Pesticide Residue Limits, "Metalaxyl", ***40 CFR 180.408***. http://www.epa.gov/pesticides/food/viewtols.htm

Metaldehyde M:0480

Use Type: Molluscicide
CAS Number: 108-62-3
Formula: $C_8H_{16}O_4$
Synonyms: 1,3,5,7-Tetroxocane, 2,4,6,8-tetramethyl-1,3,5,7-tetraoxacyclooctane
Trade Names: ANTIMILACE®; ARIOTOX®; CEKUMETA®; DEADLINE®; DURHAM®; HALIZAN®; LIMATOR®; META®; METASON®; NAMEKIL®; SLUG-TOX®; TRAILS END®
Chemical class: Aldehyde; Cyclo-octane
EPA/OPP PC Code: 053001
California DPR Chemical Code: 379
HSDB Number: 1735
UN/NA & ERG Number: UN 1332/133; IMO 4.1
RTECS® Number: XF9900000
EC Number: 203-600-2 [*Annex I Index No.:* 605-005-00-7]

Uses: A tetramer of acetaldehyde, metaldehyde is a molluscicide used in a variety of vegetable and ornamental crops in the field or greenhouse. It may be formulated with or without calcium arsenate and is also available in a mixed formulation with thiram. A U.S. EPA restricted Use Pesticide (RUP).

U.S. Maximum Allowable Residue Levels for Metaldehyde [40 CFR 180.523(a)]: artichoke, globe 0.07 ppm; berry group 13, 0.15 ppm. cactus 0.07 ppm; fruit, citrus, group 10, 0.26 ppm; lettuce 1.73 ppm; strawberry 6.25 ppm; tomato 0.24 ppm; vegetable, brassica, leafy, group 5, 2.5 ppm; watercress 3.2 ppm.

Human toxicity (long-term)[101]: 3.5 ppb, Health Advisory.

Fish toxicity (threshold)[101]: 1121 ppb, MATC (Maximum Acceptable Toxicant Concentration).

Fish toxicity (threshold)[101]: Very low–1121.12787 ppb, MATC (Maximum Acceptable Toxicant Concentration)

Regulatory Authority and Advisory Information

Acute Oral Category: 2, WARNING
Health Advisory: Mutagen, Reproductive Toxin
TSCA: 40CFR716.120(*d*)1 as aldehydes
European/International Regulations: Hazard Symbol: F, Xn; risk phrases: R11; R22; safety phrases: S2; S13; S16; S25; S46 (see Appendix 1)

Description: Metaldehyde is a white crystalline powder. Flammable solid. Mild menthol odor. Molecular weight = 176.24; Boiling point = 112–116 °C; Freezing/Melting point = 47 °C; Flash point = 36 °C. Hazard Identification (based on NFPA-704 M Rating System): Health 3, Flammability 3, Reactivity 1. Moderately soluble in water; solubility = 260 mg/L @ 30 °C.

Incompatibilities: Aldehydes form an explosive mixture with air. Incompatible with oxidizers, acids, strong reducing agents; may cause fire and explosive polymerization. Aldehydes are readily oxidized, releasing carboxylic acids. Contact with azo/diazo compounds, dithiocarbamates, nitrides, generates flammable and/or toxic gases. May react with air to release, initially, peroxo acids followed by ultimately carboxylic acids. These autoxidation reactions are activated by light, catalyzed by salts of transition metals, and are autocatalytic (catalyzed by the products of the reaction). The addition of stabilizers/antioxidants to shipments of aldehydes retards autoxidation[88].

Permissible Exposure Limits in Air: No OELs established.

Routes of Entry: Inhalation, ingestion, skin and/or eye contact.

Harmful Effects and Symptoms

Short Term Exposure: Contact can irritate the eyes, skin and respiratory tract. Exposure can cause nausea, vomiting, diarrhea, abdominal pain, irritability, sleepiness, muscle twitching, convulsions, coma and death. LD_{50} (oral, rat) = 227–283 mg/kg[83]; LD_{50} (dermal, rat) = >2000 mg/kg.

Long Term Exposure: May cause kidney and liver damage. May cause reproductive and fetal effects. Neurotoxic.

Points of Attack: Central nervous system, kidneys, and liver. Reproductive cells.

Medical Surveillance: Preplacement and periodic physical examinations should be concerned particularly with the skin, vision, central nervous system, liver and kidneys. In addition to comprehensive initial medical and work histories emphasizing reproductive experience and menstrual history, patient should have physical examination and testing of genito-urinary tract, sperm count, motility and morphology. If required, other tests, such as serum testosterone, serum follicle stimulating hormone (FSH), and serum lutenizing hormone (LH), may be indicated.

First Aid: If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least 15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately. If this chemical contacts the skin, remove contaminated clothing and wash immediately with soap and water. Seek medical attention immediately. If this chemical has been inhaled, remove from exposure, begin rescue breathing (using universal precautions) if breathing has stopped, and CPR if heart action has stopped. Transfer promptly to a medical facility. When this chemical has been swallowed, get medical attention. Give large quantities of water and induce vomiting. Do not make an unconscious person vomit.

Personal Protective Methods: Wear protective gloves and clothing to prevent any reasonable probability of dermal and/or eye contact. Safety equipment suppliers/manufacturers can provide recommendations on the most protective glove/clothing material for your operation. All protective clothing (suits, gloves, footwear, headgear) should be clean, available each day, and put on before work. Contact lenses should not be worn when working with this chemical. Wear dust-proof chemical goggles and face shield unless full facepiece respiratory protection is worn. Employees should wash immediately with soap when skin is wet or contaminated. Provide emergency showers and eyewash.

Respirator Selection: *At any concentrations above the NIOSH REL, or where there is no REL, at any detectable concentration:* SCBAF: Pd,Pp (APF = 10,000) (any NIOSH/MSHA- or European Standard EN 149-approved self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode); or SaF: Pd,Pp: ASCBA (APF = 10,000) (any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary, self-contained breathing apparatus operated in a pressure-demand or other positive-pressure mode).

Storage: Color Code-Blue: Health Hazard/Poison. Store in a secure poison location. Store in a cool, dry place or in a refrigerator[52] away from strong bases; strong acids, heat. Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: Metaldehyde can be described as FLAMMABLE SOLID, N. O. S., Hazard Class 4.1, Packing Group II or III.

Spill Handling: Evacuate and restrict persons not wearing protective equipment from area of spill or leak until clean up is complete. Dampen spilled material with toluene to avoid dust, then transfer material to a suitable container. Use absorbent paper dampened with toluene to pick up remaining material. Wash surfaces well with soap and water. Seal all wastes in vapor-tight plastic bags for eventual disposal[52]. Ventilate area of spill or leak after clean up is complete. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable. Soil Adsorption Index (K_{oc}) = 1900.

Fire Extinguishing: Flammable solid. Hazardous decomposition includes nitrogen oxides. Use dry chemical, carbon dioxide, alcohol-resistant foam extinguishers, as water may not be an effective extinguisher for fighting fire. *Fire may re-ignite once it has been extinguished*. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies. From a secure, explosion-proof location, use water spray to cool exposed containers. If cooling streams are ineffective (venting sound increases in volume and pitch, tank discolors, or shows any signs of deforming), withdraw immediately to a secure position. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode. Extinguish fires using an agent suitable for the type of surrounding fire; benomyl itself does not burn.

Disposal Method Suggested: In accordance with 40CFR165, follow recommendations for the disposal of pesticides and pesticide containers. Containers must be disposed of properly by following package label directions or by contacting your local or federal environmental control agency, or by contacting your regional EPA office.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- EXTOXNET, Extension Toxicology Network, "Pesticide Information Profile, Metaldehyde," Oregon State University, Corvallis, OR (June 1996). http://extoxnet.orst.edu/pips/metaldeh.htm
- USEPA, Office of Pesticide Programs, Pesticide Residue Limits, "Metalldehyde," ***40 CFR 180.523***. http://www.epa.gov/pesticides/food/viewtols.htm
- New Jersey Department of Health and Senior Services, "Hazardous Substance Fact Sheet, Metaldehyde," Trenton, NJ (June 1999). http://www.state.nj.us/health/eoh/rtkweb/1197.pdf
- *Note:* See the Website on META, provided by Lonza Group (Switzerland): http://www.metaldehyde.com/meta/en.html

Metamitron M:0485

Use Type: Herbicide

CAS Number: 41394-05-2

Formula: $C_{10}H_{10}N_4O$

Synonyms: 4-Amino-3-methyl-6-phenyl-1,2,4-triazin-5(4*H*)-one; 1,2,4-Triazin-5(4*H*)-one, 4-amino-3-methyl-6-phenyl-

Trade Names: BAY 6676®; BAY-DRW 1139®; DRW 1139®; GALAHAD®; GOLDBEET®; GOLTIX®; GOLTIX® 90; GOLTIX® SUPER; GOLTIX® WG; MM 70®; HERBRAK®; MARQUISE®; SKATER®; TORERO® (metamitron + ethofumesate)

Chemical class: Triazine; Triazinone

California DPR Chemical Code: 2672

UN/NA & ERG Number: UN3077 (solid)/171; UN3082 (liquid)/171

RTECS® Number: XZ3015000

EC Number: 255-349-3 [*Annex I Index No.:* 613-129-00-8]

Uses: Metamitron is a selective systemic herbicide that is absorbed through roots and leaves and inhibits photosynthesis. It is used to control grasses and broadleaf weeds in sugar beets and fodder beets. Not currently registered in the U.S. Used in most European countries and having 34 global suppliers[97].

Regulatory Authority and Advisory Information:

Acute Oral Category: 3, CAUTION

Health Advisory: Mutagen

European/International Regulations: Hazard Symbol: Xn, N; risk Phrases: R22; R43; R50; safety phrases: S2; S61 (see Appendix 1)

WGK (German Aquatic Hazard Class): 2-Hazard to waters

Description: Colorless to yellow crystalline solid. Mild, characteristic odor. Molecular weight = 202.22; Specific gravity (H_2O:1) = 1.35; Boiling point = 336 °C; (decomposes); Freezing/Melting point = 167–169 °C; Vapor pressure = 10^4 mmHg @ 25 °C. Highly soluble in water. Physical and toxicological properties may be affected by carrier solvents in commercial formulations.

Incompatibilities: Incompatible with oxidizers, acids, acid chlorides, acid halides, isocyanates, halogenated organics, peroxides, phenols (acidic), epoxides, anhydrides. Contact with strong reducing agents such as halides may generate explosive flammable gas. Decomposes in temperatures above 250 °C, producing toxic fumes, including nitrogen oxide.

Determination in Air: Filter; none; Gravimetric; NIOSH IV [Particulates NOR; #0500 (total), #0600 (respirable)][18].

Permissible Concentration in Water: Runoff from spills or fire control may cause water pollution.

Determination in Water: Log K_{ow} = <2.5. Unlikely to bioaccumulate in marine organisms.

Routes of Entry: Inhalation, passing through the unbroken skin, ingestion.

Harmful Effects and Symptoms

Short Term Exposure: May cause skin and severe eye irritation. Moderately poisonous if ingested or inhaled. May cause an allergic reaction. High levels of exposure can be fatal. LD_{50} (oral, rat) = 1200–2950 mg/kg; (dermal, rat) = >500 mg/kg.

Long Term Exposure: May cause lung irritation and damage. May cause skin allergy. Contact with some triazine compounds (such as atrazine) may increase risks of tumors known to be associated with hormonal factors. These have been observed in both animals and human beings, and are consistent with the known effects on the hypothalamic pituitary gonadal axis. Repeated exposure may cause weight loss and reduced red blood cell count. May cause reproductive and fetal effects.

Points of Attack: Liver, lungs, skin. Reproductive cells.

Medical Surveillance: Preliminary medical exam to detect chronic diseases of central nervous system, liver, heart, kidneys, lung and skin, as well as endocrinological or immunological disturbances, should protect susceptible individuals. Periodical medical exams of internal organs, skin and eyes are important to avoid chronic occupational intoxications. They should include lab and patch tests when necessary[83]. Before beginning employment and at regular times after that, for those with frequent or potentially high exposures, the following is recommended: Lung function tests. Consider chest x-ray following acute overexposure. Evaluation by a qualified allergist. Examination of the nervous system. In addition to comprehensive initial medical and work histories emphasizing reproductive experience and menstrual history, patient should have physical examination and testing of genito-urinary tract, sperm count, motility and morphology. If required, other tests, such as serum testosterone, serum follicle stimulating hormone (FSH), and serum lutenizing hormone (LH), may be indicated.

First Aid: If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least 15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately. If this chemical contacts the skin, remove contaminated clothing and wash immediately with soap and water. Seek medical attention immediately. If this chemical has been inhaled, remove from exposure, begin rescue breathing (using universal precautions) if breathing has stopped, and CPR if heart action has stopped. Transfer promptly to a medical facility. When this chemical has been swallowed, get medical attention. Give large quantities of water or milk and induce vomiting. Do not make an unconscious person vomit.

Personal Protective Methods: Applicators and other handlers must wear: Coveralls worn over long-sleeved shirt and long pants; Chemical-resistant gloves such as DuPont™ Tychem® suit fabrics, barrier laminate, or Viton®; Chemical-resistant footwear plus socks; Protective eye wear; Chemical-resistant headgear for overhead exposure; Chemical-resistant apron when cleaning equipment, mixing, or loading[83]. Agricultural Use/Engineering Controls: When handlers use closed systems, enclosed cabs, or aircraft in a manner that meets the requirements listed in the Worker Protection Standard (WPS) for agricultural pesticides, ***40 CFR 170.240(d)(4-6)***, the handler PPE requirements may be reduced or modified as specified in the Worker Protection Standard. Firefighters should wear NIOSH-approved self-contained breathing apparatus and full protective clothing.

Respirator Selection: Wherever and whenever workplace conditions warrant respirator use, a respiratory protection program must be followed that meets one or more of the following government standards: OSHA's 29 CFR 1910.134, ANSI Z88.2, or European Standard EN 149.

Shipping: Environmentally hazardous substances, solid or liquid, usually fall in Hazard Class 9.

Storage: Color Code-Blue: Health Hazard/Poison: Store in a tightly closed container in a dry, well-ventilated and secure poison location. Prior to working with this chemical you should be trained on its proper handling and storage. Where possible, automatically transfer material from other storage containers to process containers. Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Spill Handling: Do not touch damaged containers or spilled material unless wearing appropriate protective clothing. Stop leak if you can do it without risk. Prevent entry into waterways, sewers, basements or confined areas. Cover with plastic sheet to prevent spreading. Absorb or cover with dry earth, sand or other non-combustible material and transfer to containers. Do not allow water to get inside containers.

Fire Extinguishing: Hazardous decomposition includes toxic oxides of nitrogen and carbon. As an immediate precautionary measure, isolate spill or leak area in all directions for at least 50 meters/150 feet for liquids and at least 25 meters/75 feet for solids. *Fire involving storage or vehicular tanks:* isolate for 800 meters/0.5 mile in all directions; also, consider initial evacuation for 800 meters/0.5 mile in all directions. *On a small fire:* use dry chemical, CO_2, water spray or regular foam. *On a large fire:* use water spray, fog or regular foam. Do not scatter spilled material with high-pressure streams of water. Move containers from fire area if you can do it without risk. Dike fire-control water for later disposal. *Fire involving tanks:* from a secure, explosion-proof location, use water spray to cool exposed containers. If cooling streams are ineffective (venting sound increases in volume and pitch, tank discolors, or shows any signs of deforming), withdraw immediately to a secure position. Always stay away from tanks engulfed in fire. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode.

Disposal Method Suggested: Recycle any unused portion of the material for its approved use or return it to the manufacturer or supplier. Incineration with effluent gas scrubbing is recommended. Containers must be disposed of properly by following package label directions or by contacting your local or federal environmental control agency, or by contacting your regional EPA office. Ultimate disposal of the chemical must consider: the material's impact on air quality; potential migration in soil or water; effects on animal, aquatic, and plant life; and conformance with environmental and public health regulations.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov

Methamidophos M:0520

Use Type: Insecticide, Miticide

CAS Number: 10265-92-6

Formula: $C_2H_8NO_2PS$; $CH_3OP(O)(NH_2)SCH_3$

Synonyms: *O,S*-Dimethyl ester of amide of amidothioate; *O,S*-Dimethylphosphoramidothioate; ENT 27,396; Metamidofos (Spanish); Metamidofos estrella; NSC 190987

Trade Names: ACEPHATE-MET®; BAY 71625®; BAYER 71628®; CHEVRON 9006®; CHEVRON ORTHO 9006®; FILITOX®; GS-13005®; HAMIDOP®; METAFOS®; MONITOR®; MTD®; NITOFOL®; NURATRON®; ORTHO 9006®; PATROLE®; PILLARON®; SRA 5172®; SUPRACIDE®; SWIPE®; TAHMABON®; TAMARON®; VITARON®

Chemical class: Organophosphorus

EPA/OPP PC Code: 101201

California DPR Chemical Code: 1697

HSDB Number: 1593

UN/NA & ERG Number: UN2783 (solid)/152; UN3018 (liquid)/152

RTECS® Number: TB4970000

EC Number: 233-606-0 [*Annex I Index No.:* 015-095-00-4]

Uses: Methamidophos is a highly active, systemic, residual organophosphate insecticide/acaricide/avicide with contact and stomach action. Its mode of action in insects and mammals is by decreasing the activity of an enzyme important for nervous system function called acetylcholinesterase. This enzyme is essential in the normal transmission of nerve impulses. Methamidophos is a potent acetylcholinesterase inhibitor. It is effective against chewing and sucking insects and is used to control aphids, flea beetles, worms, whiteflies, thrips, cabbage loopers, Colorado potato beetles, potato tubeworms, armyworms, mites, leafhoppers, and many others. Crop uses include broccoli, Brussels sprouts, cauliflower, grapes, celery, sugar beets, cotton, tobacco, and potatoes. It is used abroad for many vegetables, hops, corn, peaches, and other crops. Generally, methamidophos is not considered phytotoxic if used as directed, but defoliation has occurred when applied as foliar spray to deciduous fruit. It is compatible with many other pesticides, but do not use with alkaline materials. Methamidophos is slightly corrosive to mild steel and copper alloys. This compound is highly toxic to mammals, birds, and bees. Do not graze treated areas, and be sure to wear protective clothing including respirator, chemical goggles, rubber gloves, and impervious protective clothing. A U.S. EPA restricted Use Pesticide (RUP). Not approved for use in EU countries[115].

U.S. Maximum Allowable Residue Levels for Methamidophos [40 CFR 180.315(a)]: in or on the following raw agricultural commodities: broccoli 1.0 ppm; Brussels sprouts 1.0 ppm; cabbage 1.0 ppm; cauliflower 1.0 ppm; cotton, undelinted seed 0.1 ppm; cucumber 1.0 ppm; eggplant 1.0 ppm; lettuce 1.0 ppm; melon 0.5 ppm; pepper 1.0 ppm; potato 0.1 ppm; and tomato 1.0 ppm. ***Regional registration, as defined in section 180.1(n) [40 CFR 180.315(b)]:*** in or on the following raw agricultural commodity: celery 1 ppm.

Human toxicity (long-term)[101]: High–7.00 ppb, Health Advisory

Fish toxicity (threshold)[101]: Low–165.16992 ppb, MATC (Maximum Acceptable Toxicant Concentration)

Regulatory Authority and Advisory Information:

Carcinogenicity[83]: EPA, Not likely to be carcinogenic to humans

Acute Oral Category: 1, DANGER–POISON

Health Advisory: Mutagen, Developmental/Reproductive Toxin

EPA Oral reference dose (RfD) = 0.00005 mg/kg/day (UF: 1000, MF: 1)

Superfund/EPCRA 302 Extremely Hazardous Substances: TPQ = 100/10,000 lb (45.4/4,540 kg)

Superfund/EPCRA 40CFR302.4 RQ: EHS, 1 lb (0.454 kg)

U.S. DOT 49CFR172.101, Inhalation Hazard Chemical as organophosphates

U.S. DOT Regulated Marine Pollutant (49CFR172.101, Appendix B)

Rotterdam Convention Annex III [Chemicals Subject to the Prior Informed Consent Procedure (PIC)] [methamidophos (soluble liquid formulations of the substance that exceed 600 g active ingredient/l)]

European/International Regulations: Hazard Symbol: T+, N; risk phrases: R24; R26/28; R50; safety phrases: S1/2; S28; S36/37; S45; S61 (see Appendix 1)

WGK (German Aquatic Hazard Class): 3-Severe hazard to waters

Description: Methamidophos is a white to off-white crystalline solid. Mercaptan odor (like sulfur). Commercially available formulations include soluble concentrate, emulsifiable concentrate, wettable powder, granules, ultra-low-volume spray and water-miscible spray concentrate. Molecular weight = 141.12; Specific gravity (H_2O:1) = 1.27; Boiling point = (decomposes); Freezing/Melting point = 44.5–45 °C; Vapor pressure = 8×10^{4} mmHg @ 20 °C; Flash point = 205 °C. Hazard Identification (based on NFPA-704 M Rating System): Health 3, Flammability 1, Reactivity 0. Highly soluble in water. Often used as a liquid in a carrier solvent which may change physical and toxicological properties.

Incompatibilities: May react violently with antimony(V) pentafluoride. Incompatible with lead diacetate, magnesium, silver nitrate. In the presence of strong reducing agents such as hydrides, organophosphates form highly toxic and flammable phosphine gas. Contact with oxidizers can cause the release of toxic oxides of phosphorus. Incompatible with strong acids or alkali. Attacks mild steel and copper-containing alloys (technical grade).

Determination in Air: OSHA versatile sampler-2; Toluene/Acetone; Gas chromatography/Flame photometric detection for sulfur, nitrogen, or phosphorus; NIOSH Method IV Method #5600, Organophosphorus pesticides[18].

Permissible Concentration in Water: State Drinking Water Guidelines: Florida 5 μg/L. Runoff from spills or fire control may cause water pollution.

Determination in Water: NIOSH Method 1657. The determination of organophosphorus pesticides in municipal and industrial wastewater by gas chromatography. Detection limit = 6.0 ng/L. Log K_{ow} = Negative. Unlikely to bioaccumulate in marine organisms.

Routes of Entry: Inhalation, ingestion and dermal contact.

Harmful Effects and Symptoms: Organophosphates are highly toxic. Symptoms may develop rapidly, or there may be a delay of several hours following exposure before they become noticeable. The delay tends to be longer in the case of some compounds that dissolve fats, lipids, oils and non-polar solvents such as toluene. Symptoms may increase in severity for more than a single day and last for several days. In severe cases of of organophosphate intoxication, respiratory failure may occur.

Short Term Exposure: Irritates the eyes. Organic phosphorus insecticides are absorbed by the skin, as well as by the respiratory and gastrointestinal tracts. They are cholinesterase inhibitors. Symptoms of exposure include headache, giddiness, blurred vision, nervousness, weakness, nausea, cramps, diarrhea, and discomfort in the chest. Signs include sweating, tearing, salivation, vomiting, cyanosis, convulsions, coma, loss of reflexes and loss of sphincter control. This material is highly toxic. Acute exposure to methamidophos may also produce the following signs and symptoms of exposure: pinpoint pupils, blurred vision, headache, dizziness, muscle spasms, and profound weakness. Vomiting, diarrhea, abdominal pain, seizures, and coma may also occur. The heart rate may decrease following oral exposure or increase following dermal exposure. Chest pain may be noted. Hypotension (low blood pressure) may be noted, although hypertension (high blood pressure) is not uncommon. Respiratory symptoms include dyspnea (shortness of breath), respiratory depression, and respiratory paralysis. Psychosis may occur. LD_{50} (oral, rat) = 7.5–30 mg/kg; LD_{50} (dermal, rat) = 50 mg/kg.

Long Term Exposure: The substance may have effects on the nervous system, resulting in delayed neuropathy. Cholinesterase inhibitor; cumulative effect is possible. A nerve toxin; may damage the nervous system with repeated exposure, resulting in convulsions, respiratory failure. May cause liver damage. May cause reproductive and fetal effects.

Points of Attack: Respiratory system, lungs, central nervous system, cardiovascular system, skin, eyes, plasma and red blood cell cholinesterase. Reproductive cells of mammals.

Medical Surveillance: Before employment and at regular times after that, the following are recommended: Plasma and red blood cell cholinesterase levels (tests for the enzyme poisoned by this chemical). If exposure stops, plasma levels return to normal in 1–2 weeks while red blood cell levels may be reduced for 1–3 months. When acetylcholinesterase enzyme levels are reduced by 25% or more below preemployment levels, risk of poisoning is increased, even if results are in lower ranges of "normal." Reassignment to work not involving organophosphate or carbamate pesticides is recommended until enzyme levels recover. If symptoms develop or overexposure occurs, repeat the above tests as soon as possible and get an exam of the nervous system. Also consider complete blood count and chest x-ray following acute overexposure. Do not drink any alcoholic beverages before or during use. Alcohol promotes absorption of organophosphates. In addition to comprehensive initial medical and work histories emphasizing reproductive experience and menstrual history, patient should have physical examination and testing of genito-urinary tract, sperm count, motility and morphology. If required, other tests, such as serum testosterone, serum follicle stimulating hormone (FSH), and serum lutenizing hormone (LH), may be indicated.

First Aid: Speed in removing material from eyes and skin is of extreme importance. If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least 15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately. If this chemical contacts the skin, remove contaminated clothing and wash immediately with soap and water. Shampoo hair promptly if contaminated. Seek medical attention immediately. If this chemical has been inhaled, remove from exposure, begin rescue breathing (using universal precautions) if breathing has stopped, and CPR if heart action has stopped. Transfer promptly to a medical facility. When this chemical has been swallowed, get medical attention. Give large quantities of water and induce vomiting. Do not make an unconscious person vomit. Obtain authorization of an antidote or performance of other invasive procedures. The effects may be delayed. Medical observation recommended. *Note to physician or authorized medical personnel:* 1,1'-trimethylenebis(4-formylpyridinium bromide)dioxime (a.k.a. TMB-4 dibromide and TMV-4) has been used as an antidote for organophosphate poisoning.

Personal Protective Methods: Wear protective gloves and clothing to prevent any reasonable probability of dermal and/or eye contact. Safety equipment suppliers/manufacturers can provide recommendations on the most protective glove/clothing material for your operation. One recommendation is the use of DuPont™ Tychem® suit fabrics[88]. All protective clothing (suits, gloves, footwear, headgear) should be clean, available each day, and put on before work. Contact lenses should not be worn when working with this chemical. Wear splash-proof chemical goggles and face shield unless full facepiece respiratory protection is worn. Employees should wash immediately with soap when skin is wet or contaminated. Provide emergency showers and eyewash.

Respirator Selection: Engineering controls should be used wherever feasible to maintain airborne concentrations of this chemical below the prescribed exposure limit. Respirators and protective equipment are less effective than engineering controls, and should be used only in non-routine or emergency situations which may result in exposure concentrations in excess of the TWA environmental limit. *At any concentrations above the NIOSH REL, or where there is no REL, at any detectable concentration:* SCBAF: Pd,Pp (APF = 10,000) (any NIOSH/MSHA- or European Standard EN 149-approved self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode); or SaF: Pd,Pp: ASCBA (APF = 10,000) (any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary, self-contained breathing apparatus operated in a pressure-demand or other positive-pressure mode).

Storage: Color Code-White: Corrosive or Contact Hazard; Store separately in a corrosion-resistant location. Color Code-Blue: Health Hazard/Poison. Store in a secure poison location. Prior to working with this chemical you should be trained on its proper handling and storage. Where possible, automatically transfer material from other storage containers to process containers. Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: Organophosphorus pesticides, solid or liquid (nonflammable), require a "poisonous materials" label. This chemical falls in Hazard Class 6.1.

Spill Handling: First remove all sources of ignition. Evacuate persons not wearing protective equipment from area of spill or leak until clean up is complete. Stay upwind; keep out of low areas. Ventilate area of spill or leak. Remove and isolate contaminated clothing at the site. Do not touch spilled material; stop leak if you can do so without risk. Use water spray to reduce vapors. *Small spills:* absorb with sand or other noncombustible absorbent material and place into containers for later disposal. *Large spills:* dike far ahead of spill for later disposal. Collect powdered material in the most convenient and safe manner and deposit in sealed containers. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable. Seek professional environmental engineering assistance from the U.S. EPA Environmental Response Team at (908) 548-8730 (24-hour response line).

Fire Extinguishing: Hazardous decomposition includes nitrogen oxides, sulfur oxides and phosphorus oxides. May be fatal if inhaled, ingested or absorbed through skin. Inhalation or contact with some of these materials will irritate or burn skin and eyes. Vapors may cause dizziness or suffocation. *Small fires:* dry chemical, carbon dioxide; water spray; or foam. *Large fires:* water spray, fog, or foam. Stay upwind; keep out of low areas. Ventilate closed spaces before entering them. Firefighting gear (including SCBA) may not provide adequate protection. If exposure occurs, remove and isolate gear immediately and thoroughly decontaminate personnel. Wear positive-pressure breathing apparatus and special protective clothing. Remove and isolate contaminated clothing at the site. Move container from fire area if you can do so without risk. Fight fire from maximum distance. Dike fire-control water for later disposal; do not scatter the material. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies. From a secure, explosion-proof location, use water spray to cool exposed containers. If cooling streams are ineffective (venting sound increases in volume and pitch, tank discolors, or shows any signs of deforming), withdraw immediately to a secure position. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode.

Disposal Method Suggested: Destruction by alkali hydrolysis or incineration. Containers must be disposed of properly by following package label directions or by contacting your local or federal environmental control agency, or by contacting your regional EPA office.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- EXTOXNET, Extension Toxicology Network, "Pesticide Information Profile, Methamidophos," Oregon State University, Corvallis, OR. http://extoxnet.orst.edu/pips/methamid.htm
- USEPA, Office of Pesticide Programs, Pesticide Residue Limits, "Methamidophos," ***40 CFR 180.315***. http://www.epa.gov/pesticides/food/viewtols.htm
- USEPA, "Chemical Profile: Methamidophos," Washington, DC, Chemical Emergency Preparedness Program (Nov.30, 1987)

Metham-sodium M:0536

Use Type: Fungicide; Nematicide, Herbicide, Soil fumigant, Algaecide

CAS Number: 137-42-8; 6734-80-1 (dihydrate)

Formula: $C_2H_4NNaS_2$; $C_2H_4NNaS_2 \cdot 2H_2O$ (dihydrate)

Synonyms: Carbam; Carbamic acid, methyldithio-, monosodium salt; Carbamic acid, *N*-methyldithio-, monosodium salt; Carbamic acid, *N*-methyldithio-, sodium salt; Carbamodithioic acid, methyl-, monosodium salt; Carbam, sodium salt; Carbathion; Carbathione; Carbation; Carbothion; Diethylamino-2,6-acetoxylidide; Methan-sodium; *N*-Methylaminodithioformic acid sodium salt; *N*-Methylaminomethanethionothiolic acid sodium salt; Methylcarbamodithioic acid sodium salt; Methyldithiocarbamic acid, sodium salt; SMDC; Sodium metam; Sodium metham; Sodium *N*-methylaminodithioformate; Sodium *N*-methylaminomethanethionothiolate; Sodium methylcarbamodithioate; Sodium methyldithiocarbamate; Sodium *N*-methyldithiocarbamate; Sodium monomethyldithiocarbamate

Trade Names: A7-VAPAM®; BASAMID-FLUID®; BUSAN®; CHAP-FUME®; DISCOVERY®; HERBATIM (dihydrate)®; KARBATION®; KARBATION (dihydrate)®; MAPOSOL®; MAPOSOL (dihydrate)®; METACIDE®; METAM (dihydrate)®; METAM-FLUID BASF®; METHAM DIHYDRATE (dihydrate)®; MONAM (dihydrate)®; N-869®; N 869 (dihydrate)®; NEMATIN®; SECTAGON®; SISTAN®; SMDC (dihydrate)®; SOLASAN 500®; SOLESAN 500®; SOMETAM®; TRAPEX®; TRIMATON (dihydrate)®; TRIMATRON®; UCETAM®; VAPAM®; VAPAM (dihydrate)®; VAPOROOTER (dihydrate)®; VDM®; VPM (dihydrate)®; VPM® Fungicide; VPN®; WOODFUME VAPAM®

Chemical class: Dithiocarbamate

EPA/OPP PC Code: 039003

California DPR Chemical Code: 616

HSDB Number: 1767

UN/NA&ERG Number: UN3267/153; UN2771(solid)/151

RTECS® Number: FC2100000

EC Number: 205-293-0 [*Annex I Index No.:* 006-013-00-8]

Uses: A general soil biocide that is used to control weeds, weed seeds, roots, tubers, rhizomes, insects, nematodes and soil inhabiting fungi on all food and non-food crops. Also used as a pre-planting fumigant in seed beds, vine crops, fruit trees, row crops, flowers and ornamentals. Environmental friendly; it breaks down after two weeks into carbon dioxide, water, and sodium and sulfur in small amounts. A U.S. EPA restricted Use Pesticide (RUP). Registered for use in some EU countries[115].

Human toxicity (long-term)[101]: High–1.76768 ppb, CHCL (Chronic Human Carcinogen Level)

Fish toxicity (threshold)[101]: Intermediate–60.02431 ppb, MATC (Maximum Acceptable Toxicant Concentration)

Regulatory Authority and Advisory Information:

Carcinogenicity[83]: EPA Group B2, Probable human carcinogen.

California Proposition 65 Chemical: Carcinogen (11/6/1998); developmental toxin (5/15/1998)

Health Advisory: Developmental/Reproductive Toxin

Acute Oral Category: 3, CAUTION

EPA Hazardous Waste Number (RCRA No.): U384

EPCRA Section 313 Form R *de minimis* concentration reporting level: 1.0%

Marine pollutant (49CFR, Subchapter 172.101, Appendix B)

U.S. DOT Regulated Marine Pollutant (49CFR172.101, Appendix B)

European/International Regulations: Hazard Symbol: Xn, Xi, H, N; risk Phrases: R22; R31/34; R43; R50/53; R63; safety phrases: S1/2; S26; S36/37/39; S45; S60; S61 (see Appendix 1)

Description: A yellow to nearly clear yellow-green solution. Also described as a colorless to white crystalline solid. Unpleasant sulfur-amine odor, similar to that of carbon disulfide. Molecular weight = 129.18, 165.21 (dihydrate); Freezing/Melting point (decomposes); Boiling point = 110 °C (technical product); Vapor pressure = 20 mmHg @ 20 °C. Readily soluble in water; solubility = 722 g/L @ 20 °C. Water reactive.

Incompatibilities: Slow reaction upon dilution produces the toxic gases hydrogen sulfide and methylisothiocyanate. This reaction is accelerated by the addition of acid[88]. May liberate toxic gas when in contact with acids. Combustible; vapors when heated or dust from dry material may form explosive mixture in air. Keep away from water, acid, oxidizing materials. Heat or contact with moisture or acids causes rapid decomposition and the generation of toxic and flammable hydrogen sulfide and carbon disulfide. Dithiocarbamates are incompatible with acids, peroxides, and acid halides. Flammable gases are generated by reaction with aldehydes, nitrides, and hydrides. Incompatible with oxidizers including peroxides, acids, acid halides, mercury[88]. Corrosive to iron, copper, brass and zinc metals, especially in the presence of moisture. Heat alkalies (lime), moisture can cause decomposition. Degradation produces ethylene thiourea.

Determination in Air: Filter; none; Gravimetric; NIOSH IV [Particulates NOR; #0500 (total), #0600 (respirable)][18].

Permissible Concentration in Water: State Drinking Water Guidelines: California 20 μg/L. Runoff from spills or fire control may cause water pollution.

Determination in Water: EPA EMSLC Method 630. The Determination of Dithiocarbamate Pesticides in Municipal and Industrial Wastewater by UV-VIS Spectrophotometry. Log K_{ow} = <0.5. Unlikely to bioaccumulate in marine organisms.

Harmful Effects and Symptoms

Short Term Exposure: The acute symptoms of exposure to metham sodium are excessive salivation, sweating, fatigue, weakness, nausea, headache, dizziness, eye and respiratory tract irritation, and skin irritation in the form of rashes[88]. Concentrated solutions are corrosive to eyes and mucous membranes. Dust inhalation can cause irritation of the respiratory system with sneezing. Eye contact can cause irritation, watering, pain, and inflammation of the eyelids. Dermal contact can cause irritation and minor ulceration. Ingestion can cause nausea, vomiting, fever, muscle twitching, seizure, rapid respiration, slow heart beat. Severe exposure may result in death. Unlike carbamates the dithiocarbamates are not cholinesterase inhibitors, but some of them may react with recently ingested alcohol or alcohol-containing products including wine, medications, and cold remedies such as cough-syrups. LD_{50} (oral, rat) = LD_{50} (oral, rat) = 845 mg/kg[83]; LD_{50} (dermal, rat) = >500 mg/kg.

Long Term Exposure: May cause skin sensitization; Liver and urinary tract effects.

Points of Attack: Respiratory system, central nervous system, cardiovascular system, skin and eyes, liver, urinary tract.

Medical Surveillance: This chemical is a suspected or known human carcinogen. Exposed persons should contact a physician for advice regarding the possible long term health effects and advice for medical monitoring. Medical observation is recommended for 24 to 48 hours following breathing overexposure, as pulmonary edema may be delayed. Before employment and at regular times after that, the following are recommended: If symptoms develop or overexposure occurs, repeat the above tests as soon as possible and get an exam of the nervous system. Also consider complete blood count and chest x-ray following acute overexposure. Evaluation by a qualified allergist, including exposure history and testing, may help diagnose allergy.

First Aid: Move victim to fresh air. Call 911 or emergency medical service. Give artificial respiration if victim is not breathing. Do not use mouth-to-mouth method if victim ingested or inhaled the substance; give artificial respiration with the aid of a pocket mask equipped with a one-way valve or other proper respiratory medical device. Administer oxygen if breathing is difficult. Remove and isolate contaminated clothing and shoes. In cases of contact with substance, immediately flush skin or eyes with running water for at least 20 minutes. For minor skin contact, avoid spreading material on unaffected skin. Keep victim warm and quiet. Effects of exposure (inhalation, ingestion or skin contact) to substance may be delayed. Ensure that medical personnel are aware of the material(s) involved and take precautions to protect themselves[ERG].

Personal Protective Methods: Reacts with the following absorbent materials: Cellulose-Based; Mineral- and Clay-Based; Dirt/Earth[88]. Wear protective gloves and clothing to prevent any reasonable probability of dermal and/or eye contact. Safety equipment suppliers/manufacturers can provide recommendations on the most protective glove/clothing material for your operation. All protective clothing (suits, gloves, footwear, headgear) should be clean, available each day, and put on before work. Contact lenses should not be worn when working with this chemical. Wear splash-proof chemical goggles and face shield unless full facepiece respiratory protection is worn. Employees should wash immediately with soap when skin is wet or contaminated. Provide emergency showers and eyewash.

Respirator Selection: *At any detectable concentration:* SCBAF: Pd,Pp (APF = 10,000) (any NIOSH/MSHA- or European Standard EN 149-approved self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode); or SaF: Pd,Pp: ASCBA (APF = 10,000) (any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary, self-contained breathing apparatus operated in a pressure-demand or other positive-pressure mode). *Escape:* 100F (APF = 50) (any air-purifying, full facepiece respirator with an N100, R100, or P100 filter k-mounted organic vapor canister having a high-efficiency particulate filter); or SCBAE (any appropriate escape-type, self-contained breathing apparatus).

Storage: Color Code-White: Corrosive or Contact Hazard; Store separately in a corrosion-resistant location. Prior to working with this chemical you should be trained on its proper handling and storage. Store in tightly closed containers in a cool, well-ventilated area. Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: Thiocarbamate and dithiocarbamate pesticides, solid, toxic, require a label of "poisonous materials." They usually fall in Hazard Class 6.1.

Spill Handling: First remove all sources of ignition. Do not touch damaged containers or spilled material unless wearing appropriate protective clothing. Stop leak if you can do it without risk. Prevent entry into waterways, sewers, basements or confined areas. Absorb or cover with dry earth, sand or other non-combustible material and transfer to containers. *Do not get water inside containers*[ERG]. Evacuate persons not wearing protective equipment from area of spill or leak until clean up is complete. Collect powdered material in the most convenient and safe manner and deposit in sealed containers. Ventilate area after clean up is complete. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable.

Fire Extinguishing: Hazardous decomposition includes oxides of nitrogen, disodium oxide, and sulfur. Extinguish fire using an agent suitable for type of surrounding fire. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies. From a secure, explosion-proof location, use water spray to cool exposed containers. If cooling streams are ineffective (venting sound increases in volume and pitch, tank discolors, or shows any signs of deforming), withdraw immediately to a secure position. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode.

Disposal Method Suggested: Do not discharge into drains or sewers. Dispose of waste material as hazardous waste using a licensed disposal contractor to an approved landfill. Consult with environmental regulatory agencies for guidance on acceptable disposal practices. Generators of waste containing this contaminant (≥100 kg/mo) must conform with EPA regulations governing storage, transportation, treatment, and waste disposal. A potential candidate for liquid injection incineration at a temperature range of 650 to 1600 °C and a residence time 0.1 to 2 seconds. Also, a potential candidate for rotary kiln incineration at a temperature range of 820 to 1600 °C and residence times of seconds for liquids and gases, and hours for solids[83].

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- "In-Row Sprayblade Fumigation with Metam Sodium to Control Weeds and Diseases," *Skagit Veg Trials,* Anderson, W. C. 'Andy,' and Haglund, William A., Washington State University, Mount Vernon, WA. http://www.mtvernon.wsu.edu/SkagitVegTrials/methamsodium.html

Methidathion M:0540

Use Type: Insecticide

CAS Number: 950-37-8

Formula: $C_6H_{11}N_2O_4PS_3$

Synonyms: *S*-(2,3-Dihydro-5-methoxy-2-oxo-1,4,4-thiadiazol-3-methyl); *O,O*-Dimethyl-*S*-(2-methoxy-1,3,4-thiadiazole-5(4H)-onyl-(4)-methyl)-phosphorodithioate; *O,O*-Dimethyl phosphorodithioate *S*-ester with 4-(mercaptomethyl)2-methoxy-δ.-1,3,4-thiadiazolin-5-one; DMTP; ENT 27,193; Metidation (Spanish); *S*-[(5-Methoxy-2-oxo-1,3,4-thiadiazol-3(2H)-yl]methyl)-*O,O*-dimethyl phosphordithioate

Trade Names: CIBA-GEIGY® GS 13005®; COBRACIDE®; FISONS NC® 2964; GEIGY® 13005;

GS-13005®; SOMONIC®; SOMONIL®; SURPRACIDE®; SUPRATHION®; ULTRACID®; ULTRACIDE®

Chemical class: Organophosphate

EPA/OPP PC Code: 100301

California DPR Chemical Code: 1689

HSDB Number: 1594

UN/NA & ERG Number: UN2783 (solid)/152

RTECS® Number: TE2100000

EC Number: 213-449-4 [*Annex I Index No.:* 015-069-00-2]

Uses: A U.S. EPA restricted Use Pesticide (RUP). Not approved for use in EU countries[115]. There are no residential uses for methidathion. Methidathion is a non-systemic organophosphate insecticide and acaricide with stomach and contact action. The compound is used to control a variety of insects and mites in many crops such as nuts, artichokes, olives, cotton, fruits, vegetables, tobacco, alfalfa, and sunflowers, and also in greenhouses and on rose cultures. It is especially useful against scale insects.

U.S. Maximum Allowable Residue Levels for Methidathion all with a Expiration/revocation date of 12/31/2016 [40 CFR 180.298 (a)]: almond hulls 6.0 ppm; artichoke, globe 0.05 ppm; citrus, oil 420.0 ppm; cotton, undelinted seed 0.2 ppm; fruit, citrus, group 10, except tangerine, 4.0 ppm; fruit, pome, group 11, 0.05 ppm; fruit, stone, group 12, 0.05 ppm; mango 0.05 ppm; nut, tree, group 14, 0.05 ppm; olive 0.05 ppm; safflower, seed 0.5 ppm; sorghum, forage, forage 2.0 ppm; sorghum, grain, forage 2.0 ppm; sorghum, grain, grain 0.2 ppm; sorghum, grain, stover 2.0 ppm; sunflower, seed 0.5 ppm; tangerine 6.0 ppm. ***[40 CFR 180.298 (c)]:*** in or on kiwifruit 0.1 ppm; longan 0.1 ppm; starfruit 0.1 ppm; sugar apple 0.2 ppm.

Human toxicity (long-term)[101]: High–1.05 ppb, Health Advisory

Fish toxicity (threshold)[101]: Extra high–0.15019 ppb, MATC (Maximum Acceptable Toxicant Concentration)

Regulatory Authority and Advisory Information:

Carcinogenicity[83]: EPA Group C, Possible human carcinogen

Health Advisory: Nerve Toxin, Mutagen, Skin irritant/sensitizer

Acute Oral Category: 1, DANGER–POISON

Superfund/EPCRA 302 Extremely Hazardous Substances: TPQ = 500/10,000 lb (227/4,540 kg)

Superfund/EPCRA 40CFR302.4 RQ: EHS, 1 lb (0.454 kg)

U.S. DOT Regulated Marine Pollutant (49CFR172.101, Appendix B)

Extremely Hazardous Substance (EPA-SARA) (TPQ = 500)[7]

U.S. DOT 49CFR172.101, Inhalation Hazard Chemical as organophosphates

European/International Regulations: Hazard Symbol: T+, Xn, N; risk phrases: R21; R28; R50/53; safety phrases: S1/2; S22; S28; S36/37; S45; S60; S61 (see Appendix 1)

WGK (German Aquatic Hazard Class): 3-Severe hazard to waters

Description: Methidathion is a colorless crystalline solid or powder. Organophosphate odor. Molecular weight = 302.34; Specific gravity (H_2O:1) = 1.495 @ 20 °C; Freezing/Melting point = 39–40 °C; Vapor pressure = 3.4×10^{6} mmHg @ 20 °C; 0.186 mmHg @ 20 °C. Henry's Law constant = 7.2×10^{6} atm-m^3/mol @ 25 °C (est)[83]. Moderately soluble in water; solubility = 225 ppm @ 20 °C. Physical and toxicological properties may be affected by carrier solvents in commercial formulations.

Incompatibilities: May react violently with antimony(V) pentafluoride. Incompatible with lead diacetate, magnesium, silver nitrate. In the presence of strong reducing agents such as hydrides, organophosphates form highly toxic and flammable phosphine gas. Contact with oxidizers can cause the release of toxic oxides of phosphorus.

Permissible Exposure Limits in Air: Protective Action Criteria (PAC) Ver. 27[89]

PAC-1: 1.8 mg/m^3
PAC-2: 20 mg/m^3
PAC-3: 160 mg/m^3

Permissible Concentration in Water: Runoff from spills or fire control may cause water pollution.

Determination in Water: Log K_{ow} = <3.0.Values above 3.0 are likely to bioaccumulate in aquatic organisms.

Routes of Entry: Inhalation, ingestion, skin and/or eye contact. Absorbed through the unbroken skin.

Harmful Effects and Symptoms

Short Term Exposure: This material is poisonous to humans. Its toxic effects are by action on the nervous system. Organic phosphorus insecticides are absorbed by the skin, as well as by the respiratory and gastrointestinal tracts. They are cholinesterase inhibitors. Symptoms of exposure include headache, giddiness, blurred vision, nervousness, weakness, nausea, cramps, diarrhea, and discomfort in the chest. Signs include sweating, tearing, salivation, vomiting, cyanosis, convulsions, coma, loss of reflexes and loss of sphincter control. Human volunteers ingesting 0.11 mg/kg/day for 6 weeks had no clinical effects. Symptoms are similar to parathion poisoning and may include nausea, vomiting, abdominal cramps, diarrhea, excessive salivation, headache, dizziness, giddiness, weakness, muscle twitching, difficult breathing, sensation of tightness of chest, blurring or dimness of vision, and loss of muscle coordination. Death may occur from failure of the respiratory center, paralysis of the respiratory muscles, intense broncho-constriction, or all three. Delayed pulmonary edema may occur after inhalation. LD_{50} (oral, rat) = 20–32 mg/kg; LD_{50} (dermal, rat) = 25 mg/kg.

Long Term Exposure: Cholinesterase inhibitor; cumulative effect is possible. A nerve toxin; methidathion may damage the nervous system with repeated exposure, resulting in convulsions, respiratory failure. May cause liver and gallbladder damage. Possible reproductive (ovaries) toxin and nerve poison.

Points of Attack: Respiratory system, lungs, central nervous system, central nervous system, cardiovascular system, skin, eyes, plasma, ovaries, and red blood cell cholinesterase.

Medical Surveillance: This chemical is a suspected or known human carcinogen. Exposed persons should contact a physician for advice regarding the possible long term health effects and advice for medical monitoring. Medical observation is recommended for 24 to 48 hours following breathing overexposure, as pulmonary edema may be delayed. Routine biological monitoring of pesticide applicators and field workers includes testing of plasma and red blood cell acetylcholinesterase levels (for enzyme poisoned by this chemical). These tests are normally accurate only if done within about two hours of exposure. If exposure stops, plasma levels return to normal in 1–2 weeks while red blood cell levels may be reduced for 1–3 months. When acetylcholinesterase enzyme levels are reduced by 25% or more below preemployment levels, risk of poisoning is increased, even if results are in lower ranges of "normal." Reassignment to work not involving organophosphate pesticides is recommended until enzyme levels recover. Do not drink any alcoholic beverages before or during use as it promotes absorption of organophosphates. ***First Aid:*** **Treatment for organophosphate poisoning consists of thorough decontamination, cardiorespiratory support, and administration of the antidotes atropine and pralidoxime. In cases of severe poisoning, diazepam, an anticonvulsant, should also be administered. Antidotes should be administered as prevention even if the diagnosis is in doubt**. *Eyes:* Speed in removing material from eyes and skin is of extreme importance. Eye contact can cause dangerous amounts of these chemicals to be quickly absorbed through the mucous membrane into the bloodstream. Immediately and gently flush eyes with plenty of warm or cold water (NO hot water) for at least 15 minutes, occasionally lifting the upper and lower eyelids. Get medical aid immediately. *Skin:* Get medical aid. Dermal contact can cause dangerous amounts of these chemicals to be absorbed into the bloodstream. Wearing the appropriate PPE equipment and respirator for organophosphate pesticides, immediately flush skin with plenty of soap and water for at least 15 minutes while removing contaminated clothing and shoes. Shampoo hair promptly if contaminated. The removed, contaminated clothing and shoes should be double-bagged and left in Hot Zone for later disposal by hazardous materials experts. Skin may also be decontaminated with diluted hypochlorite solution. *Inhalation:* Get medical aid. Do not contaminate yourself. Wearing the appropriate PPE equipment and respirator for organophosphate pesticides, immediately remove the victim from the contaminated area to fresh air. If the victim is not breathing, administer artificial respiration. Do not use mouth-to-mouth method if victim ingested or inhaled the substance; give artificial respiration with the aid of a pocket mask equipped with a one-way valve or other proper respiratory medical device. If breathing is difficult, administer oxygen through bag/mask apparatus until medical help arrives. Do not leave victim unattended. *Ingestion:* Call poison control. Loosen all clothing. Never give anything by mouth to an unconscious person. If victim is *unconscious or having convulsions,* do nothing except keep victim warm. Get medical aid. Transfer promptly to a medical facility. In cases of ingestion, **do not induce vomiting**. If the victim is alert and asymptomatic, administer a slurry of activated charcoal at a dose of 1 g/kg (infant, child, and adult dose). A soda can and straw may be of assistance when offering charcoal to a child. *In some cases you may be specifically instructed by poison control to induce vomiting by way of 2 tablespoons of syrup of ipecac (adult) washed down with a cup of water*. Do NOT give activated charcoal before or with ipecac syrup *Note to physician or authorized medical personnel:* Treat cases of respiratory compromise, coma, or excessive pulmonary secretions with respiratory support using protocols and techniques available and within the scope of training. Some cases may necessitate procedures such as endotracheal intubation or cricothyrotomy by properly trained and equipped personnel. When possible, atropine (see *Antidotes*, below) should be given under medical supervision. Patients who are comatose, hypotensive, or having seizures or cardiac arrhythmias should be treated according to advanced life support protocols. *Antidotes:* Two antidotes are administered to treat organophosphate poisoning. Atropine is a competitive antagonist of acetylcholine at muscarinic receptors and is used to control the excessive bronchial secretions which are often responsible for death. Pralidoxime relieves both the nicotinic and muscarine effects of organophosphate poisoning by regenerating acetylcholinesterase and can reduce both the bronchial secretions and the muscle weakness associated with poisoning. The initial intravenous dose of atropine in adults should be determined by the severity of symptoms: An initial adult dose of 1.0 to 2.0 mg or pediatric dose of 0.01 mg/kg (minimum 0.01 mg) should be administered intravenously. If intravenous access cannot be established, atropine may also be given intramuscularly, subcutaneously or via endotracheal tube. Doses should be repeated every 15 minutes until excessive secretions and sweating have been controlled. Once bronchial secretion has been controlled, atropine administration should be repeated whenever the secretions begin to recur. In seriously poisoned patients, very large doses may be required. Alterations of pulse rate and pupillary size should not be used as indicators of treatment adequacy. Pralidoxime should be administered as early in poisoning as possible as its efficacy may diminish when given more than 24 to 36 hours after exposure. Doses are as follows: adult 1.0 g; pediatric 25 to 50 mg/kg. The drug should be administered intravenously over 30 to 60 minutes, but in a life-threatening situation one-half of the total dose can be given per minute for a total administration time of 2 minutes. Treatment should begin to take effect within 40 minutes with a reduction in symptoms and the amount of atropine necessary to control bronchial secretion. The initial dose can be repeated in 1 hour and then every 8 to 12 hours until the patient is clinically well and no longer requires atropine. If intravenous access cannot be established, pralidoxime may also be given intramuscularly. Early administration of diazepam in addition to the combined atropine and pralidoxime treatment may help prevent the onset of seizures and potential brain and cardiac morphologic damage following high-level organophosphate poisoning.

Respirator Selection: SCBA >1.8 mg/m^3. *At any detectable concentration:* SCBAF: Pd,Pp (APF = 10,000) (any

NIOSH/MSHA- or European Standard EN 149-approved self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode); or SaF: Pd,Pp: ASCBA (APF = 10,000) (any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary, self-contained breathing apparatus operated in a pressure-demand or other positive-pressure mode). *Escape:* 100F (APF = 50) (any air-purifying, full facepiece respirator with an N100, R100, or P100 filter k-mounted organic vapor canister having a high-efficiency particulate filter); or SCBAE (any appropriate escape-type, self-contained breathing apparatus).

Storage: Color Code-Blue: Health Hazard/Poison. Store in a secure poison location. Prior to working with this chemical, you should be trained on its proper handling and storage. Store in tightly closed containers in a cool, well-ventilated area away from strong bases. Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: Organophosphorus pesticides, solid or liquid (nonflammable), require a label of "poisonous materials." This chemical falls in Hazard Class 6.1.

Spill Handling: First remove all sources of ignition. Evacuate persons not wearing protective equipment from area of spill or leak until clean up is complete. Stay upwind; keep out of low areas. Ventilate area of spill or leak. Remove and isolate contaminated clothing at the site. Do not touch spilled material; stop leak if you can do so without risk. Use water spray to reduce vapors. *Small spills:* absorb with sand or other noncombustible absorbent material and place into containers for later disposal. *Large spills:* dike far ahead of spill for later disposal. Collect powdered material in the most convenient and safe manner and deposit in sealed containers. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable. Seek professional environmental engineering assistance from the U.S. EPA Environmental Response Team at (908) 548-8730 (24-hour response line).

Fire Extinguishing: Hazardous decomposition includes oxides of phosphorus, sulfur, and nitrogen. May be fatal if inhaled, ingested or absorbed through skin. Inhalation or contact with some of these materials will irritate or burn skin and eyes. Vapors may cause dizziness or suffocation. *Small fires:* dry chemical, carbon dioxide; water spray; or foam. *Large fires:* water spray, fog, or foam. Stay upwind; keep out of low areas. Ventilate closed spaces before entering them. Firefighting gear (including SCBA) may not provide adequate protection. If exposure occurs, remove and isolate gear immediately and thoroughly decontaminate personnel. Wear positive-pressure breathing apparatus and special protective clothing. Remove and isolate contaminated clothing at the site. Move container from fire area if you can do so without risk. Fight fire from maximum distance. Dike fire-control water for later disposal; do not scatter the material. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies. From a secure, explosion-proof location, use water spray to cool exposed containers. If cooling streams are ineffective (venting sound increases in volume and pitch, tank discolors, or shows any signs of deforming), withdraw immediately to a secure position. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode.

Disposal Method Suggested: Destruction by alkali hydrolysis or incineration. Containers must be disposed of properly by following package label directions or by contacting your local or federal environmental control agency, or by contacting your regional EPA office.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- EXTOXNET, Extension Toxicology Network, "Pesticide Information Profile, Methidation," Oregon State University, Corvallis, OR (June 1996). http://extoxnet.orst.edu/pips/methidat.htm
- USEPA, Office of Pesticide Programs, Pesticide Residue Limits, "Methidathion," ***40 CFR 180.298***. http://www.epa.gov/pesticides/food/viewtols.htm
- USEPA, "Pesticide Reregistration, Methidathion Facts", Washington DC. (March 2002). http://www.epa.gov/oppsrrd1/REDs/factsheets/methidathion_fs.htm
- New Jersey Department of Health and Senior Services, "Hazardous Substance Fact Sheet, Methidathion," Trenton, NJ (July 1999). http://www.state.nj.us/health/eoh/rtkweb/1206.pdf
- USEPA, "Chemical Profile: Methidathion," Washington DC, Chemical Emergency Preparedness Program (Nov.30, 1987)
- Agency for Toxic Substances and Disease Registry, U.S. Department of Health and Human Services, Public Health Service, "Managing Hazardous Materials Incidents," Atlanta, GA (June 2003)

Methiocarb M:0550

Use Type: Acaricide, Molluscicide, Insecticide

CAS Number: 2032-65-7

Formula: $C_{11}H_{15}NO_2S$; $C_6H_2(SCH_3)(CH_3)_2OCONHCH_3$

Synonyms: Carbamic acid, methyl-, 3,5-dimethyl-4-(methylthio) phenyl ester; Carbamic acid, *N*-methyl-, 4-(methylthio)-3, 5-xylyl ester; Carbamic acid, methyl-, 4-(methylthio)-3,5-xylyl ester; 3,5-Dimethyl-4-methyl mercaptophenyl-*N*-methyl-carbamate; 3,5-Dimethyl-4-(methylthio)phenol methylcarbamate; 3,5-Dimethyl-4-methylthiophenyl *N*-methylcarbamate; 3,5-Dimethyl-4-(methylthio)phenyl methylcarbamate; EBT 25,726; Mercaptodimethur; Methyl carbamic acid 4-(methylthio)-3,5-xylyl ester; 4-Methylmercapto-3,5-dimethylphenyl *N*-methylcarbamate; 4-Methylmercapto-3,5-xylyl methylcarbamate; 4-Methylthio-3,5-dimethylphenyl methylcarbamate; 4-(Methylthio)-3,5-xylyl-*N*-methylcarbamate; 4-(Methylthio)-3,5-xylyl methylcarbamate; Metiocarb (Spanish); Metmercapturon; Phenol, 3,5-dimethyl-4-(Methylthio)-, methylcarbamate; MXMC

Trade Names: AI3-25726®; ALCO SLUB"M[C]; B 37344®; BAY 5024®; BAY 9026®; BAY 37344®; BAYER 37344®; DCR 736®; DRAZA®; DRAZA G MICROPELLETS®; H 321®; MESUROL®; METHIOCARBE®; OMS-93®; PBI SLUG GARD®; PROVADA®; SD 9228®; SLUG-GETA®[C]

Chemical class: Carbamate (N-methyl)

EPA/OPP PC Code: 100501

California DPR Chemical Code: 375

HSDB Number: 782

UN/NA & ERG Number: UN2757 (solid)/151

RTECS® Number: FC5775000

EC Number: 217-991-2; [*Annex I Index No.:* 006-023-00-2]

Uses: Used to control slugs and snails, soil insects and spider mites in pome fruit, stone fruit, hops, strawberries, potatoes, beets, maize, vegetables and ornamentals. Also used as seed treatment to control fruit flies on maize and bird repellant on berries and cherries. Methiocarb producers deleted all food uses from their product labels between 1989-92. It is A U.S. EPA restricted Use Pesticide (RUP) except for residential application.

Human toxicity (long-term)[101]: Intermediate–35.00 ppb, Health Advisory

Fish toxicity (threshold)[101]: Extra high–0.04597 ppb, MATC (Maximum Acceptable Toxicant Concentration)

Regulatory Authority and Advisory Information:

Carcinogenicity[83]: EPA Group D, Not classifiable as a human carcinogen

Acute Oral Category: 1, DANGER–POISON

Health Advisory: Nerve Toxin (S!)

Potential Ground Water Pollutant [California FAC Section 13145(d)/12811, active]

Clean Water Act: Section 311 Hazardous Substances/RQ 40CFR117.3 (same as CERCLA, see below)

EPA Hazardous Waste Number (RCRA No.): P199

Potential groundwater contaminant.

RCRA 40CFR268.48; 61FR15654, Universal Treatment Standards: Wastewater (mg/L), 0.056; Non-wastewater (mg/kg), 1.4

Superfund/EPCRA 302 Extremely Hazardous Substances: TPQ = 500/10,000 lb (227/4,540 kg)

Superfund/EPCRA 40CFR302.4 RQ: CERCLA, 10 lb (4.54 kg)

EPCRA Section 313 Form R *de minimus* concentration reporting level: 1.0%

U.S. DOT Regulated Marine Pollutant (49CFR172.101, Appendix B) as mercaptodimethur

European/International Regulations: Hazard Symbol: T, N; risk phrases: R25; R50/53; safety phrases: S1/2; S22; S37; S45; S60; S61 (see Appendix 1)

WGK (German Aquatic Hazard Class): 3-Severe hazard to waters

Description: Methiocarb is a colorless crystalline powder. Molecular weight = 225.33; Boiling point = 325 °C; Freezing/Melting point = 118–118.5 °C; Vapor pressure = 1×10^4 mmHg @ 25 °C. Hazard Identification (based on NFPA-704 M Rating System): Health 3, Flammability 1, Reactivity 0. Very slightly soluble in water; solubility = 25 ppm @ 20 °C.

Incompatibilities: Carbamates are incompatible with strong oxidizing acids, peroxides, and hydro-peroxides; strong reducing agents such as hydrides; strong acids and bases. Contact with nitrides or chemically active metals (aluminum, copper, magnesium, neptunium, sodium, tin, titanium, zinc, etc.) causes the release of potentially explosive hydrogen gas and a metal salt.

Permissible Exposure Limits in Air: Protective Action Criteria (PAC) Ver. 27[89]

PAC-1: 1.4 mg/m^3
PAC-2: 15 mg/m^3
PAC-3: 15 mg/m^3

Permissible Concentration in Water: Runoff from spills or fire control may cause water pollution.

Determination in Water: Log K_{ow} = >3.0. Values above 3.0 are likely to bioaccumulate in aquatic organisms.

Routes of Entry: Inhalation, ingestion, skin and/or eye contact.

Harmful Effects and Symptoms

Short Term Exposure: Cholinesterase toxin. Contact irritates the skin and eyes. Inhalation will irritate the respiratory tract. As a carbamate insecticide, this compound is a reversible cholinesterase inhibitor and acts on the nervous system. It is classified as very toxic, and the probable oral lethal dose for humans is 50–500 mg/kg or between 1 teaspoon and 1 ounce for a 150 lb adult. Symptoms include salivation, slowed heartbeat, spontaneous urination and defecation, labored breathing, headache, blurred vision, tremor, slight paralysis, and muscle twitching. Exposure to carbamate poisoning can also result in nausea, vomiting, diarrhea, and abdominal pain, convulsions, coma and death. Carbamate insecticides inhibit the cholinesterase activity of enzymes, causing accumulation of acetylcholine at synapses and altering the way in which nervous impulses are transmitted. However, within several hours carbamates spontaneously detach from the enzymes. Acute effects: Eye, effects other than irritation; Brain; Gastrointestinal tract; Heart, cardiovascular system; Central nervous system; Respiratory toxin other than severe or moderate irritation; Skin irritant. moderate. LD_{50} (oral, rat, both sexes) = 30 mg/kg[83]. LD_{50} (oral, rat) = 20 mg/kg; LD_{50} (dermal, rat) = 35 mg/kg.

Long Term Exposure: The substance may have effects on the central nervous system and kidneys. Chronic effects: Respiratory toxin; Kidney.

Points of Attack: Central nervous system, liver, plasma and red blood cell cholinesterase.

Medical Surveillance: Routine biological monitoring of pesticide applicators and field workers includes testing of plasma and red blood cell acetylcholinesterase levels (for enzyme poisoned by this chemical). These tests are normally accurate only if done within about two hours of exposure. If exposure stops, plasma levels return to normal in 1–2 weeks while red blood cell levels may be reduced for 1–3 months. When acetylcholinesterase enzyme levels are reduced by 25% or more below preemployment levels, risk of poisoning is increased, even if results are in lower ranges of "normal." Reassignment to work not involving carbamate pesticides is recommended until enzyme levels recover. Do not drink any alcoholic beverages before or during use. Do not drink any alcoholic beverages before or during use.

First Aid: Speed in removing material from eyes and skin is of extreme importance. *Eyes:* Eye contact can cause dangerous amounts of these chemicals to be quickly absorbed through the mucous membrane into the bloodstream. Immediately and gently flush eyes with plenty of warm or cold water (NO hot water) for at least 15 minutes, occasionally lifting the upper and lower eyelids. Get medical aid immediately. *Skin:* Get medical aid. Dermal contact can cause dangerous amounts of these chemicals to be absorbed into the bloodstream. Wearing the appropriate PPE equipment and respirator for carbamate pesticides, immediately flush skin with plenty of soap and water for at least 15 minutes while removing contaminated clothing and shoes. Shampoo hair promptly if contaminated; protect eyes. *Ingestion:* Call poison control. Loosen all clothing. Never give anything by mouth to an unconscious person. Get medical aid. Do NOT induce vomiting. * If conscious, alert, and able to swallow, rinse mouth and have victim drink 4 to 8 ounces of water. Check to see if poison control instructs you to use ipecac syrup, otherwise administer slurry of activated charcoal (2 oz in 8 oz of water). If victim is *UNCONSCIOUS OR HAVING CONVULSIONS,* do nothing except keep victim warm. **In some cases you may be specifically instructed by poison control to induce vomiting by way of 2 tablespoons of syrup of ipecac (adult) washed down with a cup of water.* Do NOT give activated charcoal before or with ipecac syrup. *Inhalation:* Get medical aid. Do not contaminate yourself. Wearing the appropriate PPE equipment and respirator for carbamate pesticides, immediately remove the victim from the contaminated area to fresh air. If the victim is not breathing, administer artificial respiration. Do not use mouth-to-mouth method if victim ingested or inhaled the substance; give artificial respiration with the aid of a pocket mask equipped with a one-way valve or other proper respiratory medical device. If breathing is difficult, administer oxygen through bag/mask apparatus until medical help arrives. Do not leave victim unattended. *Note to physician or authorized medical personnel.* Administer atropine, 2 mg (1/30 gr) intramuscularly or intravenously as soon as any local or systemic signs or symptoms of an intoxication are noted; repeat the administration of atropine every 3 to 8 minutes until signs of atropinization (mydriasis, dry mouth, rapid pulse, hot and dry skin) occur; initiate treatment in children with 0.05 mg/kg of atropine; repeat at 5 to 10 minute intervals. Watch respiration, and remove bronchial secretions if they appear to be obstructing the airway; intubate if necessary. *Medical note:* 2-PAMCI may be contraindicated in the case of some carbamate poisonings.

Personal Protective Methods: Wear protective gloves and clothing to prevent any reasonable probability of dermal and/or eye contact. Safety equipment suppliers/manufacturers can provide recommendations on the most protective glove/clothing material for your operation. DuPont™ Tychem® suit fabrics[88]. All protective clothing (suits, gloves, footwear, headgear) should be clean, available each day, and put on before work. Contact lenses should not be worn when working with this chemical. Wear dust-proof chemical goggles and face shield unless full facepiece respiratory protection is worn. Employees should wash immediately with soap when skin is wet or contaminated. Provide emergency showers and eyewash.

Respirator Selection: SCBA >1.4 mg/m^3. *At concentrations above the NIOSH REL, or where there is no REL, at any detectable concentration:* SCBAF:Pd,Pp (APF = 10,000): (any self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode); or SaF:Pd,Pp:ASCBA (APF = 10,000) (any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary self-contained positive-pressure breathing apparatus). *Escape*

GmFOv100 (APF = 50) [any air-purifying, full facepiece respirator (gas mask) with a chin-style, front- or back-mounted organic vapor canister having an N100, R100, or P100 filter]; or SCBAE (any appropriate escape-type, self-contained breathing apparatus).

Storage: Color Code-Blue: Health Hazard/Poison. Store in a secure poison location. Prior to working with this chemical you should be trained on its proper handling and storage. Store in tightly closed containers in a cool, well-ventilated area away from strong alkalis (such as sodium hydroxide, sodium bicarbonate, etc.). Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: This is a solid toxic carbamate and should be labeled "poisonous materials." It falls into Hazard Class 6.1.

Spill Handling: For solids, isolate spill or leak area in all directions for at least 25 meters/75 feet. Increase, in the downwind direction, as necessary. Do not touch damaged containers or spilled material unless wearing appropriate protective clothing. Stop leak if you can do it without risk. Prevent entry into waterways, sewers, basements or confined areas. Cover with plastic sheet to prevent spreading. Absorb or cover with dry earth, sand or other non-combustible material and transfer to containers. Do not allow water to get inside containers.

Fire Extinguishing: Hazardous decomposition includes oxides of nitrogen, sulfur, and carbon. *On small fire:* use dry chemical powder, carbon dioxide, water spray, or foam. *On large fire:* use water spray, fog or alcohol -resistant foam. Do not scatter material using straight water jet streams. Dike fire-control water for later disposal; do not scatter the material. Move containers from fire area if you can do it without risk. *Fire involving storage or vehicular tanks:* isolate for 800 meters/0.5 mile in all directions; also, consider initial evacuation for 800 meters/0.5 mile in all directions. Fight fire from maximum distance or use unmanned hose holders or monitor nozzles. Do not allow water to get inside containers. Cool containers with flooding quantities of water until well after fire is out. Withdraw immediately in the case of rising sound from venting safety devices or discoloration of tank. *Always* stay away from tanks engulfed in fire. For massive fire, use unmanned hose holders or monitor nozzles; if this is impossible, withdraw from area and let fire burn.

Disposal Method Suggested: Do not discharge into drains or sewers. Dispose of waste material as hazardous waste using a licensed disposal contractor to an approved landfill. Consult with environmental regulatory agencies for guidance on acceptable disposal practices. Generators of waste containing this contaminant (≥100 kg/mo) must conform with EPA regulations governing storage, transportation, treatment, and waste disposal. Incineration with effluent gas scrubbing is recommended. Containers must be disposed of properly by following package label directions or by contacting your local or federal environmental control agency, or by contacting your regional EPA office.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- USEPA, "Reregistration Eligibility Decision (RED) Facts, Methiocarb," Washington DC (February 1994). http://www.epa.gov/REDs/factsheets/0577fact.pdf
- USEPA, "Chemical Profile: Methiocarb," Washington DC, Chemical Emergency Preparedness Program (Nov.30, 1987)
- New Jersey Department of Health and Senior Services, "Hazardous Substance Fact Sheet, Mercaptodimethur," Trenton, NJ (November 1999). http://www.state.nj.us/health/eoh/rtkweb/1165.pdf

Methomyl M:0560

Use Type: Insecticide, Acaricide

CAS Number: 16752-77-5

Formula: $C_5H_{10}N_2O_2S$

Synonyms: Acetimidic acid, thio-*N*-(Mmthylcarbamoyl)oxy-,methyl ester; Acetimidothioic acid, methyl-*N*-(methylcarbamoyl) ester; ENT 27,341; Ethanimidothioc acid, *N*-[(methylamino)carbonyl]; Mesomile; Methyl *N*-[methylamino(carbonyl)oxy]ethanimido)thioate; Methyl-*N*-[methyl(carbamoyl)oxy]thioacetimidate; *S*-Methyl-*N*-(methylcarbamoyloxy)thioacetimidate; Metomilo (Spanish); 3-Thiabutan-2-one,*O*-(methylcarbamoyl)oxime

Trade Names: ACINATE®; AGRINATE®; CIMETLE®; DuPont™ 1179®; FRAM FLY KILL®; FLYTEK®; IMPROVED BLUE MALRIN SUGAR BAIT®; IMPROVED GOLDEN MALRIN BAIT®; INSECTICIDE 1179®; KIPSIN®; KUIK®; LANNATE®; LANNOX®; LANOX 90®; LANOX 216®; METHOMEX®; METHOMYL® 20SC; MEMILENE®; METHAVIN®; NU-BAIT II®; NUDRIN®; PILLARMATE®; RENTOKILL®; RENTOKIL FRAM FLY BAIT®; RIDECT®; SD 14999®; SOREX GOLDEN FLY BAIT®; WL 18236®

Chemical class: Carbamate (N-methyl)

EPA/OPP PC Code: 090301

California DPR Chemical Code: 383

HSDB Number: 1736

UN/NA & ERG Number: UN2757 (solid)/151

RTECS® Number: AK2975000

EC Number: 240-815-0 [*Annex I Index No.:* 006-045-00-2]

Uses: Methomyl is a broad-spectrum insecticide that is particularly effective against organophosphorus-resistant pests. It is used as an acaricide to control ticks and spiders. It is used for foliar treatment of vegetable, fruit and field crops, tobacco, cotton, commercial ornamentals, and in and around poultry houses and dairies. It is also used as a fly bait. Methomyl is effective as a "contact insecticide," because it kills target insects upon direct contact, and also as a "systemic insecticide" because of its capability to cause overall "systemic" poisoning in target insects, after it is absorbed and transported throughout the pests that feed on treated plants. It is capable of being absorbed by plants without being "phytotoxic" or harmful, to the plant. A U.S. EPA restricted Use Pesticide (RUP).

U.S. Maximum Allowable Residue Levels for Methomyl [40 CFR 180.253(a)]: in or on raw agricultural commodities as follows: alfalfa 10 ppm; apples 1 ppm; asparagus 2 ppm; avocado 2 ppm; barley (grain) 1 ppm; barley (hay) 10 ppm; barley (straw) 10 ppm; beans (dry) 0.1 ppm (negligible residues); beans (forage) 10 ppm; beans (succulent) 2 ppm; beets (tops) 6 ppm; blueberry 6 ppm; broccoli 3 ppm; brussel sprouts 2 ppm; cabbage 5 ppm; cauliflower 2 ppm; celery 3 ppm; chinese cabbage 5 ppm; collards 6 ppm; corn (fodder) 10 ppm; corn (forage) 10 ppm; corn (fresh, including sweet kerrnel and corn with husk removed) 0.1 ppm (negligible residues); corn (grain, including pop) 0.1 ppm (negligible residues); cottonseed 0.1 ppm (negligible residues); cucurbits 0.2 ppm (negligible residues); dandelions 6 ppm; endive (escarole) 5 ppm; grapefruit 2 ppm; grapes 5 ppm; grass (Bermuda) 10 ppm; grass (Bermuda, hay, dried and dehydrated) 40 ppm; hop, dried cone 12 ppm (there are no U.S. registrations for use of methomyl on hop, dried cone, as of February 14, 1990); kale 6 ppm; leek 3.0 ppm; lemons 2 ppm; lentils 0.1 ppm;

lettuce 5 ppm; mint (hay) 2 ppm; mustard greens 6 ppm; nectarines 5 ppm; oats (forage) 10 ppm; oats (grain) 1 ppm; oats (hay) 10 ppm; oats (straw) 10 ppm; onions (green) 3 ppm; oranges 2 ppm; parsley 6 ppm; peaches 5 ppm; peanuts 0.1 ppm (negligible residues); pea 5 ppm; pea (vines) 10 ppm; pecans 0.1 ppm; peppers 2 ppm; pomegranates 0.2 ppm (negligible residues); rye (forage) 10 ppm; rye (grain) 1 ppm; rye (hay) 10 ppm; rye (straw) 10 ppm; sorghum (forage) 1 ppm; sorghum (grain) 0.2 ppm (negligible residues); soybeans 0.2 ppm (negligible residues); soybeans (forage) 10 ppm; spinach 6 ppm; strawberries 2 ppm; swiss chard 6 ppm; tangerines 2 ppm; tomatoes 1 ppm; turnip greens (tops) 6 ppm; vegetables, brassica, leafy, group 6.0 ppm; vegetable (fruiting) 0.2 ppm (negligible residues); vegetables, leafy [except for beets (tops), broccoli, brussel sprouts, cabbage, cauliflower, celery, Chinese cabbage, collards, dandelions, endive (escarole), kale, lettuce, mustard greens, parsley, spinach, Swiss chard, turnip greens (tops), and watercress] 0.2 ppm (negligible residues); vegetables (root crop) 0.2 ppm (negligible residues); watercress 6 ppm; wheat (forage) 10 ppm; wheat (grain) 1 ppm; wheat (hay) 10 ppm; wheat (straw) 10 ppm. ***Regional registration, as defined in section 180.1(n) [40 CFR 180.253(c)]:*** in or on the following raw agricultural commodity: pears 4 ppm.

Human toxicity (long-term)[101]: Very low–200.00 ppb, Health Advisory

Fish toxicity (threshold)[101]: Intermediate–80.25646 ppb, MATC (Maximum Acceptable Toxicant Concentration)

Regulatory Authority and Advisory Information:

Carcinogenicity[83]: EPA Group E, evidence of non-carcinogenicity for humans

Health Advisory: Nerve Toxin, Mutagen, Endocrine disruptor (S!)

Acute Oral Category: 1, DANGER–POISON

Potential Ground Water Pollutant [California FAC Section 13145(d)/12811, active]

EPA Hazardous Waste Number (RCRA No.): P066

RCRA 40CFR268.48; 61FR15654, Universal Treatment Standards: Wastewater (mg/L), 0.028; Non-wastewater (mg/kg), 0.14

Safe Drinking Water Act: Priority List (55 FR 1470)

Superfund/EPCRA 302 Extremely Hazardous Substances: TPQ = 500/10,000 lb (227/4,540 kg)

Superfund/EPCRA 40CFR302.4 RQ: CERCLA, 100 lb (45.4 kg)

U.S. DOT Regulated Marine Pollutant (49CFR172.101, Appendix B)

European/International Regulations: Hazard Symbol: T+, N; risk phrases: R28; R50/53; safety phrases: S1/2; S28; S36/37; S45; S60; S61 (see Appendix 1)

Description: Methomyl is a white crystalline solid with a slight sulfurous odor. A noncombustible solid, which may be dissolved in flammable liquids that may alter physical properties listed here. Molecular weight = 162.23; Specific gravity (H_2O:1) = 1.2946 @ 24 °C; Boiling point = (decomposes) 335 °C; Freezing/Melting point = 79.6 °C; Vapor pressure: 0.00005 mmHg @ 25 °C; also 0.0001 mmHg[83]. Hazard Identification (based on NFPA-704 M Rating System): Health 3, Flammability 1, Reactivity 0. Highly soluble in water.

Incompatibilities: Carbamates are incompatible with strong oxidizing acids, peroxides, and hydro-peroxides; strong reducing agents such as hydrides; strong acids and bases. Contact with nitrides or chemically active metals (aluminum, copper, magnesium, neptunium, sodium, tin, titanium, zinc, etc.) causes the release of potentially explosive hydrogen gas and a metal salt. Heat causes decomposition, forming toxic and irritating fumes including nitrogen oxides, sulfur oxides, hydrogen cyanide, methyl isocyanate. Rapid decomposition in moist soils and in alkaline solutions.

Permissible Exposure Limits in Air: Protective Action Criteria (PAC) Ver. 27[89]

PAC-1: 2.5 mg/m^3

PAC-2: 10 mg/m^3

PAC-3: 23 mg/m^3

OSHA PEL (vacated 1989): TWA 2.5 mg/m^3 is enforced in some states.

ACGIH TLV®[1]: 2.5 mg/m^3 (skin)

Determination in Air: OSHA versatile sampler-2; Reagent; high-pressure liquid chromatography/Ultraviolet detection; NIOSH IV, Method #5601(18)

Permissible Concentration in Water: Federal Drinking Water Guidelines: 200 μg/L; State Drinking Water Guidelines: Arizona 180 μg/L; Maine 175 μg/L. The USEPA has calculated a no-observed-adverse-effects-level (NOAEL) of 2.5 mg/kg/day from which a lifetime health advisory of 175 μg/L has been calculated.

Determination in Water: By high-performance liquid chromatography as described in EPA Health Advisory cited below. Log K_{ow} = <1.0. Unlikely to bioaccumulate in marine organisms.

Routes of Entry: Inhalation, ingestion, skin and/or eye contact.

Harmful Effects and Symptoms

Short Term Exposure: Cholinesterase inhibitor. Irritates the eyes. May affect the nervous system, resulting in respiratory failure, convulsions. Exposure may result in death. Methomyl has high oral toxicity, moderate inhalation toxicity and low skin toxicity. The probable oral lethal dose for humans is between 7 drops and 1 teaspoon for a 150 pound adult. Death is due to respiratory arrest. Acute exposure to methomyl usually leads to a cholinergic crisis. Signs and symptoms may include increased salivation, lacrimation (tearing), spontaneous defecation, and spontaneous urination. Pinpoint pupils, blurred vision, tremor, muscle twitching, and loss of muscle coordination may occur. Mental confusion, convulsions, and coma may also be noted. Gastrointestinal effects include nausea, vomiting, diarrhea, and abdominal pain. Bradycardia (slow heart rate) occurs frequently. Dyspnea (shortness of breath), pulmonary edema, and respiratory arrest may also occur. Carbamate insecticides inhibit the cholinesterase activity of enzymes, causing accumulation of acetylcholine at synapses and altering the way in which nervous impulses are transmitted. However, within several hours carbamates spontaneously detach from the enzymes. Cholinesterase toxin. Acute effects: Eye, effects other than irritation; Brain; Gastrointestinal tract; Heart, cardiovascular system; Nervous system toxin; Central nervous system; Respiratory toxin; Respiratory irritant, severe, or moderate but not mild irritant effects; Eye irritant–moderate. LD_{50} (oral, rat) = 30–45 mg/kg. Highly toxic. LD_{50} (oral, rat) = 17 mg/kg; LD_{50} (dermal, rat) = > 1.5 g/kg.

Long Term Exposure: Cholinesterase inhibitor; cumulative effect is possible. A nerve toxin; methomyl may damage the nervous system with repeated exposure, resulting in convulsions, respiratory failure. May cause liver damage. May cause anemia. May cause reproductive and fetal effects.

Points of Attack: Eyes, respiratory system, central nervous system, cardiovascular system, liver, kidneys, blood cholinesterase; reproductive cells.

Medical Surveillance: Routine biological monitoring of pesticide applicators and field workers includes testing of plasma and red blood cell acetylcholinesterase levels (for enzyme poisoned by this chemical). These tests are normally accurate only if done within about two hours of exposure. If exposure stops, plasma levels return to normal in 1–2 weeks while red blood cell levels may be reduced for 1–3 months. When acetylcholinesterase enzyme levels are reduced by 25% or more below preemployment levels, risk of poisoning is increased, even if results are in lower ranges of "normal." Reassignment to work not involving carbamate pesticides is recommended until enzyme levels recover. Do not drink any alcoholic beverages before or during use. In addition to comprehensive initial medical and work histories emphasizing reproductive experience and menstrual history, patient should have physical examination and testing of genito-urinary tract, sperm count, motility and morphology. If required, other tests, such as serum testosterone, serum follicle stimulating hormone (FSH), and serum lutenizing hormone (LH), may be indicated.

First Aid: Speed in removing material from eyes and skin is of extreme importance. *Eyes:* Eye contact can cause dangerous amounts of these chemicals to be quickly absorbed through the mucous membrane into the bloodstream. Immediately and gently flush eyes with plenty of warm or cold water (NO hot water) for at least 15 minutes, occasionally lifting the upper and lower eyelids. Get medical aid immediately. *Skin:* Get medical aid. Dermal contact can cause dangerous amounts of these chemicals to be absorbed into the bloodstream. Wearing the appropriate PPE equipment and respirator for carbamate pesticides, immediately flush skin with plenty of soap and water for at least 15 minutes while removing contaminated clothing and shoes. Shampoo hair promptly if contaminated; protect eyes. *Ingestion:* Call poison control. Loosen all clothing. Never give anything by mouth to an unconscious person. Get medical aid. Do NOT induce vomiting. * If conscious, alert, and able to swallow, rinse mouth and have victim drink 4 to 8 ounces of water. Check to see if poison control instructs you to use ipecac syrup, otherwise administer slurry of activated charcoal (2 oz in 8 oz of water). If victim is *UNCONSCIOUS OR HAVING CONVULSIONS,* do nothing except keep victim warm. **In some cases you may be specifically instructed by poison control to induce vomiting by way of 2 tablespoons of syrup of ipecac (adult) washed down with a cup of water.* Do NOT give activated charcoal before or with ipecac syrup. *Inhalation:* Get medical aid. Do not contaminate yourself. Wearing the appropriate PPE equipment and respirator for carbamate pesticides, immediately remove the victim from the contaminated area to fresh air. If the victim is not breathing, administer artificial respiration. Do not use mouth-to-mouth method if victim ingested or inhaled the substance; give artificial respiration with the aid of a pocket mask equipped with a one-way valve or other proper respiratory medical device. If breathing is difficult, administer oxygen through bag/mask apparatus until medical help arrives. Do not leave victim unattended. *Note to physician or authorized medical personne:* Administer atropine, 2 mg (1/30 gr) intramuscularly or intravenously as soon as any local or systemic signs or symptoms of an intoxication are noted; repeat the administration of atropine every 3 to 8 minutes until signs of atropinization (mydriasis, dry mouth, rapid pulse, hot and dry skin) occur; initiate treatment in children with 0.05 mg/kg of atropine; repeat at 5 to 10 minute intervals. Watch respiration, and remove bronchial secretions if they appear to be obstructing the airway; intubate if necessary. *Medical note:* 2-PAMCI may be contraindicated in the case of some carbamate poisonings.

Personal Protective Methods: Wear protective gloves and clothing to prevent any reasonable probability of dermal and/or eye contact. Safety equipment suppliers/manufacturers can provide recommendations on the most protective glove/clothing material for your operation. DuPont™ Tychem® suit fabrics[88]. All protective clothing (suits, gloves, footwear, headgear) should be clean, available each day, and put on before work. Contact lenses should not be worn when working with this chemical. Wear dust-proof chemical goggles and face shield unless full facepiece respiratory protection is worn. Employees should wash immediately with soap when skin is wet or contaminated. Provide emergency showers and eyewash.

Respirator Selection: SCBA >2.5 mg/m^3 *At concentrations above the NIOSH REL, or where there is no REL, at any detectable concentration:* SCBAF:Pd,Pp (APF = 10,000): (any self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode); or SaF:Pd,Pp:ASCBA (APF = 10,000) (any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary self-contained positive-pressure breathing apparatus). *Escape*: GmFOv100 (APF = 50) [any air-purifying, full facepiece respirator (gas mask) with a chin-style, front- or back-mounted organic vapor canister having an N100, R100, or P100 filter]; or SCBAE (any appropriate escape-type, self-contained breathing apparatus).

Storage: Color Code-Blue: Health Hazard/Poison. Store in a secure poison location. Prior to working with this chemical you should be trained on its proper handling and storage. Store in tightly closed containers in a cool, well-ventilated area away from strong alkalis (such as sodium hydroxide, sodium bicarbonate, etc.). Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: This is a solid toxic carbamate and should be labeled "poisonous materials." It falls into Hazard Class 6.1 and Packing Group II.

Spill Handling: For solids, isolate spill or leak area in all directions for at least 25 meters/75 feet. Increase, in the downwind direction, as necessary. Do not touch damaged containers or spilled material unless wearing appropriate protective clothing. Stop leak if you can do it without risk. Prevent entry into waterways, sewers, basements or confined areas. Cover with plastic sheet to prevent spreading. Absorb or cover with dry earth, sand or other non-combustible material and transfer to containers. Do not allow water to get inside containers.

Fire Extinguishing: Decomposition (>190 °C) releases toxic oxides of nitrogen, sulfur, and carbon. *On small fire:* use dry chemical powder, carbon dioxide, water spray, or foam. *On large fire:* use water spray, fog or alcohol resistant foam. Do not scatter material using straight water jet streams. Dike fire-control water for later disposal; do not scatter the material. Move containers from fire area if you can do it without risk. *Fire involving storage or vehicular tanks:* isolate for 800 meters/0.5 mile in all directions; also, consider initial evacuation for 800 meters/0.5 mile in all directions. Fight fire from maximum distance or use unmanned hose holders or monitor nozzles. Do not allow water to get inside containers. Cool containers with flooding quantities of water until well after fire is out. Withdraw immediately in the case of rising sound from venting safety devices or discoloration of tank. *Always* stay away from tanks engulfed in fire. For massive fire, use unmanned hose holders or monitor nozzles; if this is impossible, withdraw from area and let fire burn.

Disposal Method Suggested: Do not discharge into drains or sewers. Dispose of waste material as hazardous waste using a licensed disposal contractor to an approved landfill. Consult with environmental regulatory agencies for guidance on acceptable disposal practices. Potential candidate for disposal by rotary kiln incineration with a temperature range of 820–1600 °C and a residence time of seconds for liquids and gases, and hours for solids. Also a potential candidate for fluidized bed incineration with a temperature range of 450–980 °C, with a residence time of seconds for liquids and gases, and longer for solids[83]. Hydrolysis: Alkaline hydrolysis leads to complete degradation. Landfill: The aqueous solution is noncorrosive. It is stable as a solid, in aqueous solution under normal conditions but is subject to decomposition in moist soil [UN] Generators of waste containing this contaminant (≥100 kg/mo) must conform with EPA regulations governing storage, transportation, treatment, and waste disposal.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- EXTOXNET, Extension Toxicology Network, "Pesticide Information Profile, Methomyl," Oregon State University, Corvallis, OR (June 1996). http://extoxnet.orst.edu/pips/methomyl.htm
- USEPA, Office of Pesticide Programs, Pesticide Residue Limits, "Methomyl," 180.253. http://www.epa.gov/pesticides/food/viewtols.htm
- New Jersey Department of Health and Senior Services, "Hazardous Substance Fact Sheet: Methomyl," Trenton, NJ (September 1999). http://www.state.nj.us/health/eoh/rtkweb/1208.pdf
- USEPA, Methomyl, Health and Environmental Effects Profile No. 125, Washington DC, Office of Solid Waste (April 30, 1980)
- Sax, N. I., Ed., "Dangerous Properties of Industrial Materials Report" 2, No. 5, 79-81 (1982)
- USEPA, "Health Advisory: Methomyl," Washington DC, Office of Drinking Water (August 1987)
- *USEPA, "Chemical Profile: Methomyl," Washington DC, Chemical Emergency Preparedness Progra*

Methoprene M:0565

Use Type: Insect growth hormone

CAS Number: 40596-69-8

Formula: $C_{19}H_{34}O_3$

Synonyms: 2,4-Dodecadienoic acid, 11-methoxy-3,7,11-trimethyl-, ispropyl ester, (E,E)-; 2,4-Dodecadienoic acid, 11-methoxy-3,7,11-trimethyl-, 1-methylethyl ester, (E,E)-; Isopropyl (2E,4E)-11-methoxy-3,7,11-trimethyl-2,4-dodecadienoate; Isopropyl (E,E)-11-methoxy-3,7,11-trimethyl-2,4-dodecadienoate; (E,E)-11-Methoxy-3,7,11-trimethyl-2,4-dodecandienoate; 1-Methylethyl (E,E)-11-methoxy-3,7,11-trimethyl-2,4-dodecadienoate

Trade Names: ALTOSID®; APEX®; DIACON®; DIANEX®; ENT 70,460®; EXTINGUISH®; FLEATROL®; KABAT®; MANTA®; MOORMAN'S® IGR CATTLE CONCENTRATE; OVITROL®; PHARORID®; PRECOR®; ZR-515®

Chemical class: Natural product; mimics juvenile hormone

EPA/OPP PC Code: 105401 (549500 old EPA code number)

California DPR Chemical Code: 1784

HSDB Number: 6926

UN/NA & ERG Number: UN3082 (liquid)/171

RTECS® Number: JR1685000

EC Number: 254-993-2

Uses: Methoprene is an insect growth regulator (IGR) used against a variety of insects including horn flies, mosquitoes, beetles, tobacco moths, sciarid flies, fleas (eggs and larvae), fire ants, pharoah ants, midge flies and Indian meal moths. Controlling some of these insects, methoprene is used in the production of a number of foods including meat, milk, mushrooms, peanuts, rice and cereals. It also has several uses on domestic animals (pets) for controlling fleas and to control insects in wastewater, sludge beds and ponds. For oral use in dogs, 9 weeks of age and older and 4 pounds body weight or greater, for the prevention and control of flea populations [21 CFR 520.1390]. Not approved for use in EU countries[115]. Registered for use in the U.S.

U.S. Maximum Allowable Residue Levels for Methoprene [40 CFR 180.359]: in or on the following raw agricultural commodities: barley 5 ppm; buckwheat 5 ppm; cattle, fat 1 ppm; cattle, meat 0.1 ppm; cattle, meat byproducts 0.1 ppm; corn (except popcorn and sweetcorn) 5 pm; eggs 0.1 ppm; goats, fat 1 ppm; goats, meat 0.1 ppm; goats, meat byproducts 0.1 ppm; hogs, fat 1 ppm; hogs, meat 0.1 ppm; hogs, meat byproducts 0.1 ppm; horses, fat 1 ppm; horses, meat 0.1 ppm; horses, meat byproducts 0.1 ppm; milk 0.1 ppm; millet 5 ppm; mushrooms 1 ppm; oats 5 ppm; peanuts 2 ppm; poultry, fat 1 ppm; poultry, meat 0.1 ppm; poultry, meat byproducts 0.1 ppm; rice 5 ppm; rye 5 ppm; sheep, fat 1 ppm; sheep, meat 0.1 ppm; sheep, meat byproducts 0.1 ppm; sorghum (milo) 5 ppm; and wheat 5 ppm***. [40 CFR 185.4150]:*** in or on the food additive commodity cereal grain milled fractions (except flour and rice hulls). ***[40 CFR 186.4150]***: may be safely used in accordance with the following prescribed conditions: (a) It is used as a feed additive in the form of mineral and/or protein blocks or other feed supplements in the feed of cattle at the rate of 22.7 to 45.4 mg per 100 pounds of body weight per month. (b) It is used to prevent the breeding of hornflies in the manure of treated cattle. (c) To ensure safe use of the additive, the label and labeling of the pesticide formulation containing this additive shall conform to the label and labeling registered by the U.S. EPA. (d) In or on the following feed additive commodities: cereal grain milled fractions (except flour and rice hulls) 10 ppm; rice hulls 25 ppm.

Regulatory Authority and Advisory Information:

Carcinogenicity[83]: IARC, Group 3 not classifiable as to its carcinogenicity in humans.

Acute Oral Category: 4, Caution, not acutely toxic

Description: Amber colored liquid. Faint fruity odor. Molecular weight = 310.47; Specific gravity (H_2O:1) = 0.93; Boiling point = 135 @ 0.06 mmHg; Flash point = >90 °C. Slightly soluble in water; solubility = 1.40 ppm.

Incompatibilities: This material may react as an ester. Esters react with acids to liberate heat along with alcohols and acids. Strong oxidizing acids may cause a vigorous reaction that is sufficiently exothermic to ignite the reaction products. Heat is also generated by the interaction of esters with caustic solutions. Flammable hydrogen is generated by mixing esters with alkali metals and hydrides.

Determination in Water: Log K_{ow} = >5.0. Values above 3.0 are likely to bioaccumulate in aquatic organisms.

Routes of Entry: Dermal contact, eye contact, ingestion.

Harmful Effects and Symptoms

Short Term Exposure: Moderately toxic by skin absorption and if ingested. Contact with eyes or skin may cause irritation or injury. Inhalation should be avoided LD_{50} (oral, rat) = >25 g/kg; (dermal, rat) = >2 g/kg. Very low toxicity.

First Aid: If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least 15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately. If this chemical contacts the skin, remove contaminated clothing and wash immediately with soap and water. Seek medical attention immediately. If this chemical has been inhaled, remove from exposure, begin rescue breathing (using universal precautions) if breathing has stopped, and CPR if heart action has stopped. Transfer promptly to a medical facility. When this chemical has been swallowed, get medical attention. Give large quantities of water and induce vomiting. Do not make an unconscious person vomit. Do not induce vomiting when formulations containing petroleum solvents are ingested

Respirator Selection: Wherever and whenever workplace conditions warrant respirator use, a respiratory protection program must be followed that meets one or more of the following government standards: OSHA's 29 CFR 1910.134, ANSI Z88.2, or European Standard EN 149.

Shipping: Environmentally hazardous substances, solid or liquid, usually fall in Hazard Class 9

Storage: Color Code-Blue: Health Hazard/Poison: Store in a tightly closed container in a dry, well-ventilated and secure poison location. Prior to working with this chemical you should be trained on its proper handling and storage. Where possible, automatically transfer material from other storage containers to process containers. Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Spill Handling: First remove all sources of ignition. Evacuate persons not wearing protective equipment from area of spill or leak until clean up is complete. Collect powdered material in the most convenient and safe manner and deposit in sealed containers. Ventilate area after clean up is complete. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable.

Fire Extinguishing: Combustible. Acrid smoke and fumes and oxides of carbon, including oxides of nitrogen, disodium oxide, and sulfur. Combustible. As an immediate precautionary measure, isolate spill or leak area in all directions for at least 50 meters/150 feet for liquids and at least 25 meters/75 feet for solids. *Fire involving storage or vehicular tanks:* isolate for 800 meters/0.5 mile in all directions; also, consider initial evacuation for 800 meters/0.5 mile in all directions. *On a small fire:* use dry chemical, CO_2, water spray or regular foam. *On a large fire:* use water spray, fog or regular foam. Do not scatter spilled material with high-pressure streams of water. Move containers from fire area if you can do it without risk. Dike fire-control water for later disposal. *Fire involving tanks:* from a secure, explosion-proof location, use water spray to cool exposed containers. If cooling streams are ineffective (venting sound increases in volume and pitch, tank discolors, or shows any signs of deforming), withdraw immediately to a secure position. Always stay away from tanks engulfed in fire. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode.

Disposal Method Suggested: It is the responsibility of chemical waste generators to determine if a discarded chemical is classified as a hazardous waste. See ***40 CFR*** Parts 261.3 for U.S. EPA guidelines for the classification determination. Additionally, in order to ensure complete and accurate classification, waste generators must consult state and local hazardous waste regulations. Incineration might be an effective disposal procedure where permitted. If an efficient incinerator is not available, the product should be mixed with large amounts of combustible material and contact with the smoke should be avoided. In accordance with 40CFR165, follow recommendations for the disposal of pesticides and pesticide containers.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- USEPA, Office of Pesticide Programs, "Insect Growth Regulators Fact Sheet" (December 6, 2001). http://www.epa.gov/oppbppd1/biopesticides/ingredients/factsheets/factsheet_igr.htm
- USEPA, "Reregistration Eligibility Decision (RED) Fact Sheet, Methoprene," Office of Prevention, Pesticides and Toxic Substances, Washington DC (June 2001). http://www.epa.gov/oppbppd1/biopesticides/ingredients/factsheets/factsheet_105401.pdf
- USEPA, Office of Pesticide Programs, Pesticide Residue Limits, "Methoprene," ***40 CFR 180.1033*** http://www.epa.gov/pesticides/food/viewtols.htm
- EXTOXNET, Extension Toxicology Network, "Pesticide Information Profile, Methoprene," Oregon State University, Corvallis, OR (June 1996). http://extoxnet.orst.edu/pips/methopre.htm

Methoxychlor M:0580

Use Type: Insecticide

CAS Number: 72-43-5

Formula: $C_{16}H_{15}Cl_3O_2$; $H_3COC_6H_4CH(CCl_3)C_6H_4OCH_3$

Synonyms: Benzene,1,1'-(2,2,2-trichloroethylidene) bis[4-methoxy-]; 2,2-bis(*p*-anisyl)-1,1,1-trichloroethane; 1,1-Bis(*p*-methoxyphenyl)-2,2,2-trichloroethane; 2,2-Bis(*p*-methoxyphenyl)-1,1,1-trichloroethane; Dianisyltrichlorethane;2,2-Di-*p*-anisyl-1,1,1-trichloroethane; Dimethoxy-DDT;*p,p*'-Dimethoxydiphenyltrichloroethane; Dimethoxy DT; 2,2-(*p*-Methoxyphenyl)-1,1,1-trichloroethane; Di(*p*-methoxyphenyl)-trichloro methyl methane; DMDT; *p,p*'-DMDT; ENT 1,716; Methoxide; Methoxo; *p,p'*-Methoxychlor; Methoxy DDT; Metoxicloro (Spanish); NCI-C00497; 1,1,1-Trichloro-2,2-bis(*p*-anisyl)ethane; 1,1,1-Trichloro-2,2-bis(*p*-methoxyphenol) ethanol; 1,1,1-Trichloro-2,2-bis(*p*-methoxyphenyl) ethane; 1,1,1-Trichloro-2,2-di(4-methoxyphenyl)ethane; 1,1,1-Trichloro-2,2-di(*p*-methoxyphenyl)ethane; 1,1-(2,2,2-Trichloroethylidene) bis(4-methoxybenzene)

Trade Names: CHEMFORM®; HIGALMETOX®; MARLATE®; METOX®; MOXIE®; PRENTOX®

Chemical class: Organochlorine

EPA/OPP PC Code: 034001

California DPR Chemical Code: 384

HSDB Number: 1173

UN/NA & ERG Number: UN2761 (solid)/151; UN2996 (liquid)/151; UN2995 (Organochlorine pesticides, liquid, toxic, flammable, flash point not <23 °C)/131; UN 3077/151

RTECS® Number: KJ3675000

EC Number: 200-779-9

Uses: Not approved for use in EU countries[115]. Not registered for use in the U.S. There are 33 global suppliers[97]. The U.S. EPA lists 826 active and/or canceled products containing methoxychlor. Methoxychlor was introduced as an insecticide in 1945. It is a close relative of DDT and has been increasing in use since the ban on DDT in 1972 because of its very low mammalian toxicity for home and garden, on domestic animals for fly control, for elm bark-beetle vectors of Dutch elm disease, and for blackfly larvae in streams. Methoxychlor is registered for about 87 crops such as alfalfa; nearly all fruits and vegetables, corn, wheat, rice, and other grains; beef and dairy cattle; and swine, goats and sheep, and for agricultural premises and outdoor fogging. It is available in wettable and dust powders, emulsifiable concentrates, granules, and as an aerosol. It is combined in formulations with malathion, parathion, piperonyl butoxide, and pyrethrins.

U.S. Maximum Allowable Levels for Methoxychlor: The EPA limits the amount of methoxychlor present in agricultural products to 1–100 ppm. The Food and Drug Administration (FDA) limits the amount of methoxychlor in bottled water to 0.04 ppm

Human toxicity (long-term)[101]: Intermediate–40.00 ppb, MCL (Maximum Contaminant Level)

Fish toxicity (threshold)[101]: Extra high–0.11310 ppb, MATC (Maximum Acceptable Toxicant Concentration)

Regulatory Authority and Advisory Information:

Carcinogenicity[83]: EPA Group D, Not classifiable as a human carcinogen; IARC, Group 3 not classifiable as to its carcinogenicity in human.

Health Advisory: Mutagen, Developmental/Reproductive Toxin

Acute Oral Category: 4, Caution

Acceptable Daily Intake (ADI) = 0.1 mg/kg, based on 2-yr feeding study (oral, rats) = 200 ppm[83].

Clean Air Act: Hazardous Air Pollutants (Title I, Part A, Section 112)

Clean Water Act: Section 311 Hazardous Substances/RQ 40CFR117.3 (same as CERCLA, see below); Section 313 Water Priority Chemicals (57FR41331, 9/9/92); Section 313 Water Priority Chemicals (57FR41331, 9/9/92)

EPA Hazardous Waste Number (RCRA No.): U247; D014

RCRA Toxicity Characteristic (Section 261.24), Maximum Concentration of Contaminants, regulatory level, 10.0 mg/L

RCRA 40CFR268.48; 61FR15654, Universal Treatment Standards: Wastewater (mg/L), 0.25; Non-wastewater (mg/kg), 0.18

RCRA 40CFR264, Appendix 9; TSD Facilities Ground Water Monitoring List. Suggested test method(s) (PQL *u*g/L): 8080(2); 8270(10)

Safe Drinking Water Act: MCL, 0.04 mg/L; MCLG, 0.04 mg/L; Regulated chemical (47 FR 9352); Priority List (55 FR 1470)

Superfund/EPCRA 40CFR302.4 RQ: CERCLA, 1 lb (0.45 kg)

EPCRA Section 313 Form R *de minimis* concentration reporting level: 1.0%

The EPA limits the amount of methoxychlor present in agricultural products to 1–100 ppm

WGK (German Aquatic Hazard Class): 3-Severe hazard to waters.

Description: Methoxychlor is a white, off-white or yellow crystalline solid. It is often dissolved in a combustible or flammable liquid carriers such as diesel oil. Slight fruity odor. Molecular weight = 345.65; Specific gravity (H_2O:1) = 1.4; Freezing/Melting point = 77.78 °C[9]; Vapor pressure = very low; Hazard Identification (based on NFPA-704 M Rating System): Health 2, Flammability 1, Reactivity 0. Practically insoluble in water; solubility = 3.9×10^2 ppm @ 24 °C. Physical and toxicological properties may be affected by carrier solvents in commercial formulations.

Incompatibilities: Incompatible with oxidizers (peroxides, perchlorates, nitrates, chlorine, etc.), alkaline materials; chemically active metals. Corrodes iron and aluminum in the presence of moisture. Will attack some forms of plastics and rubbers[9].

Permissible Exposure Limits in Air

OSHA PEL: 15 mg/m^3 (*total dust*) TWA

NIOSH REL: A potential occupational carcinogen. Limit exposure to lowest feasible concentration. See *NIOSH Pocket Guide*, Appendix A

ACGIH TLV®[1]: 10 mg/m^3 TWA not classifiable as a human carcinogen

NIOSH IDLH: potential occupational carcinogen 5000 mg/m^3

Protective Action Criteria (PAC) Ver. 27[89]

PAC-1: 30 mg/m^3

PAC-2: 53 mg/m^3

PAC-3: 7000 mg/m^3

Determination in Air: Filter; Isooctane; Gas chromatography/Electrochemical detection; NIOSH II(4), Method #S371[18].

Permissible Concentration in Water: Federal Drinking Water Standards: EPA 40 μg/L; State Drinking Water Guidelines: Arizona 340 μg/L; Maine 35 μg/L; State Drinking Water Standards: California 35 μg/L. Canadian Drinking Water Standards: MAC 0.9 mg/L.

Determination in Water: EPA Method D3086. GC method with ECD for the determination of organochlorine pesticides in water and wastewater. Log K_{ow} = >3.0+. Values above 3.0 are likely to bioaccumulate in marine organisms. The primary hazard of this pesticide is the threat to the environment. Immediate steps should be taken to limit its spread to the environment. Can easily penetrate the soil and contaminate groundwater and nearby streams.

Routes of Entry: Inhalation, ingestion, skin and/or eyes. Passes through the unbroken skin.

Harmful Effects and Symptoms

Short Term Exposure: *Inhalation*: The results of accidental exposure and animal studies suggest that high levels may cause irritation to nose and throat, headache, nausea, vomiting, staggering walk, drowsiness, convulsions, coma and death. *Skin:* Absorbed in significant amounts especially when dissolved in organic solvents. Local irritation and numbing of affected area may be experienced. *Eyes:* May cause irritation. *Ingestion:* Symptoms are similar to those listed under inhalation. Ingestion of 5 ounces a day for 6 weeks resulted in no observable symptoms. The least amount causing death has been reported as one pound. Exposure can cause anxiety, fatigue, nausea, vomiting, dizziness, confusion, weakness, "pins and needles" in extremities, muscle twitching and tremor. Higher levels can cause convulsions, unconsciousness and even death. *Note:* For application, methoxychlor is dissolved in organic or petroleum distillate solvents. These solvents may have poisonous effects in addition to those above. The estimated fatal oral dose for humans is 450 g/subject (approximately 6 g/kg body weight)[IARC]. LD_{50} (oral, rabbit) = >6 g/kg; (dermal, rat) = >6 g/kg[96].

Long Term Exposure: May cause tumors. Organochlorine pesticides are highly toxic to mammals and will accumulate in the tissues of living organisms. Methoxychlor has been shown to affect reproduction. May affect liver, kidneys, and central nervous system. Very high exposures may cause anemia. May disrupt the estrous cycle. May be a reproductive toxin. Potential neurotoxin.

Points of Attack: Central nervous system, liver, kidneys. Cancer site in animals: liver and ovarian cancer. Reproductive cells.

Medical Surveillance: Liver and kidney function tests. Complete blood count. In addition to comprehensive initial medical and work histories emphasizing reproductive experience and menstrual history, patient should have physical examination and testing of genito-urinary tract, sperm count, motility and morphology. If required, other tests, such as serum testosterone, serum follicle stimulating hormone (FSH), and serum lutenizing hormone (LH), may be indicated.

First Aid: If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least 15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately. If this chemical contacts the skin, remove contaminated clothing and wash immediately with soap and water. Seek medical attention immediately. If this chemical has been inhaled, remove from exposure, begin rescue breathing (using universal precautions) if breathing has stopped, and CPR if heart action has stopped. Transfer promptly to a medical facility. When this chemical has been swallowed, get medical attention. Give large quantities of water and induce vomiting. Do not make an unconscious person vomit.

Personal Protective Methods: Wear protective gloves and clothing to prevent any reasonable probability of dermal and/or eye contact. Safety equipment suppliers/manufacturers can provide recommendations on the most protective glove/clothing material for your operation. All protective clothing (suits, gloves, footwear, headgear) should be clean, available each day, and put on before work. Contact lenses should not be worn when working with this chemical. Wear dust-proof chemical goggles and face shield unless full facepiece respiratory protection is worn. Employees should wash immediately with soap when skin is wet or contaminated. Provide emergency showers and eyewash.

Respirator Selection: SCBA >30 mg/m^3. Wherever and whenever workplace conditions warrant respirator use, a respiratory protection program must be followed that meets one or more of the following government standards: OSHA's 29 CFR 1910.134, ANSI Z88.2, or European Standard EN 149. Where the neat (undiluted) test chemical is weighed and diluted, wear a NIOSH-approved half-face respirator equipped with a combination filter cartridge, i.e. organic vapor/acid gas/HEPA (specific for organic vapors, HCl, acid gas, SO_2 and a high-efficiency particulate filter)[88].

Storage: Color Code-Blue (dry material): Health Hazard/Poison (Toxic): Store in a secure, locked and cool, ventilated area. Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: Organochlorine pesticides, liquid or solid (non-flammable), require a “poisonous materials” label. They fall in Hazard Class 6.1. Organochlorine pesticides, liquid, toxic, flammable, flash point not <23 °C, require both a “poisonous materials” and a “flammable material” label. They fall in Hazard Class 6.1. Labels 6.1, 3.

Spill Handling: For solids, isolate spill or leak area in all directions for at least 25 meters/75 feet. Increase, in the downwind direction, as necessary. Do not touch damaged containers or spilled material unless wearing appropriate protective clothing. Stop leak if you can do it without risk. Prevent entry into waterways, sewers, basements or confined areas. Cover with plastic sheet to prevent spreading. Absorb or cover with dry earth, sand or other non-combustible material and transfer to containers. Do not allow water to get inside containers.

Fire Extinguishing: Hazardous decomposition includes oxides of carbon and toxic hydrogen chloride gas. *On a small fire:* use dry chemical, CO_2 or water spray. *On a large fire:* use water spray, fog or regular foam. Move containers from fire area if you can do it without risk. Dike fire-control water for later disposal; do not scatter the material. Use water spray or fog; do not use straight streams. *Fire involving tanks or car/trailer loads*: if tank, rail car or tank truck is involved in a fire, isolate for 800 meters/0.5 mile in all directions; also, consider initial evacuation for 800 meters/0.5 mile in all directions. Fight fire from maximum distance or use unmanned hose holders or monitor nozzles. Do not get water inside containers. Cool containers with flooding quantities of water until well after fire is out. Withdraw immediately in the case of rising sound from venting safety devices or discoloration of tank. ALWAYS stay away from tanks engulfed in fire. For massive fire, use unmanned hose holders or monitor nozzles; if this is impossible, withdraw from area and let fire burn. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies.

Disposal Method Suggested: Do not discharge into drains or sewers. Dispose of waste material as hazardous waste using a licensed disposal contractor to an approved landfill. Contact a licensed disposal facility about surplus and non-recyclable solutions. Burn in a chemical incinerator equipped with an afterburner and scrubber. Extra care must be exercised as the material in an organic solvent is highly flammable. Consult with environmental regulatory agencies for guidance on acceptable disposal practices. Generators of waste containing this contaminant (≥100 kg/mo) must conform with EPA regulations governing storage, transportation, treatment, and waste disposal. A is a potential candidate for incineration by rotary kiln with a temperature range of 820–1600 °C and a residence time of seconds for liquid or gas and hours for solid. Control acid mist from exhaust gases[83]. Containers must be disposed of properly by following package label directions or by contacting your local or federal environmental control agency, or by contacting your regional EPA office.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- EXTOXNET, Extension Toxicology Network, “Pesticide Information Profile, Methoxychlor,” Oregon State

University, Corvallis, OR (June 1996). http://extoxnet.orst.edu/pips/methoxyc.htm

- New Jersey Department of Health and Senior Services, “Hazardous Substance Fact Sheet, Methoxychlor,” Trenton, NJ (November 1999). http://www.state.nj.us/health/eoh/rtkweb/rtkhsfs.htm
- Agency for Toxic Substances and Disease Registry, “ToxFAQs for Methoxychlor,” Atlanta, GA (September 2002). http://www.atsdr.cdc.gov/tfacts47.html
- Sax, N. I., Ed., “Dangerous Properties of Industrial Materials Report” 7, No. 5, 79-87 (1987)
- New York State Department of Health, “Chemical Fact Sheet: Methoxychlor,” Albany, NY, Bureau of Toxic Substance Assessment (Mar.1986 and Version 2)

Methoxyfenozide M:0603

Use Type: Insecticide
CAS Number: 161050-58-4
Formula: $C_{22}H_{28}N_2O_3$
Synonyms: Benzoic acid, 3-methoxy-2-methyl-2-(3,5-dimethylbenzoyl)-2-(1,1-dimethylethyl)hydrazide
Trade Names: INTREPID®; PRODIGY®
Chemical class: Diacylhydrazine
EPA/OPP PC Code: 121027
California DPR Chemical Code: 5698
HSDB Number: 7936
UN/NA & ERG Number: UN3077 (solid)/171; UN3082 (liquid)/171
RTECS® Number: Not found
EC Number: Not assigned
Uses: Methoxyfenozide prevents insects from molting, or shedding their exoskeleton in order to grow, e. g., caterpillars and lychee webworms.
U.S. Maximum Allowable Residue Levels for Methoxyfenozide [40 CFR 180.544(a)(1)]: acerola 0.4 ppm; almond, hulls 25 ppm; animal feed, nongrass, group 18, forage 50.0 ppm; animal feed, nongrass, group 18, hay 150.0 ppm; apple, wet pomace 7.0 ppm; artichoke, globe 3.0 ppm; avocado 0.6 ppm; bean, dry, seed 0.24 ppm; brassica, head and stem, subgroup 5A, 7.0 ppm; brassica, leafy greens, subgroup 5B, 30 ppm; bushberry subgroup 13-07B, 3.0 ppm; canistel 0.6 ppm; cattle, fat 0.50 ppm; cattle, meat 0.02 ppm; coriander, leaves 30 ppm; corn, field, forage 15 ppm; corn, field, grain 0.05 ppm; corn, field, refined oil 0.20 ppm; corn, field, stover 125 ppm; corn, pop, grain 0.05 ppm; corn, pop, stover 125 ppm; corn, sweet, forage 30 ppm; corn, sweet, kernel plus cob with husks removed 0.05 ppm; corn, sweet, stover 60 ppm; cotton, gin byproducts 35 ppm; cotton, undelinted seed 2.0 ppm; cranberry 0.5 ppm; feijoa 0.4 ppm; fruit, pome, group 11, 1.5 ppm; fruit, stone, group 12, except plum, prune, fresh 3.0 ppm; goat, fat 0.50 ppm; goat, meat 0.02 ppm; grain, aspirated fractions 2.0 ppm; grape 1.0 ppm; grape, raisin 1.5 ppm; grass, forage, fodder and hay, group 17, forage 18.0 ppm; grass, forage, fodder and hay, group 17, hay 30.0 ppm; guava 0.4 ppm; hog, fat 0.1 ppm; hog, meat 0.02 ppm; horse, fat 0.50 ppm; horse, meat 0.02 ppm; jaboticaba 0.4 ppm; leaf petioles subgroup 4B, 25 ppm; leafy greens subgroup 4A, 30 ppm; longan 2.0 ppm; lychee 2.0 ppm; mango 0.6 ppm; milk 0.10 ppm; nut, tree, group 14, 0.10 ppm; okra 2.0 ppm; onion, green, subgroup 3-07B, 5.0 ppm; papaya 0.6 ppm; passionfruit 0.4 ppm; pea and bean, succulent shelled, subgroup 6B, 0.2 ppm; pea, blackeyed, seed 4.0 ppm; pea, dry seed 2.5 ppm; pea, southern, seed 4.0 ppm; peanut 0.02 ppm; peanut, hay 55.0 ppm; peanut, oil 0.04 ppm; peppermint, tops 7.0 ppm; pistachio 0.10 ppm; plum, prune, fresh 0.30 ppm; pomegranate 0.6 ppm; poultry, fat 0.02 ppm; poultry, meat 0.02 ppm; pulasan 2.0 ppm; rambutan 2.0 ppm; sapodilla 0.6 ppm; sapote, black 0.6 ppm; sapote, mamey 0.6 ppm; sheep, fat 0.50 ppm; sheep, meat 0.02 ppm; soybean, aspirated grain fractions 160 ppm; soybean, forage 30 ppm; soybean, hay 80 ppm; soybean, hulls 2.0 ppm; soybean, seed 1.0 ppm; Spanish lime 2.0 ppm; spearmint, tops 7.0 ppm; star apple 0.6 ppm; starfruit 0.4 ppm; strawberry 1.5 ppm; turnip, greens 30 ppm; vegetable, cucurbit, group 9, 0.3 vegetable, foliage of legume, except soybean, subgroup 7A, 35 ppm; vegetable, fruiting, group 8, 2.0 ppm; vegetable, leaves of root and tuber, group 2, 30 ppm; vegetable, legume, edible podded, subgroup 6A, 1.5 ppm; vegetable, root, subgroup 1A, 0.5 ppm; vegetable, tuberous and corm, except potato, subgroup 1D, 0.02 ppm; wax jambu 0.4 ppm. ***For combined residues of the insecticide methoxyfenozide and its glucuronide metabolite RH-141,518; beta-D-glucopyranuronic acid, 3-[2-(1,1-dimethylethyl)-2-(3,5-dimethylbenzoyl)-hydrazino]carbonyl-2-methylphenyl-] in the following commodities [40 CFR 180.544(a)(2)]:*** Cattle, liver 0.40 ppm; Cattle, meat byproducts, except liver 0.10 ppm; Egg 0.02 ppm; Goat, liver 0.40 ppm; Goat, meat byproducts, except liver 0.10 ppm; Hog, liver 0.1 ppm; Hog, meat byproducts, except liver 0.02 ppm; Horse, liver 0.40 ppm; Horse, meat byproducts, except liver 0.10 ppm; Poultry, liver 0.10 ppm; Poultry, meat byproducts, except liver 0.02 ppm; Sheep, liver 0.40 ppm; Sheep, meat byproducts, except liver 0.10. ***Regional registration, as defined in section 180.1(n) [40 CFR 180.544(c)]:*** Citrus, oil 100 ppm; Fruit, citrus, group 10, 10 ppm.
Regulatory Authority and Advisory Information:
Carcinogenicity: EPA, Not likely to be a human carcinogen
Health Advisory: Suspected groundwater pollutant.
Description: White crystalline solid or powder. Molecular weight = 368.47; Specific gravity (H_2O:1) = 0.63; Boiling point = (decomposes); Freezing/Melting point = 204–207 °C; Vapor pressure = 3.5×10^{11} mmHg @ 25 °C[83]. Henry's Law constant = 3.84×10^{12} atm-m^3/mol @ 25 °C (est)[83]. Low solubility in water.
Permissible Concentration in Water: Federal Drinking Water Guidelines: 700 ppb[14].
Determination in Water: Log K_{ow} = >3.5. Values above 3.0 are likely to bioaccumulate in aquatic organisms.
Routes of Entry: Dermal contact, inhalation, ingestion.
Harmful Effects and Symptoms
Short Term Exposure: Contact with eyes or skin may cause irritation or injury. Inhalation should be avoided; use

NIOSH- or CEN (UK)-approved air-purifying respirators for pesticides. Harmful if swallowed. At high levesl of exposure may affect glandular systems. LD_{50} (oral, dermal, rat) = >5 g/kg.

Long Term Exposure: At high levels of exposure may affect endocrine system, thyroid and adrenal glands.

Points of Attack: Adrenal glands, endocrine system, thyroid.

Medical Surveillance: If symptoms develop or overexposure is suspected, the following may be useful: Exam of the nervous system. Thyroid function tests.

First Aid: If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least 15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately. If this chemical contacts the skin, remove contaminated clothing and wash immediately with soap and water. Seek medical attention immediately. If this chemical has been inhaled, remove from exposure, begin rescue breathing (using universal precautions) if breathing has stopped, and CPR if heart action has stopped. Transfer promptly to a medical facility. When this chemical has been swallowed, get medical attention. Give large quantities of water and induce vomiting. Do not make an unconscious person vomit.

Personal Protective Methods: Applicators and other handlers must wear: Coveralls worn over long-sleeved shirt and long pants; Chemical-resistant gloves such as DuPont™ Tychem® suit fabrics, barrier laminate, or Viton®; Chemical-resistant footwear plus socks; Protective eye wear; Chemical-resistant headgear for overhead exposure; Chemical-resistant apron when cleaning equipment, mixing, or loading[83]. Agricultural Use/Engineering Controls: When handlers use closed systems, enclosed cabs, or aircraft in a manner that meets the requirements listed in the Worker Protection Standard (WPS) for agricultural pesticides, ***40 CFR 170.240(d)(4-6)***, the handler PPE requirements may be reduced or modified as specified in the Worker Protection Standard. Firefighters should wear NIOSH-approved self-contained breathing apparatus and full protective clothing.

Respirator Selection: Wherever and whenever workplace conditions warrant respirator use, a respiratory protection program must be followed that meets one or more of the following government standards: OSHA's 29 CFR 1910.134, ANSI Z88.2, or European Standard EN 149.

Storage: Color Code-Blue: Health Hazard/Poison. Store in a secure poison location. Prior to working with this chemical you should be trained on its proper handling and storage. Store in tightly closed containers in a cool, well-ventilated area. Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: Environmentally hazardous substances, solid or liquid, usually fall in Hazard Class 9

Spill Handling: First remove all sources of ignition. Evacuate persons not wearing protective equipment from area of spill or leak until clean up is complete. Collect powdered material in the most convenient and safe manner and deposit in sealed containers. Ventilate area after clean up is complete. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable.

Fire Extinguishing: Hazardous decomposition includes oxides of nitrogen and carbon. As an immediate precautionary measure, isolate spill or leak area in all directions for at least 50 meters/150 feet for liquids and at least 25 meters/75 feet for solids. *Fire involving storage or vehicular tanks:* isolate for 800 meters/0.5 mile in all directions; also, consider initial evacuation for 800 meters/0.5 mile in all directions. *On a small fire:* use dry chemical, CO_2, water spray or regular foam. *On a large fire:* use water spray, fog or regular foam. Do not scatter spilled material with high-pressure streams of water. Move containers from fire area if you can do it without risk. Dike fire-control water for later disposal. *Fire involving tanks:* from a secure, explosion-proof location, use water spray to cool exposed containers. If cooling streams are ineffective (venting sound increases in volume and pitch, tank discolors, or shows any signs of deforming), withdraw immediately to a secure position. Always stay away from tanks engulfed in fire. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode.

Disposal Method Suggested: Dissolve or mix the material with a combustible solvent and burn in a chemical incinerator equipped with an afterburner and scrubber. All federal, state, and local environmental regulations must be observed.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- USEPA, Office of Pesticide Programs, Pesticide Residue Limits, "Methoxyfenozide," ***40 CFR 180.544***. http://www.epa.gov/fedrgstr/EPA-PEST/2002/September/Day-20/p23996.htm

Methyl bromide M:0720

Use Type: Fumigant, Herbicide, Insecticide, Nematicide

CAS Number: 74-83-9

Formula: CH_3Br

Synonyms: Bromomethane; Methane, bromo-; Methylbromid; Metilbromid (Spanish); Monobromomethane

Trade Names: BROM-O-GAS®; BROM-O-SOL®; DAWSON® 100; DOWFUME®; EDCO®; EMBAFUME®; HALON 1001®; ISCOBROME®; KAYAFUME®; MATABROM®; METHO-GAS®; M-B-C FUMIGANT®; R 40B1®; ROTOX®; TERABOL®; TERR-O-GAS®; ZYTOX®

Chemical class: Organohalide; Halogenated organic compound

EPA/OPP PC Code: 053201

California DPR Chemical Code: 385

HSDB Number: 779

UN/NA & ERG Number: UN1062/123

RTECS® Number: PA4900000

EC Number: 200-813-2 [*Annex I Index No.:* 602-002-00-3]

Uses: The primary use of methyl bromide is as an insect fumigant to control insects, nematodes, weeds and pathogens in more than 100 crops and for soil, grain storage, warehouses, mills, ships, etc. Use of methyl bromide in the U.S. will be phased out under the requirements of the Montreal Protocol, with some exemptions. Methyl bromide is also used as a chemical intermediate and a methylating agent, a refrigerant, a herbicide, a fire-extinguishing agent, a low-boiling solvent in aniline dye manufacture, for degreasing wool, for extracting oils from nuts, seeds, and flowers, and in ionization chambers. It is used as an intermediate in the manufacture of many drugs. A U.S. EPA restricted Use Pesticide (RUP), NO INERT. Still actively registered for use in the U.S. (2013). As of March 18, 2005, the use of methyl bromide in the EU was banned for most purposes, including quarantine and pre-shipment fumigations.Registered for use in the U.S.

U.S. Maximum Allowable Residue Levels for Methyl Bromide [40 CFR 180.123(a)(1)]: almond, postharvest 200.0 ppm; apple, postharvest 5.0 ppm; apricot, postharvest 20.0 ppm; artichoke, jerusalem, postharvest 30.0 ppm; asparagus, postharvest 100.0 ppm; avocado, postharvest 75.0 ppm; barley, grain, postharvest 50.0 ppm; bean, lima, postharvest 50.0 ppm; bean, postharvest 50.0 ppm; bean, snap, succulent, postharvest 50.0 ppm; bean, succulent, postharvest 50.0 ppm; beet, garden, roots, postharvest 30.0 ppm; beet, sugar, roots, postharvest 30.0 ppm; blueberry, postharvest 20.0 ppm; butternut, postharvest 200.0 ppm; cabbage, postharvest 50.0 ppm; cacao bean, roasted bean, postharvest 50.0 ppm; cantaloupe, postharvest 20.0 ppm; carrot, roots, postharvest 30.0 ppm; cashew, postharvest 200.0 ppm; cherry, sweet, postharvest 20.0 ppm; cherry, tart, postharvest 20.0 ppm; chestnut, postharvest 200.0 ppm; cippolini, bulb, postharvest 50.0 ppm; citron, citrus, postharvest 30.0 ppm; coconut, copra, postharvest 100.0 ppm; coffee, bean, green, postharvest 75.0 ppm; corn, field, grain, postharvest 50.0 ppm; corn, pop, postharvest 240.0 ppm; corn, sweet, kernel plus cob with husks removed, postharvest 50.0 ppm; cucumber, postharvest 30.0 ppm; cumin, seed, postharvest 100.0 ppm; eggplant, postharvest 20.0 ppm; garlic, postharvest 50.0 ppm; ginger, postharvest 100.0 ppm; grape, postharvest 20.0 ppm; grapefruit, postharvest 30.0 ppm; hazelnut, postharvest 200.0 ppm; horseradish, postharvest 30.0 ppm; kumquat, postharvest 30.0 ppm; lemon, postharvest 30.0 ppm; lime, postharvest 30.0 ppm; melon, honeydew, postharvest 20.0 ppm; muskmelon, postharvest 20.0 ppm; nectarine, postharvest 20.0 ppm; nut, brazil, postharvest 200.0 ppm; nut, hickory, postharvest 200.0 ppm; nut, macadamia, postharvest 200.0 ppm; oat, postharvest 50.0 ppm; okra, postharvest 30.0 ppm; onion, bulb, postharvest 20.0 ppm; onion, green, postharvest 20.0 ppm; orange, postharvest 30.0 ppm; parsnip, roots, postharvest 30.0 ppm; peach, postharvest 20.0 ppm; peanut, postharvest 200.0 ppm; pear, postharvest 5.0 ppm; pea, blackeyed, postharvest 50.0 ppm; pea, postharvest 50.0 ppm; pecan, postharvest 200.0 ppm; pepper, postharvest 30.0 ppm; pimento, postharvest 30.0 ppm; pineapple, postharvest 20.0 ppm; pistachio, postharvest 200.0 ppm; plum, postharvest 20.0 ppm; pomegranate, postharvest 100.0 ppm; potato, postharvest 75.0 ppm; pumpkin, postharvest 20.0 ppm; quince, postharvest 5.0 ppm; radish, postharvest 30.0 ppm; rice, grain, postharvest 50.0 ppm; rutabaga, roots, postharvest 30.0 ppm; rutabaga, tops, postharvest 30.0 ppm; rye, grain, postharvest 50.0 ppm; salsify, roots, postharvest 30.0 ppm; sorghum, grain, grain, postharvest 50.0 ppm; soybean, postharvest 200.0 ppm; squash, summer, postharvest 30.0 ppm; squash, winter, postharvest 20.0 ppm; squash, zucchini, postharvest 20.0 ppm; strawberry, postharvest 60.0 ppm; sweet potato, postharvest 75.0 ppm; tangerine, postharvest 30.0 ppm; timothy, hay, postharvest 50.0 10/19/10 tomato, postharvest 20.0 ppm; turnip, roots, postharvest 30.0 ppm; walnut, postharvest 200.0 ppm; watermelon, postharvest 20.0 ppm; wheat 50.0 ppm. ***[40 CFR 180.123(a)(2)]:*** Inorganic bromide may be present as a residue in certain processed foods in accordance with the following conditions: (i) When inorganic bromide residues are present as a result of fumigation of the processed food with methyl bromide or from such fumigation in addition to the authorized use of methyl bromide on the source raw agricultural commodity, as provided for in this part, the total residues of inorganic bromides (calculated as Br) shall not exceed the following levels: (a) 400 ppm in or on egg, dried and herb, processed and spice. (b) 325 ppm in or on cheese, parmesan and cheese, roquefort cheese. (c) 250 ppm in or on tomato, concentrated products and fig, dried fruit. (d) 125 ppm in or on processed foods other than those listed above. (ii) When inorganic bromide residues are present in malt beverage, fermented in accordance with 21 CFR 172.730(a)(2), the amount shall not exceed 25 ppm (calculated as Br). (iii) Where tolerances are established on both the raw agricultural commodities and processed foods made therefrom, the total residues of inorganic bromides in or on the processed food shall not be greater than those designated in paragraph (a)(2) of this section, unless a higher level is established elsewhere in this part. ***[40 CFR 180.123(a)(3)]:*** Tolerances are established for residues of inorganic bromides (calculated as Br) as follows: (i) 400 ppm for residues in or on dog food, resulting from fumigation with methyl bromide. (ii) 125 ppm for residues in or on processed commodities for animal feedstuffs from barley, corn, grain sorghum, oat, rice, rye and wheat, resulting directly from fumigation with methyl bromide or from carryover and concentration of residues of inorganic bromides from fumigation of the grains with methyl bromide. ***Regional registration, as defined in section 180.1(n) [40 CFR 180.123©)]:*** (calculated as Br) in or on the following food commodity grown in soil fumigated with methyl bromide. Ginger, postharvest, 100 ppm. ***[40 CFR 180.124]:*** A tolerance is established for residues of the fumigant methyl bromide, including metabolites and degradates, in or on the commodity in the table below. Compliance with the tolerance level specified below is to be determined by measuring only methyl bromide. Cotton, undelinted seed: 150 ppm. ***[40 CFR 180.521(a)]:*** Fumigants may be safely used in or on grain-mill machinery in accordance with the following prescribed conditions: (1) The fumigants consist of methyl bromide. (2) To assure safe use of the fumigant, its label and labeling shall conform to the label and labeling registered by the U.S. Environmental Protection Agency. (3) Residues of inorganic bromides (calculated as Br) in milled fractions derived from cereal grain from all fumigation sources, including fumigation of grain-mill machinery, shall not exceed 125 ppm. ***[40 CFR 180.522(a)]:*** Fumigants for processed grain may be safely used, in accordance with the following conditions. (1) Methyl bromide. Total residues of inorganic bromides (calculated as Br) from the use of this fumigant shall not exceed 125 parts per milion. (2) Methyl bromide is used to fumigate corn grits and cracked rice in the production of fermented malt beverage. (3) To assure safe use of the fumigant, its label and labeling shall conform to the label and labeling registered by the U.S. Environmental Protection Agency, and the usage employed should conform with such label or labeling. (4) The total residue of inorganic bromides in fermented malt beverage, resulting from the use of corn grits and cracked rice fumigated with the fumigant described in paragraph (a)(2) of this section plus additional residues of inorganic bromides that may be present from uses in accordance with other regulations in this chapter promulgated under section 408 and/or 409 of the Act, does not exceed 25 ppm bromide (calculated as Br). ***[40 CFR 180.2020]:*** when applied as a pre-plant soil fumigant. All pre-plant soil uses. Non-food determinations. Methyl bromide does not need a tolerance or exemption from the requirement of a tolerance based on EPA's determination that they are not likely to result in residues in or on food.

Human toxicity (long-term)[101]: Intermediate–10.00 ppb, Health Advisory

Fish toxicity (threshold)[101]: Very low–1760.07814 ppb, MATC (Maximum Acceptable Toxicant Concentration)

Regulatory Authority and Advisory Information:

Carcinogenicity[83]: EPA, Not Likely to be a human carcinogen; IARC, Group 3 not classifiable as to its carcinogenicity in humans; ACGIH A4, not classified as a human carcinogen

California Proposition 65 Chemical: Listed; Developmental/Reproductive Toxin (1/1/1993)

Health Advisory: Mutagen

Acute Oral Category: 2, WARNING

List of priority pollutants (U.S. EPA)

U.S. DOT 49CFR172.101, Inhalation Hazard Chemical

OSHA 29CFR1910.119, Appendix A, Process Safety List of Highly Hazardous Chemicals, TQ = 2500 lb (1135 kg)

Clean Air Act: Hazardous Air Pollutants (Title I, Part A, Section 112); Stratospheric ozone protection (Title VI, Subpart A, Appendix A), Class I, Ozone Depletion Potential = 0.7

Clean Water Act: 40CFR423, Appendix A, Priority Pollutants; Section 313 Water Priority Chemicals (57FR41331, 9/9/92)

EPA Hazardous Waste Number (RCRA No.): U029

RCRA 40CFR268.48; 61FR15654, Universal Treatment Standards: Wastewater (mg/L), 0.11; Non-wastewater (mg/kg), 15

RCRA 40CFR264, Appendix 9; TSD Facilities Ground Water Monitoring List. Suggested test method(s) (PQL *u*g/L): 8010(20); 8240(10)

Safe Drinking Water Act: Priority List (55 FR 1470)

Superfund/EPCRA 302 Extremely Hazardous Substances: TPQ = 1000 lb (454 kg)

Superfund/EPCRA 40CFR302.4 RQ: CERCLA, 1000 lb (454 kg)

EPCRA Section 313 Form R *de minimis* concentration reporting level: 1.0%

U.S. DOT Regulated Marine Pollutant (49CFR172.101, Appendix B). Only as methyl bromide and ethylene dibromide mixture, liquid

California Proposition 65 Developmental/Reproductive toxin (methyl bromide, as a structural fumigant) (1/1/1993)

European/International Regulations: Hazard Symbol: T, N; risk phrases: R23/25; R36/37/38; R48/20; R50/59; R68; safety phrases: S1/2; S15; S27; S36/39; S38; S45; S59; S61 (see Appendix 1)

WGK (German Aquatic Hazard Class): 3-Severe hazard to waters

Description: Methyl bromide is a colorless gas. Chloroform-like odor at high concentrations. A liquid below 3.3 °C. Shipped as a liquefied compressed gas. Molecular weight = 94.95; Specific gravity (H_2O:1) = 1.676 @ 25 °C; Boiling point = 3.5 °C; Freezing/Melting point = –93.68 °C; Relative vapor density (air = 1) = 3.36; Vapor pressure = 1.9 atm; 750 mmHg @ 3.3 °C; Flash point = practically non-flammable except in presence of a high-energy ignition source; Autoignition temperature = 537 °C. Explosive limits: LEL = 10.0% (3000 ppm); UEL = 16.0%. Hazard Identification (based on NFPA-704 M Rating System): Health 3, Flammability 1, Reactivity 0. Soluble in water; solubility = >15,000 mg/L @ 25 °C.

Incompatibilities: Not flammable but will combust in the presence of strong oxidizers and in high temperatures[17]. Attacks aluminum to form *spontaneously* flammable aluminum trimethyl. Incompatible with strong oxidizers, aluminum, dimethylsulfoxide, ethylene oxide, water. Attacks aluminum, zinc, magnesium, alkali metals and their alloys, creating a pyrophoric gas that may be a fire and explosion hazard. Attacks some rubbers and coating.

Permissible Exposure Limits in Air: Conversion factor: 1 ppm = 3.89 mg/m^3 @ 25 °C & 1 atm

OSHA PEL: 20 ppm/80 mg/m^3 Ceiling Concentration [skin]

NIOSH REL: A potential occupational carcinogen. Limit exposure to lowest feasible concentration. See *NIOSH Pocket Guide*, Appendix A

ACGIH TLV®[1]: 1 ppm/3.9 mg/m^3 [skin]; not classifiable as a human carcinogen

NIOSH IDLH: 250 ppm

Protective Action Criteria (PAC) Ver. 27[89]

PAC-1: 19 ppm
PAC-2: **210** ppm
PAC-3: **740** ppm

*AEGLs (Acute Emergency Guideline Levels) and ERPGs (Emergency Response Planning Guideline) are in **bold face**.

DFG MAK: [skin], Carcinogen Category 3B

Determination in Air: Charcoal adsorption, workup with CS_2, analysis by gas chromatography/flame ionization. See NIOSH Method 2520[18].

Permissible Concentration in Water: Federal Drinking Water Guidelines: 10 μg/L; State Drinking Water Guidelines: Arizona 0.19 μg/L; Massachusetts 10 μg/L; Minnesota 10 μg/L; Wisconsin 10 μg/L.

Determination in Water: Inert gas purge followed by gas chromatography with halide-specific detection (EPA Method 601) or gas chromatography plus mass spectrometry (EPA Method 624). Log K_{ow} = <2.0. Unlikely to bioaccumulate in marine organisms.

Routes of Entry: Methyl bromide is absorbed well by the lungs and to some degree through intact skin. Oral exposure is rare because methyl bromide is a gas at room temperature, but it may be absorbed by the gastrointestinal tract. Exposure by any route can cause systemic effects.

Harmful Effects and Symptoms: *Warning*: Effects may be delayed for hours to days. Caution is advised.

Short Term Exposure: Methyl bromide is a neurotoxic gas that can cause convulsions, coma, and long-term neuromuscular and cognitive deficits. Exposure to high concentrations of pure methyl bromide may cause inflammation of the bronchi or lungs, an accumulation of fluid in the lung, and irritation of the eyes and nose. Tearing agents added to methyl bromide to provide warning of its presence can also cause these symptoms, even at very low concentrations. Dermal contact with high vapor concentrations or with liquid methyl bromide can cause systemic toxicity and may cause stinging pain and blisters. Methyl bromide irritates the respiratory tract. Inhalation of the gas can cause pulmonary edema, a medical emergency that can be delayed for several hours. This can cause death. May affect the central nervous system, causing psychological disturbances. Signs and symptoms of acute exposure to methyl bromide may be severe and include tremors, convulsions, brain hemorrhage, paralysis, coma, and permanent brain damage. Respiratory effects include cough, tachypnea (rapid respiratory rate), pulmonary edema, and respiratory collapse. Cyanosis (blue tint to the skin and mucous membranes), pallor, ventricular fibrillation, and circulatory collapse may also occur. Lethargy, profound weakness, headache, dizziness, mental confusion, slurring of speech, staggering gait, and blurred or double vision are often found. Gastrointestinal signs and symptoms include nausea, vomiting, abdominal pain, and anorexia. Oliguria (scanty urination), anuria (lack of urine formation), kidney hemorrhage, and kidney failure may occur. Contact with methyl bromide may cause dermatitis (red, inflamed skin) and conjunctivitis (red, inflamed eyes). *Inhalation:* A level of 35 ppm can cause nausea, vomiting, loss of appetite, headache, dizziness, drowsiness and dimming of vision. These effects go away soon after exposure ceases. Headaches, dizziness, and weakness can be felt at 100 ppm and can last for months after exposure. Higher levels have caused coughing, nose and throat irritation, disturbed speech and walk, visual disturbances, twitching, numbness, paralysis, convulsions and permanent nerve damage. Symptoms are often delayed 2–48 hours. Exposures of 10,000 ppm for a few minutes can cause death. Can cause abdominal cramps, respiratory failure resulting in death. *Skin*: Contact with liquid can cause burning or tingling sensation, itching, redness and swelling. Large amounts can cause blisters, numbness or aching pain. Methyl bromide can be absorbed through the skin and cause symptoms described under inhalation. Death has occurred from skin absorption. *Eye*: Can cause irritation, tearing, reddening or burning pain. *Ingestion:* Can cause throat and stomach irritation as well as symptoms described under inhalation. Delayed pulmonary edema may occur after inhalation. LD_{50} (oral, rat) = 100–200 mg/kg.

Long Term Exposure: May cause tumors. Repeated exposures have been associated with peripheral neuropathies, especially sensory neuropathy, impaired gait, behavioral changes, and mild liver and kidney dysfunction. Visual impairment secondary to atrophy of the optic nerve has been reported. Chronic exposure may be more serious for children because of their potential longer latency period. *Carcinogenicity[83]:* The International Agency for Research on Cancer has determined that methyl bromide is not classifiable as to its carcinogenicity to humans. *Reproductive and developmental effects:* Methyl bromide is not considered a reproductive or developmental toxin. Levels between 20 and 35 ppm can cause symptoms as described under short term inhalation. Symptoms can last months or years, or can be permanent. Repeated or prolonged contact with skin may cause dermatitis, lung damage and broncho-spasms. Methyl bromide may affect the central nervous system, causing paralysis, poor vision, psychological disorders, hallucinations, numbness in the arms and legs, brain damage. May cause liver and kidney damage. Methyl bromide is a mutagen and may have a cancer risk. May damage the testes.

Points of Attack: Eyes, skin, respiratory system, central nervous system, brain, kidney. Cancer site in animals: lung, kidney, and forestomach tumors.

Medical Surveillance: Comprehensive physical examination with emphasis on the genito-urinary tract analysis to include sperm count, motility and morphology. Other tests, such as serum testosterone, serum follicle stimulating hormone (FSH), and serum lutenizing hormone (LH), may be carried out if, in the opinion of a physician, they are indicated. Production of effects on the reproductive system. Medical observation is recommended for 24 to 48 hours following breathing overexposure, as pulmonary edema may be delayed. Evaluate the central nervous system, respiratory tract, and skin in preplacement and periodic examinations. Examination of the nervous system. Blood test for bromides (unexposed persons usually have serum levels of 5 mg/L or below). Kidney function tests. Evaluation for brain effects.

First Aid: *Emergency life-support procedures:* Acute exposure to methyl bromide may require decontamination and life support for the victims. Emergency personnel should wear protective clothing appropriate to the type and degree of contamination. Air-purifying or supplied-air respiratory equipment should also be worn, as necessary. Rescue vehicles should carry supplies such as plastic sheeting and disposable plastic bags to assist in preventing spread of contamination. *Inhalation exposure:* 1. Move victims to fresh air. Emergency personnel should avoid self-exposure to methyl bromide. 2. Evaluate vital signs including pulse and respiratory rate, and note any trauma. If no pulse is detected, provide CPR. If not breathing, provide artificial respiration. If breathing is labored, administer oxygen or other respiratory support. 3. Obtain authorization and/or further instructions from the local hospital for administration of an antidote or performance of other invasive procedures. 4. Transport to a health care facility. *Dermal/eye exposure:* 1. Remove victims from exposure. Emergency personnel should avoid self- exposure to methyl bromide. 2. Evaluate vital signs including pulse and respiratory rate, and note any trauma. If no pulse is detected, provide CPR. If not breathing, provide artificial respiration. If breathing is labored, administer oxygen or other respiratory support. 3. Remove contaminated clothing as soon as possible. 4. If eye exposure has occurred, eyes must be flushed with lukewarm water for at least 15 minutes. 5. Wash exposed skin areas twice with soap and water. 6. Obtain authorization and/or further instructions from the local hospital for administration of an antidote or performance of other invasive procedures. 7. Transport to a health care facility[ERG]. *Note to physician or authorized medical personnel:* In cases of respiratory compromise secure airway and respiration via endotracheal intubation. If not possible, perform cricothyroidotomy if equipped and trained to do so. Treat patients who have bronchospasm with aerosolized bronchodilators. The use of bronchial sensitizing agents in situations of multiple chemical exposures may pose additional risks. Consider the health of the myocardium before choosing which type of bronchodilator should be administered. Cardiac sensitizing agents may be appropriate; however, the use of cardiac sensitizing agents after exposure to certain chemicals may pose enhanced risk of cardiac arrhythmias (especially in the elderly). Consider racemic epinephrine aerosol for children who develop stridor. Dose 0.25–0.75 mL of 2.25% racemic epinephrine solution in 2.5 cc water, repeat every 20 minutes as needed, cautioning for myocardial variability. Patients who are comatose, hypotensive, or are having seizures or cardiac arrhythmias should be treated according to advanced life support protocols. If evidence of shock or hypotension is observed begin fluid administration. For adults, bolus 1000 mL/hour intravenous saline or lactated Ringer's solution if blood pressure is under 80 mmHg; if systolic pressure is over 90 mmHg, an infusion rate of 150 to 200 mL/hour is sufficient. For children with compromised perfusion administer a 20 mL/kg bolus of normal saline over 10 to 20 minutes, then infuse at 2 to 3 mL/kg/hour.

Personal Protective Methods: *Note:* Do not wear *ordinary rubber gloves* or *adhesive bandages* while using methyl bromide. It can dissolve rapidly through rubber or adhesive tape and cause severe symptoms. Wear appropriate personal protective clothing to prevent the skin from becoming frozen from contact with the evaporating liquid or from contact with vessels containing the liquid: **8 hr:** Responder™ suits; Trychem 1000™ suits. **4 hr**: butyl rubber gloves, suits, boots; Neoprene™ rubber gloves, suits, boots; Teflon™ gloves, suits, boots. Also, Saranex™ and styrene-butadiene rubber are among the recommended protective materials. Safety equipment suppliers/manufacturers can provide recommendations on the most protective glove/clothing material for your operation. All protective clothing (suits, gloves, footwear, headgear) should be clean, available each day, and put on before work. Contact lenses should not be worn when working with this chemical. Wear eye protection to prevent any reasonable probability of eye contact. Employees should wash immediately with soap when skin is wet or contaminated. Provide emergency showers and eyewash.

Respirator Selection: SCBA >19 ppm. NIOSH: *At concentrations above the NIOSH REL, or where there is no REL, at any detectable concentration:* SCBAF: Pd,Pp (APF = 10,000) (any NIOSH/MSHA- or European Standard EN 149-approved self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode); or SaF: Pd,Pp: ASCBA (APF = 10,000) (any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary, self-contained breathing apparatus operated in a pressure-demand or other positive-pressure mode). *Escape:* GmFOv (APF = 50) [any air-purifying, full facepiece respirator (gas mask) with a chin-style, front-or back-mounted organic vapor canister] or SCBAE (any appropriate escape-type, self-contained breathing apparatus).

Storage: Color Code-Red Stripe: Flammability Hazard: Store separately from all other flammable materials. Prior to working with this chemical you should be trained on its proper handling and storage. Before entering confined space where this chemical may be present, check to make sure that an explosive concentration does not exist. Store in tightly closed containers in a cool, well-ventilated area away from chlorine compounds, oxidizing agents, and combustible materials. Sources of ignition, such as smoking and open flames, are prohibited where the chemical is handled, used, or stored. Use only non-sparking tools and equipment, especially when opening and closing containers. Wherever this chemical is used, handled, manufactured, or stored, use explosion-proof electrical equipment and fittings. Piping should be electrically bonded and grounded. Procedures for the handling, use and storage of cylinders should be in compliance with OSHA 1910.101 and 1910.169, as with the recommendations of the Compressed Gas Association.

Shipping: Methyl bromide requires a shipping label of "POISON GAS." It usually falls in Hazard Class 2.3. It is a violation of transportation regulations to refill compressed gas cylinders without the express written permission of the owner.

Spill Handling: If in a building, evacuate building and confine vapors by closing doors and shutting down HVAC systems. Restrict persons not wearing protective equipment from area of spill or leak until clean up is complete. Ventilate area of spill or leak to disperse the gas. Wear chemical protective suit with self-contained breathing apparatus to combat spills. Stay upwind and use water spray to "knock down" vapor; contain runoff. Stop the flow of gas, if it can be done safely from a distance. If source is a cylinder and the leak cannot be stopped in place, remove the leaking cylinder to a safe place; and repair leak or allow cylinder to empty. Keep this chemical out of confined spaces, such as a sewer, because of the possibility of explosion, unless the sewer is designed to prevent the buildup of explosive concentrations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable.

Initial isolation and protective action distances

Distances shown are likely to be affected during the first 30 minutes after materials are spilled and could increase with time. If more than one tank car, cargo tank, portable tank, or large cylinder involved in the incident is leaking, the protective action distance may need to be increased. You may need to seek emergency information from CHEMTREC at (800) 424-9300 or seek professional environmental engineering assistance from the U.S. EPA Environmental Response Team at (908) 48-8730 (24-hour response line).

Small spills (from a small package or a small leak from a large package)

First: isolate in all directions (feet/meters) 100/30
Then: Protect persons downwind (miles/kilometers)
  Day 0.1/0.2
  Night 0.1/0.2

Large spills (from a large package or from many small packages)

First: isolate in all directions (feet/meters) 500/150
Then: Protect persons downwind (miles/kilometers)
  Day 0.4/0.6
  Night 1.4/2.3

Fire Extinguishing: Hazardous decomposition includes hydrogen bromide, bromine, carbon oxybromide, and carbon monoxide. NEVER direct water jet on liquid. Methyl bromide is a flammable gas, especially in the presence of a high-energy ignition source. Non-flammable at room temperature. Establish forced ventilation to keep levels below explosive limit. If liquid is spilled, evacuate area of spill; absorb liquid in vermiculite, dry sand, earth, or similar material and deposit in sealed containers for later disposal. If gas is leaked, do not extinguish the fire unless the flow of gas can be stopped and any remaining gas is out of the line. Specially trained personnel may use fog lines to cool exposures and let the fire burn itself out. Vapors are heavier than air and will collect in low areas. Vapors may travel long distances to ignition sources and flashback. Vapors in confined areas may explode when exposed to fire. Containers may explode in fire. Storage containers and parts of containers may rocket great distances, in many directions. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies. From a secure, explosion-proof location, use water spray to cool exposed containers. If cooling streams are ineffective (venting sound increases in volume and pitch, tank discolors, or shows any signs of deforming), withdraw immediately to a secure position. If cylinders are exposed to excessive heat from fire or flame contact, withdraw immediately to a secure location. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode.

Disposal Method Suggested: Consult with environmental regulatory agencies for guidance on acceptable disposal practices. Generators of waste containing this contaminant (≥100 kg/mo) must conform with EPA regulations governing storage, transportation, treatment, and waste disposal. Generators of waste (equal to or greater than 100 kg/mo) containing this contaminant, EPA hazardous waste number U029, must conform with USEPA regulations in storage, transportation, treatment and disposal of waste. Controlled incineration with adequate scrubbing and ash disposal facilities[14]. A potential candidate for rotary kiln incineration at a temperature range of 820 to 1600 °C and residence times of seconds for liquids and gases, and hours for solids. A potential candidate for fluidized bed incineration at a temperature range of 450 to 980 °C and residence times of seconds for liquids and gases, and longer for solids[14]. Alternative from the United Nations. Treatment and Disposal Methods for Waste Chemicals Dec. 1985, p. 204: Pour onto vermiculite, sodium bicarbonate or a soda-ash mixture (90:10). Mix and shovel into paper boxes. Place in an open incinerator. Cover with scrap wood and paper. Ignite with an excelsior train; stay on upwind side or pump into a closed incinerator with afterburner. "Dissolve in a flammable solvent. Spray into the fire box of an incinerator equipped with afterburner and scrubber" but methyl bromide gas is very toxic and incineration by a layman appears to be too hazardous. Methyl bromide is apparently degraded rapidly in the sunlight in air and a preferable disposal procedure for the layman would be to release a small amount slowly to the atmosphere in a well-ventilated outdoor location. Recommendable methods:

Incineration & evaporation. Peer-review: Methyl bromide is a toxic gas and incineration may be difficult to arrange safely unless an efficient method of feeding the gas into the incinerator can be arranged. Incineration requires dilution with excess fuel. (Peer-review conclusions of an IRPTC expert consultation)[UN].

References:

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- New Jersey Department of Health and Senior Services, "Hazardous Substance Fact Sheet, Methyl Bromide," Trenton, NJ (June 1998). http://www.state.nj.us/health/eoh/rtkweb/1231.pdf
- USEPA, Halomethanes: Ambient Water quality Criteria, Washington DC (1980)
- Agency for Toxic Substances and Disease Registry, U.S. Department of Health and Human Services, Public Health Service, "Managing Hazardous Materials Incidents," Atlanta, GA (June 2003)
- USEPA, Bromomethane, Health and Environmental Effects Profile No. 29, Washington DC, Office of Solid Waste (April 30, 1980)
- USEPA, "Chemical Hazard Information Profile: Methyl Bromide," Washington DC, Office of Toxic Substances (Feb.20, 1985)
- USEPA, "Chemical Profile: Methyl Bromide," Washington DC, Chemical Emergency Preparedness Program (Nov.30, 1987)
- New York State Department of Health, "Chemical Fact Sheet: Methyl Bromide," Albany, NY, Bureau of Toxic Substance Assessment (March 1986 and Version 3)
- Sax, N. I., Ed., "Dangerous Properties of Industrial Materials Report" 5, No. 6, 37-40 (1985)

Methyl parathion M:1070

Use Type: Insecticide, Nematicide

CAS Number: 298-00-0

Formula: $C_8H_{10}NO_5PS$

Synonyms: Dimethyl *p*-nitrophenyl monothiophosphate; Dimethyl-*p*-nitrophenyl monothiophosphate; *O,O*-Dimethyl *O*-*p*-nitrophenyl phosphorothioate; *O,O*-Dimethyl *O*-(4-nitrophenyl)phosphorothioate; *O,O*-Dimethyl *O*-(*p*-nitrophenyl) phosphorothioate; Dimethyl *p*-nitrophenyl phosphorothionate; *O,O*-Dimethyl *O*-4-nitrophenyl phosphorothioate; Dimethyl 4-nitrophenyl phosphorothionate; *O,O*-Dimethyl *O*-(*p*-nitrophenyl) thionophosphate; Dimethyl *p*-nitrophenyl thiophosphate; *O,O*-Dimethyl *O*-*p*-nitrophenyl thiophosphate; *O,O*-Dimethyl *O*-(*p*-nitrophenyl) thiophosphate; Dimethyl parathion; ENT 17,292; Methyl fosferno; Methyl niran; Methylthiophos; Metilparationa (Spanish); NCI-C02971; *p*-Nitrophenyldime thylthionophosphate; M-Parathion; Parathion-methyl; Parathion Metile (Spanish); Partron M; Phenol, *p*-Nitro-, *O*-ester with *O,O*-dimethyl phosphorothioate; Phosphorothioic acid, *O,O*-dimethyl *O*-(*p*-nitrophenyl) ester; Phosphorothioic acid, *O,O*-dimethyl *O*-(4-nitrophenyl) ester

Trade Names: A-GRO®[C]; AI3-17292®; ATOMIC®[C]; AZOFOS®; AZOPHOS; BAMA BRAND®[C]; BAY 11405®; BAY E-601®; BLADAN M®; CEKUMETHION®; CLEAN CROP®[C]; COTTON TOX DUST®[C]; DALF®; DECLARE®; DEVITHION®; DREXEL METHYL PARATHION 4E®[C]; DURHAM[C]; E 601®; EMMY®[C]; E-Z-FLO®[C]; FALL OUT®[C]; FMC NYNAMITE®[C]; FOLIDOC®; FOLIDOL-80®; FOLIDOL M®; FOLIDOL M-40®; FOSFERNO M 50®; GEARPHOS®; 8056HC®; KILEX PARATHION®; ME-PARATHION®; MEPTOX®; METACID 50®; METACIDE®; METAFOS®; METAPHOS®; METRON®; METHYL-E 605®; METRON®; NITROX®; NITROX® 80; OLEOVOFOTOX®; PARAPEST M-50®; PENNCAP M®; PENNCAP MLS®; QUINOPHOS®; SEIS-TRES 6-3®; SINAFID M-48®; SIXTY-THREE SPECIAL E. C. INSECTICIDE®; TEKWAISA®; THIOPHENIT®; THYLPAR M-50®; TOLL®; VERTAC METHYL PARATHION TECHNISCH 80%®; WOFATOX 50 EC®

Chemical class: Organophosphate

EPA/OPP PC Code: 053501

California DPR Chemical Code: 394

HSDB Number: 1168

UN/NA & ERG Number: UN2783 (solid)/152

RTECS® Number: TG175000

EC Number: 206-050-1 [*Annex I Index No.:* 015-035-00-7]

Uses: A U.S. EPA restricted Use Pesticide (RUP). Severely Restricted for use in EU, as parathion-methyl. This material is used as an insecticide on over 50 crops, primarily cotton, but also on walnuts, corn, dried beans and almonds and on several ornamentals. It is no longer allowed to be used on crops consumed by children.

U.S. Maximum Allowable Residue Levels for Methyl Parathion or its methyl homolog [40 CFR 180.121(a)]: in or on the following raw agricultural commodities: alfalfa (fresh) 1.25 ppm; alfalfa hay 5 ppm; almonds 0.1(N) ppm; almond hulls 3 ppm; apples 1 ppm; apricots 1 ppm; artichokes 1 ppm; avocados 1 ppm; barley 1 ppm; beans 1 ppm; beet greens (alone) 1 ppm; beets (with or without tops) 1 ppm; beets, sugar 0.1(N) ppm; beets, sugar (tops) 0.1(N) ppm; blackberries 1 ppm; blueberries (huckleberries) 1 ppm; boysenberries 1 ppm; broccoli 1 ppm; brussels sprouts 1 ppm; cabbage 1 ppm; carrots 1 ppm; cauliflower 1 ppm; celery 1 ppm; cherries 1 ppm; citrus fruits 1 ppm; clover 1 ppm; collards 1 ppm; corn 1 ppm; corn, forage 1 ppm; cottonseed 0.75 ppm; cranberries 1 ppm; cucumbers 1 ppm; currants 1 ppm; dates 1 ppm; dewberries 1 ppm; eggplants 1 ppm; endive (escarole) 1 ppm; figs 1 ppm; filberts 0.1(N) ppm; garlic 1 ppm; gooseberries 1 ppm; grapes 1 ppm; grass (forage) 1 ppm; guavas 1 ppm; hops 1 ppm; kale 1 ppm; kohlrabi

1 ppm; lettuce 1 ppm; loganberries 1 ppm; mangoes 1 ppm; melons 1 ppm; mustard greens 1 ppm; mustard seed 0.2 ppm; nectarines 1 ppm; oats 1 ppm; okra 1 ppm; olives 1 ppm; onions 1 ppm; parsnips (with or without tops) 1 ppm; parsnip greens (alone) 1 ppm; peaches 1 ppm; peanuts 1 ppm; pears 1 ppm; peas 1 ppm; peas, forage 1 ppm; pecans 0.1(N) ppm; peppers 1 ppm; pineapples 1 ppm; plums (fresh prunes) 1 ppm; potatoes 0.1(N) ppm; pumpkins 1 ppm; quinces 1 ppm; radishes (with or without tops) 1 ppm; radish, tops 1 ppm; rape seed 0.2 ppm; raspberries 1 ppm; rice 1 ppm; rutabagas (with or without tops) 1 ppm; rutabaga tops 1 ppm; safflower seed 0.1(N) ppm; sorghum 0.1(N) ppm; sorghum fodder 3 ppm; sorghum forage 3 ppm; soybeans 0.1 ppm; soybean hay 1 ppm; spinach 1 ppm; squash, 1 ppm; strawberries 1 ppm; summer squash 1 ppm; sugarcane 0.1(N) ppm; sugarcane fodder 0.1(N) ppm; sugarcane forage 0.1(N) ppm; sunflower seed 0.2 ppm; sweet potatoes 0.1(N) ppm; Swiss chard 1 ppm; tomatoes 1 ppm; turnips (with or without tops) 1 ppm; turnips greens 1 ppm; vetch 1 ppm; walnuts 0.1(N) ppm; wheat 1 ppm; and youngberries 1 ppm. Tolerances are established for residues of the insecticide *O,O*-dimethyl-*O*-*p*-nitrophenyl thiophosphate (the methyl homolog of parathion) ***[40 CFR 180.121(b)]:*** in or on the following raw agricultural commodities: birdsfoot trefoil forage 1.25 ppm; birdsfoot trefoil hay 5 ppm; guar beans 0.2 ppm; lentils 1 ppm; parsley 1 ppm; and vegetables, leafy, Brassica (cole) 1.0 ppm. ***While petitions for tolerances for negligible residues are pending and until action is completed on these petitions, interim tolerances are established for residues of the listed pesticide chemicals [40 CFR 180.319]:*** in or on raw agricultural commodities as follows: parathion or its methyl homolog, insecticide, rye 0.5 ppm.

Human toxicity (long-term)[101]: High–2.00 ppb, Health Advisory

Fish toxicity (threshold)[101]: High–5.59677 ppb, MATC (Maximum Acceptable Toxicant Concentration)

Regulatory Authority and Advisory Information:

Carcinogenicity[83]: IARC Group 3, unclassifiable; EPA, Not likely to be carcinogenic to human.

Acute Oral Category: 1, DANGER–POISON (Extreme)

Health Advisory: Nerve Toxin, Mutagen, Developmental/Reproductive Toxin, Endocrine disruptor (S!)

Potential Ground Water Pollutant [California FAC Section 13145(d)/12811, active]

U.S. DOT 49CFR172.101, Inhalation Hazard Chemical

Clean Water Act: Section 311 Hazardous Substances/RQ 40CFR117.3 (same as CERCLA, see below)

EPA Hazardous Waste Number (RCRA No.): P071

RCRA 40CFR268.48; 61FR15654, Universal Treatment Standards: Wastewater (mg/L), 0.014; Non-wastewater (mg/kg), 4.6

RCRA 40CFR264, Appendix 9; TSD Facilities Ground Water Monitoring List. Suggested test method(s) (PQL *u*g/L): 8140(0.5); 8270(10)

Superfund/EPCRA 302 Extremely Hazardous Substances: TPQ = 100/10,000 lb (45.4/4,540 kg)

Superfund/EPCRA 40CFR302.4 RQ: CERCLA, 100 lb (45.4 kg)

EPCRA Section 313 Form R *de minimis* concentration reporting level: 1.0%

U.S. DOT 49CFR172.101, Inhalation Hazard Chemical as organophosphates

U.S. DOT Regulated Marine Pollutant (49CFR172.101, Appendix B), severe pollutant

Rotterdam Convention Annex III [Chemicals Subject to the Prior Informed Consent Procedure (PIC)] [methyl-parathion (emulsifiable concentrates (EC) @ or >19.5% active ingredient and dusts @ or >1.5% active ingredient)]

European/International Regulations: Hazard Symbol: T+, Xn, N; risk phrases: R5; R10; R24; R26/28; R48/22; R50/53; safety phrases: S1/2; S28; S36/37; S45; S60; S61 (see Appendix 1)

WGK (German Aquatic Hazard Class): 3-Severe hazard to waters

Description: Methyl parathion is a white to yellow-brown, crystalline solid with a garlic odor. The commercial product in xylene is a tan liquid (80% methyl parathion/20% xylene). Molecular weight = 263.21; Specific gravity (H_2O:1) = 1.358 @ 20 °C; Boiling point = 147.8; Freezing/Melting point = 37.2 °C; Vapor pressure = 0.00001 mmHg @ 20 °C; Flash point = 46 °C. LEL (Lower Explosive Limit) = 39,000 ppm. Hazard Identification (based on NFPA-704 M Rating System): Health 4, Flammability 1, Reactivity 2. Low solubility in water; solubility = 0.006% @ 25 °C.

Incompatibilities: Dangerous when heated. May react violently with antimony(V) pentafluoride. Incompatible with lead diacetate, magnesium, silver nitrate. In the presence of strong reducing agents such as hydrides, organophosphates form highly toxic and flammable phosphine gas. Contact with oxidizers can cause the release of toxic oxides of phosphorus. Rapidly decomposed by alkalies. Explosive risk when heated above 50 °C. The liquid xylene solution decomposes violently at 120 °C. Half decomposed in 8 days at 40 °C. When a sample was heated in a small test tube it decomposed in a few minutes, the residue exploded[Food Chem. 4(1):42. 1956].

Permissible Exposure Limits in Air: OSHA PEL: None

NIOSH REL: 0.2 mg/m^3 TWA [skin]

ACGIH TLV®[1]: 0.2 mg/m^3 TWA, measured as inhalable fraction and vapor [skin]; not classifiable as a human carcinogen; BEI$_A$ issued as Acetylcholinesterase inhibiting pesticides.

Protective Action Criteria (PAC)*

PAC-1: 0.11 mg/m^3

PAC-2: **1.2**$_A$ mg/m^3

PAC-3: **3.5**$_A$ mg/m^3

*AEGLs (Acute Emergency Guideline Levels) are in **bold face**. Subscript “**A**” is a 60-minute value.

Determination in Air: OSHA versatile sampler-2; Toluene/Acetone; Gas chromatography/Flame photometric detection for sulfur, nitrogen, or phosphorus; NIOSH IV, Method #5600, Organophosphorus pesticides[18].

Permissible Concentration in Water: Federal Drinking Water Guidelines: 1 μg/L; State Drinking Water Guidelines: Arizona 1.8 μg/L; Maine 2 μg/L; Florida 10 μg/L; California 2 μg/L.

Determination in Water: Log K_{ow} = ~3.0. Values above 3.0 are likely to bioaccumulate in marine organisms.

Routes of Entry: Inhalation, skin absorption, ingestion, skin and/or eye contact.

Harmful Effects and Symptoms

Short Term Exposure: Methyl parathion may affect the nervous system, causing convulsion, respiratory failure, and death. An acetyl-cholinesterase inhibitor. Acute exposure to parathion-methyl may produce the following symptoms: pinpoint pupils, blurred vision, headache, dizziness, muscle spasms, and profound weakness. Vomiting, diarrhea, abdominal pain, seizures, and coma may also occur. High exposure may result in death. The heart rate may decrease following oral exposure or increase following dermal exposure. Hypotension (low blood pressure) may occur although hypertension (high blood pressure) is not uncommon. Chest pain may be noted. Respiratory symptoms include dyspnea (shortness of breath), respiratory depression, and respiratory paralysis. Psychosis may occur. Because this is a mutagen, handle it as a possible carcinogen–with extreme caution. Methyl parathion may damage the developing fetus. This material is extremely toxic; the probable oral lethal dose is 5–50 mg/kg, or between 7 drops and 1 teaspoonful for a 150–lb person. Delayed pulmonary edema may occur after inhalation. LD_{50} (oral, rat) = 3–24 mg/kg; (dermal, rat) = 45–67 mg/kg.

Long Term Exposure: Cholinesterase inhibitor; cumulative effect is possible. A nerve toxin; parathion-methyl may damage the nervous system with repeated exposure, resulting in convulsions, respiratory failure. May cause personality changes; depression, anxiety, irritability. May cause liver damage. May damage the developing fetus.

Points of Attack: Respiratory system, lungs, central nervous system, cardiovascular system, skin, eyes, plasma and red blood cell cholinesterase.

Medical Surveillance: Medical observation is recommended for 24 to 48 hours following breathing overexposure, as pulmonary edema may be delayed. Routine biological monitoring of pesticide applicators and field workers includes testing of plasma and red blood cell acetylcholinesterase levels (for enzyme poisoned by this chemical). These tests are normally accurate only if done within about two hours of exposure. If exposure stops, plasma levels return to normal in 1–2 weeks while red blood cell levels may be reduced for 1–3 months. When acetylcholinesterase enzyme levels are reduced by 25% or more below preemployment levels, risk of poisoning is increased, even if results are in lower ranges of "normal." Reassignment to work not involving organophosphate pesticides is recommended until enzyme levels recover. Do not drink any alcoholic beverages before or during use as it promotes absorption of organophosphates.

First Aid: **Treatment for organophosphate poisoning consists of thorough decontamination, cardiorespiratory support, and administration of the antidotes atropine and pralidoxime. In cases of severe poisoning, diazepam, an anticonvulsant, should also be administered. Antidotes should be administered as prevention even if the diagnosis is in doubt**. Speed in removing material from eyes and skin is of extreme importance. *Eyes:* Eye contact can cause dangerous amounts of these chemicals to be quickly absorbed through the mucous membrane into the bloodstream. Immediately and gently flush eyes with plenty of warm or cold water (NO hot water) for at least 15 minutes, occasionally lifting the upper and lower eyelids. Get medical aid immediately. *Skin:* Get medical aid. Dermal contact can cause dangerous amounts of these chemicals to be absorbed into the bloodstream. Wearing the appropriate PPE equipment and respirator for organophosphate pesticides, immediately flush skin with plenty of soap and water for at least 15 minutes while removing contaminated clothing and shoes. Shampoo hair promptly if contaminated. The removed, contaminated clothing and shoes should be double-bagged and left in Hot Zone for later disposal by hazardous materials experts. Skin may also be decontaminated with diluted hypochlorite solution. *Inhalation:* Get medical aid. Do not contaminate yourself. Wearing the appropriate PPE equipment and respirator for organophosphate pesticides, immediately remove the victim from the contaminated area to fresh air. If the victim is not breathing, administer artificial respiration. Do not use mouth-to-mouth method if victim ingested or inhaled the substance; give artificial respiration with the aid of a pocket mask equipped with a one-way valve or other proper respiratory medical device. If breathing is difficult, administer oxygen through bag/mask apparatus until medical help arrives. Do not leave victim unattended. *Ingestion:* Call poison control. Loosen all clothing. Never give anything by mouth to an unconscious person. If victim is *unconscious or having convulsions,* do nothing except keep victim warm. Get medical aid. Transfer promptly to a medical facility. In cases of ingestion, **do not induce vomiting**. If the victim is alert and asymptomatic, administer a slurry of activated charcoal at a dose of 1 g/kg (infant, child, and adult dose). A soda can and straw may be of assistance when offering charcoal to a child. *In some cases you may be specifically instructed by poison control to induce vomiting by way of 2 tablespoons of syrup of ipecac (adult) washed down with a cup of water*. Do NOT give activated charcoal before or with ipecac syrup

Note to physician or authorized medical personnel: Treat cases of respiratory compromise, coma, or excessive pulmonary secretions with respiratory support using protocols and techniques available and within the scope of training. Some cases may necessitate procedures such as endotracheal intubation or cricothyrotomy by properly trained and equipped personnel. When possible, atropine (see *Antidotes*, below) should be given under medical supervision. Patients who are comatose, hypotensive, or having seizures or cardiac arrhythmias should be treated according to advanced life support protocols. *Antidotes:* Two antidotes are administered to treat organophosphate poisoning. Atropine is a competitive antagonist of acetylcholine at muscarinic receptors and is used to control the excessive bronchial secretions which are often responsible for death. Pralidoxime relieves both the nicotinic and muscarine effects of organophosphate poisoning by regenerating acetylcholinesterase and can reduce both the bronchial secretions and the muscle weakness associated with poisoning. The initial intravenous dose of atropine in adults should be determined by the severity of symptoms: An initial adult dose of 1.0 to 2.0 mg or pediatric dose of 0.01 mg/kg (minimum 0.01 mg) should be administered intravenously. If intravenous access cannot be established, atropine may also be given intramuscularly, subcutaneously or via endotracheal tube. Doses should be repeated every 15 minutes until excessive secretions and sweating have been controlled. Once bronchial secretion has been controlled, atropine administration should be repeated whenever the secretions begin to recur. In seriously poisoned patients, very large doses may be required. Alterations of pulse rate and pupillary size should not be used as indicators of treatment adequacy. Pralidoxime should be administered as early in poisoning as possible as its efficacy may diminish when given more than 24 to 36 hours after exposure. Doses are as follows: adult 1.0 g; pediatric 25 to 50 mg/kg. The drug should be administered intravenously over 30 to 60 minutes, but in a life-threatening situation one-half of the total dose can be given per minute for a total administration time of 2 minutes. Treatment should begin to take effect within 40 minutes with a reduction in symptoms and the amount of atropine necessary to control bronchial secretion. The initial dose can be repeated in 1 hour and then every 8 to 12 hours until the patient is clinically well and no longer requires atropine. If intravenous access cannot be established, pralidoxime may also be given intramuscularly. Early administration of diazepam in addition to the combined atropine and pralidoxime treatment may help prevent the onset of seizures and potential brain and cardiac morphologic damage following high-level organophosphate poisoning.

Personal Protective Methods: Wear protective gloves and clothing to prevent any reasonable probability of dermal and/or eye contact. Safety equipment suppliers/manufacturers can provide recommendations on the most protective glove/clothing material for your operation. All protective clothing (suits, gloves, footwear, headgear) should be clean, available each day, and put on before work. Contact lenses should not be worn when working with this chemical. Wear splash-proof chemical goggles and face shield unless full facepiece respiratory protection is worn. Employees should wash immediately with soap when skin is wet or contaminated. Provide emergency showers and eyewash.

Respirator Selection: SCBA >0.11 mg/m^3. NIOSH: *2 mg/m^3:* CcrOv95 (APF = 10) [any air-purifying half-mask respirator equipped with an organic vapor cartridge(s) in combination with an N95, R95, or P95 filter. The following filters may also be used: N99, R99, P99, N100, R100, P100]; or Sa (APF = 10) (any supplied-air respirator). *5 mg/m^3:* Sa:Cf (APF = 25) (any supplied-air respirator operated in a continuous-flow mode); or PaprOvHie (APF = 25) (any powered air-purifying respirator with an organic vapor cartridge in combination with a high-efficiency particulate filter). *10 mg/m^3*: CcrFOv100 (APF = 50) [any air-purifying full facepiece respirator equipped with organic vapor cartridge(s) in combination with an N100, R100, or P100 filter]; or GmFOv100 (APF = 50) [any air-purifying, full facepiece respirator (gas mask) with a chin-style, front- or back-mounted organic vapor canister having an N100, R100, or P100 filter]; or PaprTOvHie (APF = 50) [any powered, air-purifying respirator with a tight-fitting facepiece and organic vapor cartridge(s) in combination with a high-efficiency particulate filter]; or SaT: Cf (APF = 50) (any supplied-air respirator that has a tight-fitting facepiece and is operated in a continuous-flow mode); or SCBAF (APF = 50) (any self-contained breathing apparatus with full facepiece); or SaF (APF = 50) (any supplied-air respirator with a full facepiece). *200 mg/m^3:* SaF: Pd,Pp (APF = 2000) (any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode). *Emergency or planned entry into unknown concentrations or IDLH conditions:* SCBAF: PD, PP (any self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode); or SaF: Pd,Pp: ASCBA (APF = 10,000) (any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary self-contained breathing apparatus operated in a pressure-demand or other positive-pressure mode). *Escape:* GmFOv100 (APF = 50) [any air-purifying, full facepiece respirator (gas mask) with a chin-style, front- or back-mounted organic vapor canister having an N100, R100, or P100 filter]; or SCBAE (any appropriate escape-type, self-contained breathing apparatus).

Storage: Color Code-Blue: Health Hazard/Poison: Store in a secure poison location. Store in tightly closed containers in a cool, well-ventilated area away from heat sources, since violent reactions may occur. See incompatible material listed above. If this material contains a flammable carrier, sources of ignition, such as smoking and open flames, are prohibited where this chemical is handled, used, or stored. Metal containers involving the transfer of 5 gallons or more of this chemical should be grounded and bonded. Drums must be equipped with self-closing valves, pressure vacuum bungs, and flame arresters. Use only non-sparking tools and equipment, especially when opening and closing containers of this chemical. Wherever this chemical is used, handled, manufactured, or stored, use explosion-proof electrical equipment and fittings. Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: Organophosphorus pesticides, solid, toxic, n.o.s. require a shipping label of "poisonous materials." Hazard Class is 6.1. Methyl parathion, solid and liquid, carry the symbol "D." The letter "D" identifies proper shipping names which are appropriate for describing materials for *domestic* transportation but may be inappropriate for international transportation under the provisions of international regulations (e.g., IMO, ICAO). An alternate proper shipping name may be selected when either domestic or international transportation is involved. Methyl parathion, solid, requires a shipping label of "poisonous materials." It usually falls in Hazard Class 6.1 and Packing Group II. Methyl parathion, liquid, requires a shipping label of "poisonous materials." It usually falls in Hazard Class 6.1 and Packing Group II.

Spill Handling: Do not touch spilled material; stop leak if you can do it without risk. Use water spray to reduce vapors. Evacuate and restrict persons not wearing protective equipment from area of spill or leak until clean up is complete. Absorb liquids in vermiculite, dry sand, earth, peat, carbon, or a similar material and deposit in sealed containers. Collect powdered material in the most convenient and safe manner and deposit in sealed containers. Ventilate and wash area of spill or leak after clean up is complete. Keep this chemical out of a confined space, such as a sewer, because of the possibility of an explosion, unless the sewer is designed to prevent the build-up of explosive concentrations. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable.

Fire Extinguishing: Hazardous decomposition includes oxides of phosphorus, sulfur, and nitrogen. This chemical is a combustible solid. Often available and used in a flammable liquid solution. Use dry chemical, carbon dioxide; or alcohol foam extinguishers. Vapors from the liquid are heavier than air and will collect in low areas. Vapors may travel long distances to ignition sources and flashback. Vapors in confined areas may explode when exposed to fire. Containers may explode in fire. Storage containers and parts of containers may rocket great distances, in many directions. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies. From a secure, explosion-proof location, use water spray to cool exposed containers. If cooling streams are ineffective (venting sound increases in volume and pitch, tank discolors, or shows any signs of deforming), withdraw immediately to a secure position. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode.

Disposal Method Suggested: Consult with environmental regulatory agencies for guidance on acceptable disposal practices. Generators of waste containing this contaminant (≥100 kg/mo) must conform with EPA regulations governing storage, transportation, treatment, and waste disposal. Incineration (816 °C, 0.5 second minimum for primary combustion; 1204 °C, 1.0 second for secondary combustion) with adequate scrubbing and ash disposal facilities. In accordance with 40CFR165, follow recommendations for the disposal of pesticides and pesticide containers. Containers must be disposed of properly by following package label directions or by contacting your local or federal environmental control agency, or by contacting your regional EPA office.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- USEPA, "Methyl Parathion Rick Management Decision," Washington DC (August 10, 1999). http://www.epa.gov/pesticides/factsheets/chemicals/mpfactsheet.htm#action
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- Agency for Toxic substances and Disease Registry, "ToxFAQs for Methyl Parathion," Atlanta, GA (September 2001). http://www.atsdr.cdc.gov/tfacts48.html
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- USEPA, "Chemical Profile: Parathion-Methyl," Washington DC, Chemical Emergency Preparedness Program (Nov.30, 1987)
- USEPA, "Health Advisory: Methyl Parathion," Washington DC, Office of Drinking Water (August 1987)

Metiram M:1306

Use Type: Fungicide

CAS Number: 9006-42-2; 9063-14-3

Formula: $C_{16}H_{33}N_{11}S_{16}Zn_3$

Synonyms: Carbamic acid, 1*H*-benzimidazol-2-yl-, carbatene; Carbamodithioic acid, 1,2-ethanydiylbis-, polymer with ammonia complex of zinc EBDC; Caswell No. 041A; EBDC, polymer with ammonia complex of zinc EBDC; Ethylenebis(dithiocarbamic acid), polymer with ammonia complex of zinc EBDC; Mixture of 5.2 parts by weight (83.9%) of [ethylenebis(dithiocarbamato)] zinc with 1 part by weight (16.1%) ethylenebis(dithiocarmabic acid), bimolecular and trimolecular cyclic anhydrosulfides and disulfides; *tris*[Amine(ethylenebis(dithiocarbamato))] zinc(2+1) (tetrahydro-1,2,4,7-dithiadiazocine-3, 8-dithione)polymer; Zinc ammoniate ethylenebis(dithiocarbamate)-poly(ethylenethiuram disulfide); Zinc metiram; Zineb-ethylene thiuram disulfide adduct

Trade Names: ATLAS® BRAND[C]; AMAREX®; NIA 9102®[C]; NIAGARA[C]; POLYCARBACIN®; POLYCARBACINE®; POLYCARBAZIN®; POLYCARBAZINE®; POLYMARCIN®; POLYMARCINE®; POLYMARSIN®; POLYMARZIN®; POLYMARZINE®; POLYRAM®

Chemical class: Dithiocarbamate

EPA/OPP PC Code: 014601

California DPR Chemical Code: 493

HSDB Number: 6705

UN/NA & ERG Number: UN3077(solid)/171; UN2771(solid)/151

RTECS® Number: TR6250000

Uses: Metiram is used to protect fruits, vegetables, field crops and other crops and ornamentals against many types of fungi and other foliar diseases.

U.S. Maximum Allowable Residue Levels for Metiram [40 CFR 180.217 (a)]: apple 2.0 ppm; potato 0.5 ppm.

Human toxic ity (long-term)[101]: High–2.10 ppb, Health Advisory

Fish toxicity (threshold)[101]: Intermediate–24.87820 ppb, MATC (Maximum Acceptable Toxicant Concentration)

Regulatory Authority and Advisory Information:

Carcinogenicity[83]: EPA Group B2, Probable human carcinogen

California Proposition 65 Chemical: Carcinogen (1/1/1990) and developmental toxin (3/30/1999)

EPA ADI (Acceptable Daily Intake) = 0.0003 mg/kg

Acute Oral Category: 4, Caution, not acutely toxic

Health Advisory: Mutagen, Developmental Toxin; Endocrine disruptor (Confirmed, German Environmental Agency)

EPCRA Section 313 Form R *de minimis* concentration reporting level: 1.0%

EPA Hazardous Waste Number (RCRA No.): U114

Clean Water Act: Section 307 (a)(1)Toxic Pollutants as zinc and compounds

Safe Drinking Water Act: SMCL, 5 mg/L; Priority List (55 FR 1470) as zinc

AB 2588-Air Toxics "Hot Spots" Chemicals (CAL) as zinc compounds

The "Director's List" (CAL/OSHA) as zinc compounds

Description: Light yellow solid or powder at room temperature. Characteristic dithiocarbamate odor. Molecular weight 1088.7; Specific gravity (H_2O:1) = 1.86; Boiling point = (decomposes); Freezing/Melting point = (decomposes) >140 °C; Vapor pressure = $<10^{7}$ mmHg @ 20 °C. Practically insoluble in water.

Incompatibilities: Combustible material. Dust may form explosive mixture in air. Water, acid, oxidizing materials. Heat or contact with moisture or acids causes rapid decomposition and the generation of toxic and flammable hydrogen sulfide and carbon disulfide. Flammable gases are generated by reaction with aldehydes, nitrides, and hydrides. Incompatible with oxidizers including peroxides, acids, acid halides, mercury[88]. Decomposition products in fire include oxides of nitrogen and sulfur. Corrosive to iron, copper brass and zinc metals, especially in the presence of moisture. Heat alkalies (lime), moisture can cause decomposition. Decomposes on prolonged storage. Degradation produces ethylene thiourea.

Permissible Concentration in Water: Canadian Drinking Water Standards: AO ≤ 5.0 mg[Zn]/L. Runoff from spills or fire control may cause water pollution. The U.S. EPA[6] has set 5 ppm for the prevention of adverse effects due to the organoleptic properties of zinc.

Determination in Water: EPA EMSLC Method 630. The Determination of Dithiocarbamate Pesticides in Municipal and Industrial Wastewater by UV-VIS Spectrophotometry. Log K_{ow} = <2.0. Unlikely to bioaccumulate in marine organisms.

Harmful Effects and Symptoms

Short Term Exposure: Low levels of toxicity. Concentrated solutions are slightly corrosive to eyes and mucous membranes. Dust inhalation can cause irritation of the respiratory system with sneezing. Eye contact can cause irritation, watering, pain, and inflammation of the eyelids. Dermal contact can cause irritation and minor ulceration. Ingestion can cause nausea, vomiting, fever, muscle twitching, seizure, rapid respiration, slow heart beat. Severe exposure may result in death. Unlike carbamates the dithiocarbamates are not cholinesterase inhibitors, but some of them may react with recently ingested alcohol or alcohol-containing products including wine, medications, and cold remedies such as cough-syrups. LD_{50} (oral, rat) = >2.5 g/kg; LD_{50} (dermal, rat) = >2 g/kg.

Long Term Exposure: May cause skin sensitization.

Points of Attack: Respiratory system, central nervous system, cardiovascular system, skin, eyes. Repeated or prolonged contact with skin may result in dermatitis (red inflamed skin).

Medical Surveillance: This chemical is a suspected or known human carcinogen. Exposed persons should contact a physician for advice regarding the possible long term health effects and advice for medical monitoring. There are tests available to measure zinc in your blood, urine, hair, saliva, and feces. High levels of zinc in the feces can mean high recent zinc exposure. High levels of zinc in the blood can mean high zinc consumption and/or high exposure. Tests to measure zinc in hair may provide information on long-term zinc exposure; however, the relationship between levels in your hair and the amount of zinc you were exposed to is not clear. Before employment and at regular times after that, the following are recommended: If symptoms develop or overexposure occurs, repeat the above tests as soon as possible and get an exam of the nervous system. Also consider complete blood count and chest x-ray following acute overexposure. Evaluation by a qualified allergist, including exposure history and testing, may help diagnose allergy.

First Aid: If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least 15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately. If this chemical contacts the skin, remove contaminated clothing and wash immediately with soap and water. Seek medical attention immediately. If this chemical has been inhaled, remove from exposure, begin rescue breathing (using universal precautions) if breathing has stopped, and CPR if heart action has stopped. Transfer promptly to a medical facility. When this chemical has been swallowed, get medical attention. If victim is conscious and able to swallow, have victim drink 4 to 8 ounces of water. Do not induce vomiting. *Note to physician or authorized medical personnel*: Medical observation is recommended for 24 to 48 hours following breathing overexposure, as pulmonary edema may be delayed. As first aid for pulmonary edema, a doctor or authorized paramedic might consider administering a corticosteroid spray. Cigarette smoking may exacerbate pulmonary injury and should be discouraged for at least 72 hours following exposure.

Personal Protective Methods: Reacts with the following absorbent materials: Cellulose-Based; Mineral- and Clay-Based; Dirt/Earth[88]. Wear protective gloves and clothing to prevent any reasonable probability of dermal and/or eye contact. Safety equipment suppliers/manufacturers can provide recommendations on the most protective glove/clothing material for your operation. All protective clothing (suits, gloves, footwear, headgear) should be clean, available each day, and put on before work. Contact lenses should not be worn when working with this chemical. Wear splash-proof chemical goggles and face shield unless full facepiece respiratory protection is worn. Employees should wash immediately with soap when skin is wet or contaminated. Provide emergency showers and eyewash.

Respirator Selection: *At any detectable concentration:* SCBAF: Pd,Pp (APF = 10,000) (any NIOSH/MSHA- or European Standard EN 149-approved self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode); or SaF: Pd,Pp: ASCBA (APF = 10,000) (any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary, self-contained breathing apparatus operated in a pressure-demand or other positive-pressure mode). *Escape:* 100F (APF = 50) (any air-purifying, full facepiece respirator with an N100, R100, or P100 filter k-mounted organic vapor canister having a high-efficiency particulate filter); or SCBAE (any appropriate escape-type, self-contained breathing apparatus).

Storage: Color Code-Blue: Health Hazard/Poison: Store in a tightly closed container in a dry, well-ventilated and secure poison location. Prior to working with this chemical you should be trained on its proper handling and storage. Where possible, automatically transfer material from other storage containers to process containers.

Shipping: Environmentally hazardous substances, solid or liquid, usually fall in Hazard Class 9.

Spill Handling: First remove all sources of ignition. Evacuate persons not wearing protective equipment from area of spill or leak until clean up is complete. Collect powdered material in the most convenient and safe manner and deposit in sealed containers. Ventilate area after clean up is complete. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable.

Fire Extinguishing: Hazardous decomposition includes oxides of nitrogen, carbon, sulfur and zinc. As an immediate precautionary measure, isolate spill or leak area in all directions for at least 50 meters/150 feet for liquids and at least 25 meters/75 feet for solids. *Fire involving storage or vehicular tanks:* isolate for 800 meters/0.5 mile in all directions; also, consider initial evacuation for 800 meters/0.5 mile in all directions. *On a small fire:* use dry chemical, CO_2, water spray or regular foam. *On a large fire:* use water spray, fog or regular foam. Do not scatter spilled material with high-pressure streams of water. Move containers from fire area if you can do it without risk. Dike fire-control water for later disposal. *Fire involving tanks:* from a secure, explosion-proof location, use water spray to cool exposed containers. If cooling streams are ineffective (venting sound increases in volume and pitch, tank discolors, or shows any signs of deforming), withdraw immediately to a secure position. Always stay away from tanks engulfed in fire. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode.

Disposal Method Suggested: Do not discharge into drains or sewers. Dispose of waste material as hazardous waste using a licensed disposal contractor to an approved landfill. Consult with environmental regulatory agencies for guidance on acceptable disposal practices. Generators of waste containing this contaminant (≥100 kg/mo) must conform with EPA regulations governing storage, transportation, treatment, and waste disposal. A potential candidate for liquid injection incineration at a temperature range of 650 to 1,600 °C and a residence time 0.1 to 2 seconds. Also, a potential candidate for rotary kiln incineration at a temperature range of 820 to 1,600 °C and residence times of seconds for liquids and gases, and hours for solids[83].

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- EXTOXNET, Extension Toxicology Network, "Pesticide Information Profile, Metiram," Oregon State University,

Corvallis, OR (June 1996). http://extoxnet.orst.edu/pips/metiram.htm

- USEPA, Office of Pesticide Programs, Pesticide Residue Limits, "Metiram," ***40 CFR 180.217***. http://www.epa.gov/pesticides/food/viewtols.htm

Metobromuron M:1308

Use Type: Herbicide
CAS Number: 3060-89-7
Formula: $C_9H_{11}BrN_2O_2$
Synonyms: 3-(4-Bromophenyl)-1-methoxy-1-methylurea; 3-(*p*-Bromophenyl)-1-methoxy-1-methylurea; *N*′-(4-Bromophenyl)-*N*-methoxy-*N*-methylurea; 3-(*p*-Bromophenyl)-1-methyl-1-methoxyurea; Metobromuron [3-(*p*-bromophenyl)-1-methoxy-1-methylurea]; Urea, *N*′-(4-bromophenyl)-*N*-methoxy-*N*-methyl-
Trade Names: C-3126®; CIBA 3126®; PATORAN®; PATTONEX®
Chemical class: Urea
EPA/OPP PC Code: 035901
California DPR Chemical Code:
HSDB Number: 1741
UN/NA & ERG Number: Consult appropriate Dangerous Goods Regulations, including 49CFR
RTECS® Number: YS3325000
EC Number: 221-301-5
Uses: Pre-emergence herbicide. Used against grasses and broadleaf weed control on flax, groundnuts, potatoes, beans, soybeans, sunflowers, tomatoes, and tobacco. Pending for use in EU countries[115]. Not registered for use in the U.S. There are 24 global suppliers[97].
U.S. Maximum Allowable Residue Levels for the herbicide Metobromuron, [40 CFR 180.250]: in or on the raw agricultural commodity, potatoes 0.2 ppm.
Regulatory Authority and Advisory Information:
Description: White crystalline solid or powder. Commercial product may be in a flammable hydrocarbon carrier. Molecular weight = 259.11; Specific gravity (H_2O:1) = 1.59; Freezing/Melting point = 95 °C; Vapor pressure = 3×10^6 mmHg @ 20 °C; Soluble in water; solubility = 8.8 mg/L@ 20 °C. Physical and toxicological properties may be affected by carrier solvents in commercial formulations.
Incompatibilities: May react with strong oxidizers such as chlorates, peroxides, nitrates, etc.
Determination in Water: FDA Method 242.4 *Method for Substituted Urea Herbicides* High-Performance Liquid Chromatography with Fluorescence Detection with no Detection limit reported. Log K_{ow} = ~2.5. Unlikely to bioaccumulate in marine organisms.
Incompatibilities: Oxidizers (chlorates, nitrates, peroxides, permanganates, perchlorates, chlorine, bromine, fluorine, etc); strong acid.
Determination in Air: Filter; none; Gravimetric; NIOSH IV [Particulates NOR; #0500 (total), #0600 (respirable)][18].
Harmful Effects and Symptoms
Short Term Exposure: Contact with eyes or skin may cause irritation or injury. Inhalation should be avoided; use NIOSH- or CEN (UK)-approved air-purifying respirators for pesticides. May be harmful if swallowed. Dermal contact may cause severe irritation or burns. LD_{50} (oral, rat) = >5 g/kg.
Long Term Exposure: May cause skin sensitization.
Points of Attack: Skin.
Medical Surveillance: Evaluation by a qualified allergist, including exposure history and testing, may help diagnose allergy. Preliminary medical exam to detect chronic diseases of central nervous system, liver, heart, kidneys, lung and skin, as well as endocrinological or immunological disturbances, should protect susceptible individuals. Periodical medical exams of internal organs, skin and eyes are important to avoid chronic occupational intoxications. They should include lab and patch tests when necessary[83].
First Aid: If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least 15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately. If this chemical contacts the skin, remove contaminated clothing and wash immediately with soap and water. Seek medical attention immediately. If this chemical has been inhaled, remove from exposure, begin rescue breathing (using universal precautions) if breathing has stopped, and CPR if heart action has stopped. Transfer promptly to a medical facility. When this chemical has been swallowed, get medical attention. Give large quantities of water. Do not induce vomiting when formulations containing petroleum solvents are ingested. Do not make an unconscious person vomit.
Personal Protective Methods: Wear protective gloves and clothing to prevent any reasonable probability of dermal and/or eye contact. Safety equipment suppliers/manufacturers can provide recommendations on the most protective glove/clothing material for your operation. All protective clothing (suits, gloves, footwear, headgear) should be clean, available each day, and put on before work. Contact lenses should not be worn when working with this chemical. Wear dust-proof chemical goggles and face shield unless full facepiece respiratory protection is worn. Employees should wash immediately with soap when skin is wet or contaminated. Provide emergency showers and eyewash.
Respirator Selection: *At any detectable concentration:* SCBAF: Pd,Pp (APF = 10,000) (any NIOSH/MSHA- or European Standard EN 149-approved self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode); or SaF: Pd,Pp: ASCBA (APF = 10,000) (any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary, self-contained breathing apparatus operated in a pressure-demand or other positive-pressure mode). *Escape:* 100F (APF = 50) (any air-purifying, full facepiece respirator with an N100, R100, or P100 filter k-mounted organic vapor canister having a high-efficiency particulate filter); or SCBAE (any appropriate escape-type, self-contained breathing apparatus).

Storage: Color Code-Blue: Health Hazard/Poison. Store in a secure poison location. Prior to working with metobromuron you should be trained on its proper handling and storage. Store in tightly closed containers in a cool, well-ventilated area. Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: Consult appropriate Dangerous Goods Regulations, including 49CFR, for additional description requirements, mode-specific, or quantity-specific shipping requirements.

Spill Handling: First remove all sources of ignition. Evacuate persons not wearing protective equipment from area of spill or leak until clean up is complete. Do not touch spilled material; stop leak if you can do it without risk. Use water spray to reduce vapors. Collect powdered material in the most convenient and safe manner and deposit in sealed containers. *Large spills:* dike far ahead of spill for later disposal. Ventilate area after clean up is complete. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable.

Fire Extinguishing: Hazardous decomposition includes oxides of nitrogen and carbon, and corrosive fumes of bromine. Use dry chemical, carbon dioxide; water spray; or standard foam extinguishers. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies. From a secure, explosion-proof location, use water spray to cool exposed containers. If cooling streams are ineffective (venting sound increases in volume and pitch, tank discolors, or shows any signs of deforming), withdraw immediately to a secure position. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode.

Disposal Method Suggested: Hydrolysis is not recomended as a disposal procedure because of the generation of the toxic products 3,4-dichloroaniline and dimethylamine. Incinerate in a unit with effluent gas scrubbing. Containers must be disposed of properly by following package label directions or by contacting your local or federal environmental control agency, or by contacting your regional EPA office.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- United States National Library of Medicine, *ChemIDplus Advanced*, Bethesda, MD. http://chem.sis.nlm.nih.gov/chemidplus/rn/3060-89-7

Metolachlor M:1310

Use Type: Herbicide

CAS Number: 51218-45-2; 87392-12-9 (S-)

Formula: $C_{15}H_{22}ClNO_2$

Synonyms: 2-Chloro-6'-ethyl-*N*-(2-methoxy-1-methylethyl) acet-*o*-toluidide; α-Chloro-2'-ethyl-6'-methyl-*N*-(1-methyl-2-methoxyethyl)-acetanilide; 2-Chloro-*N*-(2-ethyl-6-methylphenyl)-*N*-(2-methoxy-1-methylethyl) acetamide; 2-Chloro-*N*(6-ethyl-*o*-tolyl)-*N*-(2-methoxy-1-methylethyl)-acetamide; 2-Ethyl-6-methyl-1-*N*-(2-methoxy-1-methylethyl)chloroacetanilide; Metelilachlor

Trade Names: BICEP®[C]; BROADSTRIKE®; CGA-24705®; CINCH®; CODAL®; COTORAN® MULTI®; CYCLE®[C] DREXEL ME-TOO-LACHLOR®; DUAL®; DUAL MAGNUM®; DUET®[C]; INTER PLUS®; MEDAL®[C]; MILOCEP®; ONTRACK 8E®[C]; PENNANT®[C]; PRELUDE®[C]; PRIMAGRAM®; PRIMEXTRA®; TURBO®

Chemical class: Chloroacetanilide; Chloroacetamide

EPA/OPP PC Code: 108801; 288700 (old EPA product code)

California DPR Chemical Code: 1996

HSDB Number: 6706

UN/NA & ERG Number: UN3082 (liquid)/171

RTECS® Number: AN3430000

EC Number: 257-060-8

Uses: Not approved for use in EU countries[115]. Registered for use in the U.S. Metolachlor is a selective herbicide that is usually applied to crops before plants emerge from the soil, and is used to control certain broadleaf and annual grassy weeds in field corn, soybeans, peanuts, grain sorghum, potatoes, pod crops, cotton, safflower, stone fruits, nut trees, highway rights-of-way and woody ornamentals. Prior to the RED of April, 1995, its primary use was on corn, soybeans and sorghum. It inhibits protein synthesis; thus, high-protein crops (e. g., soy) can be adversely affected by excessive metolachlor application. Additives may be included in product formulations to help protect sensitive crops (i.e., sorghum) from injury.

U.S. Maximum Allowable Residue Levels for Metolachlor including its metabolites and degradates [40 CFR 180.368(a)(1)]: almond, hulls 0.30 ppm; animal feed, nongrass, group, 18 ppm; 1.0 ppm; cattle, fat 0.02 ppm; cattle, kidney 0.20 ppm; cattle, liver 0.05 ppm; cattle, meat 0.02 ppm; cattle, meat byproducts, except kidney and liver 0.04 ppm; corn, field, forage 6.0 ppm; corn, field, grain 0.10 ppm; corn, field, stover 6.0 ppm; corn, sweet, forage 6.0 ppm; corn, sweet, kernel plus cob with husks removed 0.10 ppm; corn, sweet, stover 6.0 ppm; cotton, gin byproducts 4.0 ppm; cotton, undelinted seed 0.10 ppm; dillweed 0.50 ppm; egg 0.02 ppm; goat, fat 0.02 ppm; goat, kidney 0.20 ppm; goat, liver 0.05 ppm; goat, meat 0.02 ppm;

goat, meat byproducts, except kidney and liver 0.04 ppm; grass, forage 10 ppm; grass, hay 0.20 ppm; horse, fat 0.02 ppm; horse, kidney 0.20 ppm; horse, liver 0.05 ppm; horse, meat 0.02 ppm; horse, meat byproducts, except kidney and liver 0.04 ppm; milk 0.02 ppm; nut, tree, group, 14 ppm; 0.10 ppm; okra 0.50 ppm; peanut 0.20 ppm; peanut, hay 20 ppm; peanut, meal 0.40 ppm; potato 0.20 ppm; poultry, fat 0.02 ppm; poultry, meat 0.02 ppm; poultry, meat byproducts 0.05 ppm; safflower, seed 0.10 ppm; sheep, fat 0.02 ppm; sheep, kidney 0.20 ppm; sheep, liver 0.05 ppm; sheep, meat 0.02 ppm; sheep, meat byproducts, except kidney and liver 0.04 ppm; sorghum, grain, forage 1.0 ppm; sorghum, grain, grain 0.30 ppm; sorghum, grain, stover 4.0 ppm; soybean, forage 5.0 ppm; soybean, hay 8.0 ppm; soybean, seed 0.20 ppm; tomato 0.10 ppm; vegetable, foliage of legume, subgroup 7A, except soybean 15.0 ppm; vegetable, legume, group 6 0, 30 ppm. ***[40 CFR 180.368(a)(2)]:*** asparagus 0.10 ppm; beet, sugar, molasses 2.0 ppm; beet, sugar, roots 0.5 ppm; beet, sugar, tops 15.0 ppm; brassica, head and stem, subgroup 5A, 0.60 ppm; brassica, leafy greens, subgroup 5B, 1.8 ppm; bushberry subgroup 13-07B, 0.15 ppm; caneberry subgroup 13-07A, 0.10 ppm; carrot, roots 0.40 ppm; cattle, fat 0.02 ppm; cattle, kidney 0.20 ppm; cattle, liver 0.05 ppm; cattle, meat 0.02 ppm; cattle, meat byproducts, except kidney and liver 0.04 ppm; corn, field, grain 0.10 ppm; corn, field, forage 6.0 ppm; corn, field, stover 6.0 ppm; corn, pop, grain 0.10 ppm; corn, pop, stover 6.0 ppm; corn, sweet, forage 6.0 ppm; corn, sweet, kernel plus cob with husks removed 0.10 ppm; corn, sweet, stover 6.0 ppm; cotton, gin byproducts 4.0 ppm; cotton, undelinted seed 0.10 ppm; cucumber 0.13 ppm; egg 0.02 ppm; grain, aspirated fractions 0.70 ppm; goat, fat 0.02 ppm; goat, kidney 0.20 ppm; goat, liver 0.05 ppm; goat, meat 0.02 ppm; goat, meat byproducts, except kidney and liver 0.04 ppm; grass, forage 10.0 ppm; grass, hay 0.20 ppm; horse, fat 0.02 ppm; horse, kidney 0.20 ppm; horse, liver 0.05 ppm; horse, meat 0.02 ppm; horse, meat byproducts, except kidney and liver 0.04 ppm; leaf petioles, subgroup 4B, 0.10 ppm; melon, subgroup 9A, 0.10 ppm; milk 0.02 ppm; okra 0.10 ppm; onion, bulb, subgroup 3-07A, 0.10 ppm; onion, green, subgroup 3-07B, 2.0 ppm; peanut 0.20 ppm; peanut, hay 20.0 ppm; peanut, meal 0.40 ppm; poultry, fat 0.02 ppm; poultry, meat 0.02 ppm; poultry, meat byproducts 0.05 ppm; pumpkin 0.10 ppm; safflower, seed 0.10 ppm; sesame, seed 0.13 ppm; sheep, fat 0.02 ppm; sheep, kidney 0.20 ppm; sheep, liver 0.05 ppm; sheep, meat 0.02 ppm; sheep, meat byproducts, except kidney and liver 0.04 ppm; sorghum, grain, forage 1.0 ppm; sorghum, grain, grain 0.3 ppm; sorghum, grain, stover 4.0 ppm; sorghum, sweet, stalk 4.0 ppm; soybean, forage 5.0 ppm; soybean, hay 8.0 ppm; soybean, seed 0.20 ppm; spinach 0.50 ppm; squash, winter 0.10 ppm; sunflower, seed 0.50 ppm; sunflower, meal 1.0 ppm; tomato, paste 0.30 ppm; turnip, greens 1.8 ppm; vegetable, foliage of legume, except soybean, subgroup 7A, 15.0 ppm; vegetable, fruiting, group 8, except tabasco pepper, 0.10 ppm; vegetable, legume, group 6, 0.30 ppm; vegetable, root, except sugar beet, subgroup 1B, except carrot, 0.30 ppm; vegetable, tuberous and corm, subgroup 1C, 0.20 ppm. ***[40 CFR 180.368(c)(1)]:*** pepper, nonbell 0.50 ppm. ***[40 CFR 180.368(c)(2)]:*** pepper, tabasco 0.50 ppm. ***[40 CFR 180.368(d)(1)]:*** animal feed, nongrass, group, 18 ppm; 1.0 ppm; barley, grain 0.10 ppm; barley, hay 0.80 ppm; barley, straw 0.80 ppm; buckwheat, grain 0.10 ppm; millet, forage 0.50 ppm; millet, grain 0.10 ppm; millet, hay 0.80 ppm; millet, straw 0.80 ppm; oat, forage 0.50 ppm; oat, grain 0.10 ppm; oat, hay 0.80 ppm; oat, straw 0.80 ppm; rice, grain 0.10 ppm; rye, forage 0.50 ppm; rye, grain 0.10 ppm; rye, straw 0.80 ppm; wheat, forage 0.50 ppm; wheat, grain 0.10 ppm; wheat, hay 0.80 ppm; wheat, straw 0.80 ppm. ***[40 CFR 180.368(d)(2)]:*** animal feed, nongrass, group, 18 ppm; 1.0 ppm; barley, grain 0.10 ppm; barley, hay 0.50 ppm; barley, straw 0.50 ppm; buckwheat, grain 0.10 ppm; millet, forage 0.50 ppm; millet, grain 0.10 ppm; millet, hay 0.50 ppm; millet, straw 0.50 ppm; oat, forage 0.50 ppm; oat, grain 0.10 ppm; oat, hay 0.50 ppm; oat, straw 0.50 ppm; rice, grain 0.10 ppm; rye, forage 0.50 ppm; rye, grain 0.10 ppm; rye, straw 0.50 ppm; wheat, forage 0.50 ppm; wheat, grain 0.10 ppm; wheat, hay 0.50 ppm; wheat, straw 0.50 ppm.

Human toxicity (long-term)[101]: Very low–100.00 ppb, Health Advisory

Fish toxicity (threshold)[101]: Very low –1117.14617 ppb, MATC (Maximum Acceptable Toxicant Concentration)

Regulatory Authority and Advisory Information:

Carcinogenicity[83]: EPA Group C, Possible human carcinogen

Health Advisory: Category: Mutagen, Developmental/Reproductive Toxin, Skin irritant/sensitizer, Endocrine disruptor (S!)

Acute Oral Category: 3, CAUTION

Potential Ground Water Pollutant [California FAC Section 13145(d)/12811, active]

Description: Metolachlor is a colorless to off-white or tan to brown, oily liquid. Slightly sweet odor. Molecular weight = 283.81; Specific gravity (H_2O:1) = 1.12 @ 20 °C; Boiling point = 100 °C. It is stable to ~300 °C; Vapor pressure = 1.5×10^5 mmHg @ 20 °C. Flash point = 110 °C(cc)[86]. Hazard Identification (based on NFPA-704 M Rating System): Health 1, Flammability 1, Reactivity 0. High solubility in water; solubility = 510 ppm @ 20 °C.

Incompatibilities: Oxidizers, strong acids, nitrate.

Permissible Concentration in Water: Federal Drinking Water Guidelines: 100 ppb[93]; EPA Health Advisory: 700 μg/L; State Drinking Water Guidelines: Wisconsin 15 μg/L; Minnesota 300 μg/L; Minnesota 800 μg/L for Metolachlor-ESA (ethane sulfonic acid) or Metolachlor-OXA (oxanilic acid); Connecticut 10 μg/L; Maine 100 μg/L; Massachusetts 100 μg/L; Florida 110 μg/L. Canadian Drinking Water Standards: MAC 0.05 mg/L EU Drinking Water Guidelines (MAC) = 0.01 mg/L.

Determination in Water: Extraction with methylene chloride followed by separation by gas chromatography and measurement using a nitrogen-phosphorus detector. Log K_{ow} = >3.0. Values above 3.0 are likely to bioaccumulate in marine organisms.

Routes of Entry: Inhalation; through the unbroken skin.

Harmful Effects and Symptoms

Short Term Exposure: Irritates the eyes and skin. Signs of human intoxication from metolachlor and/or its formulations (presumably following acute deliberate or accidental exposures) include abdominal cramps, anemia, ataxia, dark urine, methemoglobinemia, cyanosis, hypothermia, collapse, convulsions, diarrhea, gastrointestinal irritation, jaundice, weakness, nausea, shock, sweating, vomiting, central nervous system depression, dizziness, dyspnea, liver damage, nephritis, cardiovascular failure, skin irritation, dermatitis, sensitization dermatitis, eye and mucous membrane irritation, corneal opacity and adverse reproductive effects. LD_{50} (oral, rats) = <3 g/kg[86]; LD_{50} (dermal, rat) = >3.5 g/kg.

Long Term Exposure: May cause tumors. Limited evidence of carcinogenicity animals[83]. Possible skin sensitizer

Points of Attack: Blood; skin.

Medical Surveillance: Preliminary medical exam to detect chronic diseases of central nervous system, liver, heart, kidneys, lung and skin, as well as endocrinological or immunological disturbances, should protect susceptible individuals. Periodical medical exams of internal organs, skin and eyes are important to avoid chronic occupational intoxications. They should include lab and patch tests when necessary[83]. This chemical is a suspected or known human carcinogen. Exposed persons should contact a physician for advice regarding the possible long term health effects and advice for medical monitoring. Test for methemoglobinemia. Complete blood count. Evaluation by a qualified allergist, including exposure history and testing, may help diagnose allergy.

First Aid: If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least 15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately. If this chemical contacts the skin, remove contaminated clothing and wash immediately with soap and water. Seek medical attention immediately. If this chemical has been inhaled, remove from exposure, begin rescue breathing (using universal precautions) if breathing has stopped, and CPR if heart action has stopped. Transfer promptly to a medical facility. When this chemical has been swallowed, get medical attention. Give large quantities of water and induce vomiting. Do not make an unconscious person vomit. *Note to physician or authorized medical personnel:* Treat for methemoglobinemia. Spectrophotometry may be required for precise determination of levels of methemoglobinemia in urine.

Respirator Selection: Wherever and whenever workplace conditions warrant respirator use, a respiratory protection program must be followed that meets one or more of the following government standards: OSHA's 29 CFR 1910.134, ANSI Z88.2, or European Standard EN 149.

Storage: Color Code-Blue: Health Hazard/Poison. Store in a secure poison location. Prior to working with this chemical you should be trained on its proper handling and storage. Store in tightly closed containers in a cool, well-ventilated area. If this material contains a flammable carrier, sources of ignition, such as smoking and open flames, are prohibited where this chemical is used, handled, or stored in a manner that could create a potential fire or explosion hazard. Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: This material may be classified as Environmentally hazardous substances, liquid or solid, n.o.s. It usually falls in Hazard Class 9.

Spill Handling: For liquids, isolate spill or leak area in all directions for at least 50 meters/150 feet. Increase, in the downwind direction, as necessary. Do not touch damaged containers or spilled material unless wearing appropriate protective clothing. Stop leak if you can do it without risk. Prevent entry into waterways, sewers, basements or confined areas. Cover with plastic sheet to prevent spreading. Absorb or cover with dry earth, sand or other non-combustible material and transfer to containers. Do not allow water to get inside containers.

Fire Extinguishing: Hazardous decomposition includes oxides of nitrogen and carbon and hydrogen chloride gas. As an immediate precautionary measure, isolate spill or leak area in all directions for at least 50 meters/150 feet for liquids and at least 25 meters/75 feet for solids. *Fire involving storage or vehicular tanks:* isolate for 800 meters/0.5 mile in all directions; also, consider initial evacuation for 800 meters/0.5 mile in all directions. *On a small fire:* use dry chemical, CO_2, water spray or regular foam. *On a large fire:* use water spray, fog or regular foam. Do not scatter spilled material with high-pressure streams of water. Move containers from fire area if you can do it without risk. Dike fire-control water for later disposal. *Fire involving tanks:* from a secure, explosion-proof location, use water spray to cool exposed containers. If cooling streams are ineffective (venting sound increases in volume and pitch, tank discolors, or shows any signs of deforming), withdraw immediately to a secure position. Always stay away from tanks engulfed in fire. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode.

Disposal Method Suggested: Do not discharge into drains or sewers. Dispose of waste material as hazardous waste using a licensed disposal contractor to an approved landfill. Consult with environmental regulatory agencies for guidance on acceptable disposal practices. If allowed, incineration with effluent gas scrubbing is recommended. Containers must be disposed of properly by following package label directions or by contacting your local or federal environmental control agency, or by contacting your regional EPA office.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- EXTOXNET, Extension Toxicology Network, "Pesticide Information Profile, Metolachlor," Oregon State University, Corvallis, OR (June 1996). http://extoxnet.orst.edu/pips/metolach.htm
- USEPA, Office of Pesticide Programs, Pesticide Residue Limits, "Metolachlor," ***40 CFR 180.368***. http://www.epa.gov/pesticides/food/viewtols.htm
- USEPA, "Reregistration Eligibility Decision (RED), Metolachlor," Washington DC (April 1995). http://www.epa.gov/REDs/0001.pdf
- USEPA, "Health Advisory," Washington DC, Office of Drinking Water (August 1987)

Metolcarb M:1320

Use Type: Insecticide, Acaricide

CAS Number: 1129-41-5

Formula: $C_9H_{11}NO_2$; $C_6H_4(CH_3)OCONHCH_3$

Synonyms: Carbamic acid, methyl-, 3-methylphenyl ester; Carbamic acid, methyl-, 3-tolyl ester; Carbophen; *m*-Cresyl methylcarbamate; *m*-Cresyl ester of *N*-methylcarbamic acid; *m*-Cresyl methyl carbamate; Dicresyl; Dicresyl *N*-methylcarbamate; Metholcarb; Methylcarbamic acid *m*-toyl ester; 3-Methylphenyl-*N*-methylcarbamate; *m*-Methylphenyl methylcarbamate; MTMC; *m*-Tolyester kyseliny methyl karbaminove; *m*-Tolyl-*N*-methylcarbamate; 3-Tolyl-*N*-methylcarbamate

Trade Names: DRC 3341®; KUMIAI®; METACRATE®; S 1065®; SOGATOX DUST® 22; TSUMACIDE®; TSUMAUNKA®; VADEN®

Chemical class: Carbamate (N-methyl)

EPA/OPP PC Code: Not assigned

California DPR Chemical Code:

HSDB Number: 6416

UN/NA & ERG Number: UN2757 (solid)/151

RTECS® Number: FC8050000

EC Number: 214-446-0 [*Annex I Index No.:* 0666-056-00-2]

Uses: Metolcarb is an insecticide for the control of rice green leafhoppers, plant-hoppers, codling moth, citrus mealy bug, onion thrips, fruit flies, bollworms and aphids. Not registered for use in the U.S. Not listed for use in EU countries[115].

Regulatory Authority and Advisory Information: Acute Oral Category: 2, WARNING

Health Advisory: Nerve Toxin (S!)

EPA Hazardous Waste Number (RCRA No.): P190

RCRA 40CFR268.48; 61FR15654, Universal Treatment Standards: Wastewater (mg/L), 0.056; Non-wastewater (mg/kg), 1.4

Superfund/EPCRA 302 Extremely Hazardous Substances: TPQ = 100/10,000 lb (45.4/4,540 kg)

Superfund/EPCRA 40CFR302.4 RQ: EHS, 1 lb (0.454 kg)

European/International Regulations: Hazard Symbol: Xn, N; risk phrases: R22; R51/53; Safety phrases: S2; S61 (see Appendix 1)

WGK (German Aquatic Hazard Class): 2-Hazard to waters

Description: Metolcarb is a colorless crystalline solid. Molecular weight = 165.21; Boiling point = 240; Freezing/Melting point = 74–77.8 °C; Flash point >100 °C. Hazard Identification (based on NFPA-704 M Rating System): Health 3, Flammability 0, Reactivity 0. Highly soluble in water.

Incompatibilities: Carbamates are incompatible with reducing agents, strong acids, oxidizing acids, peroxides, and bases. Contact with active metals or nitrides causes the release of flammable, and potentially explosive, hydrogen gas. May form explosive materials with phosphorus pentachloride.

Permissible Exposure Limits in Air: No standards found.

Permissible Concentration in Water: Runoff from spills or fire control may cause water pollution.

Determination in Water: Log K_{ow} = <2.0. Unlikely to bioaccumulate in marine organisms.

Routes of Entry: Inhalation, ingestion, skin and/or eye contact.

Harmful Effects and Symptoms

Short Term Exposure: Metolcarb is a carbamate insecticide. Signs and symptoms of poisoning by carbamates are similar to those for organic phosphorus compounds. Symptoms of poisoning by organic phosphorus compounds include headache, giddiness, nervousness, blurred vision, weakness, nausea, cramps, diarrhea, and discomfort in the chest. Signs include sweating, myosis, tearing, salivation and other excessive respiratory tract secretion, vomiting, cyanosis, uncontrollable muscle twitches followed by muscular weakness, convulsions, coma, loss of reflexes, and loss of muscular control. Carbamate insecticides inhibit the cholinesterase activity of enzymes, causing accumulation of acetylcholine at synapses and altering the way in which nervous impulses are transmitted. However, within several hours carbamates spontaneously detach from the enzymes. Metolcarb exhibits high oral and skin toxicity, and moderate inhalation toxicity. Some carbamates appear to be carcinogenic, teratogenic, and/or mutagenic. Carbamates are cholinesterase inhibitors. LD_{50} (oral, rat) = >250 mg/kg; LD_{50} (dermal, rat) = 900 mg/kg.

Long Term Exposure: Cholinesterase inhibitor; cumulative effect is possible. This chemical may damage the nervous system with repeated exposure, resulting in convulsions, respiratory failure. May cause liver damage.

Points of Attack: Respiratory system, lungs, central nervous system, cardiovascular system, skin, eyes, plasma and red blood cell cholinesterase.

Medical Surveillance: Routine biological monitoring of pesticide applicators and field workers includes testing of plasma and red blood cell acetylcholinesterase levels (for enzyme poisoned by this chemical). These tests are normally accurate only if done within about two hours of exposure. If exposure stops, plasma levels return to normal in 1–2 weeks while red blood cell levels may be reduced for 1–3 months. When acetylcholinesterase enzyme levels are reduced by 25% or more below preemployment levels, risk of poisoning is increased, even if results are in lower ranges of "normal." Reassignment to work not involving carbamate pesticides is recommended until enzyme levels recover. Do not drink any alcoholic beverages before or during use. Also consider complete blood count and chest x-ray following acute overexposure.

First Aid: Speed in removing material from eyes and skin is of extreme importance. *Eyes:* Eye contact can cause dangerous amounts of these chemicals to be quickly absorbed through the mucous membrane into the bloodstream. Immediately and gently flush eyes with plenty of warm or cold water (NO hot water) for at least 15 minutes, occasionally lifting the upper and lower eyelids. Get medical aid immediately. *Skin:* Get medical aid. Dermal contact can cause dangerous amounts of these chemicals to be absorbed into the bloodstream. Wearing the appropriate PPE equipment and respirator for carbamate pesticides, immediately flush skin with plenty of soap and water for at least 15 minutes while removing contaminated clothing and shoes. Shampoo hair promptly if contaminated; protect eyes. *Ingestion:* Call poison control. Loosen all clothing. Never give anything by mouth to an unconscious person. Get medical aid. Do NOT induce vomiting. * If conscious, alert, and able to swallow, rinse mouth and have victim drink 4 to 8 ounces of water. Check to see if poison control instructs you to use ipecac syrup, otherwise administer slurry of activated charcoal (2 oz in 8 oz of water). If victim is *UNCONSCIOUS OR HAVING CONVULSIONS,* do nothing except keep victim warm. **In some cases you may be specifically instructed by poison control to induce vomiting by way of 2 tablespoons of syrup of ipecac (adult) washed down with a cup of water.* Do NOT give activated charcoal before or with ipecac syrup. *Inhalation:* Get medical aid. Do not contaminate yourself. Wearing the appropriate PPE equipment and respirator for carbamate pesticides, immediately remove the victim from the contaminated area to fresh air. If the victim is not breathing, administer artificial respiration. Do not use mouth-to-mouth method if victim ingested or inhaled the substance; give artificial respiration with the aid of a pocket mask equipped with a one-way valve or other proper respiratory medical device. If breathing is difficult, administer oxygen through bag/mask apparatus until medical help arrives. Do not leave victim unattended. *Note to physician or authorized medical personnel.* Administer atropine, 2 mg (1/30 gr) intramuscularly or intravenously as soon as any local or systemic signs or symptoms of an intoxication are noted; repeat the administration of atropine every 3 to 8 minutes until signs of atropinization (mydriasis, dry mouth, rapid pulse, hot and dry skin) occur; initiate treatment in children with 0.05 mg/kg of atropine; repeat at 5 to 10 minute intervals. Watch respiration, and remove bronchial secretions if they appear to be obstructing the airway; intubate if necessary. *Medical note:* 2-PAMCI may be contraindicated in the case of some carbamate poisonings.

Personal Protective Methods: Wear protective gloves and clothing to prevent any reasonable probability of dermal and/or eye contact. Safety equipment suppliers/manufacturers can provide recommendations on the most protective glove/clothing material for your operation. DuPont™ Tychem® suit fabrics[88]. All protective clothing (suits, gloves, footwear, headgear) should be clean, available each day, and put on before work. Contact lenses should not be worn when working with this chemical. Wear dust-proof chemical goggles and face shield unless full facepiece respiratory protection is worn. Employees should wash immediately with soap when skin is wet or contaminated. Provide emergency showers and eyewash.

Respirator Selection: *At concentrations above the NIOSH REL, or where there is no REL, at any detectable concentration:* SCBAF:Pd,Pp (APF = 10,000): (any self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode); or SaF:Pd,Pp:ASCBA (APF = 10,000) (any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary self-contained positive-pressure breathing apparatus). *Escape*: GmFOv100 (APF = 50) [any air-purifying, full facepiece respirator (gas mask) with a chin-style, front- or back-mounted organic vapor canister having an N100, R100, or P100 filter]; or SCBAE (any appropriate escape-type, self-contained breathing apparatus).

Storage: Color Code-Blue: Health Hazard/Poison. Store in a secure poison location. Prior to working with this chemical you should be trained on its proper handling and storage. Store in tightly closed containers in a cool, well-ventilated area away from strong alkalis (such as sodium hydroxide, sodium bicarbonate, etc.). Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: This is a solid toxic carbamate and should be labeled "poisonous materials." It falls into Hazard Class 6.1.

Spill Handling: For solids, isolate spill or leak area in all directions for at least 25 meters/75 feet. Increase, in the downwind direction, as necessary. Do not touch damaged containers or spilled material unless wearing appropriate protective clothing. Stop leak if you can do it without risk. Prevent entry into waterways, sewers, basements or confined areas. Cover with plastic sheet to prevent spreading. Absorb or cover with dry earth, sand or other non-combustible material and transfer to containers. Do not allow water to get inside containers.

Fire Extinguishing: Hazardous decomposition includes oxides of nitrogen and carbon. *On small fire:* use dry chemical powder, carbon dioxide, water spray, or foam. *On large fire:* use water spray, fog or alcohol-resistant foam. Do not scatter material using straight water jet streams. Dike fire-control water for later disposal; do not scatter the material. Move containers from fire area if you can do it without risk. *Fire involving storage or vehicular tanks:* isolate for 800 meters/0.5 mile in all directions; also, consider initial evacuation for 800 meters/0.5 mile in all directions. Fight fire from maximum distance or use unmanned hose holders or monitor nozzles. Do not allow water to get inside containers. Cool containers with flooding quantities of water until well after fire is out. Withdraw immediately in the case of rising sound from venting safety devices or discoloration of tank. *Always* stay away from tanks engulfed in fire. For massive fire, use unmanned hose holders or monitor nozzles; if this is impossible, withdraw from area and let fire burn.

Disposal Method Suggested: Do not discharge into drains or sewers. Dispose of waste material as hazardous waste using a licensed disposal contractor to an approved landfill. Consult with environmental regulatory agencies for guidance on acceptable disposal practices. Generators of waste containing this contaminant (≥100 kg/mo) must conform with EPA regulations governing storage, transportation, treatment, and waste disposal. Incineration with effluent gas scrubbing is recommended. Containers must be disposed of properly by following package label directions or by contacting your local or federal environmental control agency, or by contacting your regional EPA office.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- New Jersey Department of Health and Senior Services, "Hazardous Substance Fact Sheet, Metolcarb," Trenton, NJ (July 2000). http://www.state.nj.us/health/eoh/rtkweb/2563.pdf
- USEPA, "Chemical Profile: Metolcarb," Washington DC, Chemical Emergency Preparedness Program (Nov.30, 1987)

Metribuzin M:1330

Use Type: Herbicide

CAS Number: 21087-64-9

Formula: $C_8H_{14}N_4OS$

Synonyms: 4-Amino-6-*tert*-butyl-3-(methylthio)-1,2,4-triazin-5-one; 4-Amino-6-*tert*-butyl-3-methylthio-As-triazin-5-one; 4-Amino-6-(1,1-dimethylethyl)-3-(methylthio)-1,2,4-triazin-5-(4H)-one; Metribuzina (Spanish); 1,2,4-Triazin-5-(4H)-one, 4-amino-6-(1,1-dimethylethyl)-3-(methylthio)-; As-triazin-5(4H)-one,4-amino-6-*tert*-butyl-3-(methylthio)-

Trade Names: AUTHORITY®; AXIOM® Metribuzin; BAY 61597®; BAY DIC 1468®; BAYER 6159H®; BAYER 6443H®; BAYER 94337®; BOUNDARY®; CANOPY®; CONQUEST®; DIC 1468®; DOMAIN®; LEXONE®; LEXONEEX®; PREVIEW®[C]; PYTHON®; SENCOR®; SENCORAL®; SENCOREX®; SENCORER®; VAPCOR®

Chemical class: Triazinone

EPA/OPP PC Code: 101101

California DPR Chemical Code: 1692

HSDB Number: 6844

UN/NA & ERG Number: UN3077(solid)/171

RTECS® Number: XZ2990000

EC Number: 244-209-7 [*Annex I Index No.:* 606-034-00-8]

Uses: Metribuzin is a selective triazine herbicide which inhibits photosynthesis of susceptible plant species. It is used for control of annual grasses and numerous broadleaf weeds in asparagus, potatoes, lucerne, peas, lentils, soya beans, sugar cane, sainfoin, pineapples and cereals. It is applied to fallow lands. Metribuzin is available as liquid suspension, water dispersible granular, and dry flowable formulations.

U.S. Maximum Allowable Residue Levels for Metribuzin (40 CFR 180.332): alfalfa, forage 2 ppm; alfalfa, hay 7 ppm; asparagus 0.1 ppm; barley, grain 0.75 ppm; barley, hay 7 ppm; barley, pearled barley 3 ppm; barley, straw 1 ppm; carrot, roots 0.3 ppm; cattle, fat 0.7 ppm; cattle, meat 0.7 ppm; cattle, meat byproducts 0.7 ppm; corn, field, forage 0.1 ppm; corn, field, grain 0.05 ppm; corn, field, stover 0.1 ppm; corn, pop, grain 0.05 ppm; corn, sweet, forage 0.1 ppm; corn, sweet, kernel plus ppm; cob with husks removed 0.05 ppm; corn, sweet, stover 0.1 ppm; egg 0.01 ppm; goat, fat 0.7 ppm; goat, meat 0.7 ppm; goat, meat byproducts 0.7 ppm; grass, forage 2 ppm; grass, hay 7 ppm; hog, fat 0.7 ppm; hog, meat 0.7 ppm; hog, meat byproducts 0.7 ppm; horse, fat 0.7 ppm; horse, meat 0.7 ppm; horse, meat byproducts 0.7 ppm; lentil 0.05 ppm; milk 0.05 ppm; pea 0.1 ppm; pea, dry 0.05 ppm; pea, dry, seed 0.05 ppm; pea, field, hay 4 ppm; pea, field, vines 0.5 ppm; pea, succulent 0.1 ppm; potato 0.6 ppm; potato, chips 3 ppm; poultry, fat 0.7 ppm; poultry, meat 0.7 ppm; poultry, meat byproducts 0.7 ppm; sainfoin, forage 2 ppm; sainfoin, hay 7 ppm; sheep, fat 0.7 ppm; sheep, meat 0.7 ppm; sheep, meat byproducts 0.7 ppm; soybean, forage 4 ppm; soybean, hay 4 ppm; soybean, seed 0.3 ppm; sugarcane, cane 0.1 ppm; sugarcane, molasses 2 ppm; tomato 0.1 ppm; wheat, bran 3 ppm; wheat, forage 2 ppm; wheat, germ 3 ppm; wheat, grain 0.75 ppm; wheat, hay 7 ppm; wheat, middlings 3 ppm; wheat, shorts 3 ppm; wheat, straw 1 ppm.

Human toxicity (long-term)[101]: Very low–200.00 ppb, Health Advisory

Fish toxicity (threshold)[101]: Very low–7683.76758 ppb, MATC (Maximum Acceptable Toxicant Concentration)

Regulatory Authority and Advisory Information:

Carcinogenicity[83]: EPA Group D, Not classifiable as a human carcinogen

Health Advisory: Mutagen, Developmental/Reproductive Toxin, Endocrine disruptor (S!)

Acute Oral Category: 3, CAUTION

Potential Ground Water Pollutant [California FAC Section 13145(d)/12811, active]

EPCRA Section 313 Form R *de minimis* concentration reporting level: 1.0%

Safe Drinking Water Act: Priority List (55 FR 1470)

European/International Regulations: Hazard Symbol: Xn, N; risk phrases: R9; R22; R50/53; safety phrases: S2; S60; S61 (see Appendix 1)

Description: Metribuzin is a white crystalline solid. Mild, sulfurous odor. Molecular weight = 214.31; Specific gravity (H_2O:1) =1.28 @ 20 °C; Boiling point = (decomposes) 132 °C; Freezing/Melting point = 125–127 °C; Vapor pressure = 4×10^7 mmHg. Highly soluble in water; solubility = 1.2×10^3 ppm. Available in various concentrations (4%, 50%, 75%, etc.). Physical and toxicological properties may be affected by carrier solvents in commercial formulations.

Incompatibilities: Decomposition starts in temperatures >125 °C. Strong oxidizers. When heated to decomposition, forms oxides of nitrogen and sulfur.

Permissible Exposure Limits in Air: OSHA PEL: None
NIOSH REL: 5 mg/m^3 TWA
ACGIH TLV®[1]: 5 mg/m^3 TWA, not classifiable as a human carcinogen

Permissible Concentration in Water: Federal Drinking Water Standards: EPA 70 μg/L; State Drinking Water Guidelines: Maine 175 μg/L; Florida 180 μg/L; Minnesota 200 μg/L; Wisconsin 250 μg/L. Canadian Drinking Water Standards: MAC 0.08 mg/L.

Determination in Water: Solvent extraction with methylene chloride followed by exchange to acetone, separation by gas chromatography and measurement with a thermionic bead detector. Log K_{ow} = <2.0. Unlikely to bioaccumulate in marine organisms.

Routes of Entry: Inhalation, ingestion, skin and/or eye contact.

Harmful Effects and Symptoms

Short Term Exposure: Metribuzin can affect you when breathed in and by passing through your skin. Acute poisoning can cause difficult breathing and drowsiness. High exposures may cause upset stomach, fatigue, and depression of the central nervous system, causing poor coordination, tremors and weakness. LD_{50} (oral, rat) = 1100 mg/kg[83]; (dermal, rat) = >2 g/kg.

Long Term Exposure: Repeated or high exposure may cause liver enzyme changes, goiter, and affect thyroid function.

Points of Attack: Central nervous system, thyroid and liver.

Medical Surveillance: Preliminary medical exam to detect chronic diseases of central nervous system, liver, heart, kidneys, lung and skin, as well as endocrinological or immunological disturbances, should protect susceptible individuals. Periodical medical exams of internal organs, skin and eyes are important to avoid chronic occupational intoxications. They should include lab and patch tests when necessary[83]. If symptoms develop or overexposure is suspected, the following may be useful: Thyroid function test.

First Aid: If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least 15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately. If this chemical contacts the skin, remove contaminated clothing and wash immediately with soap and water. Seek medical attention immediately. If this chemical has been inhaled, remove from exposure, begin rescue breathing (using universal precautions) if breathing has stopped, and CPR if heart action has stopped. Transfer promptly to a medical facility. When this chemical has been swallowed, get medical attention. Give large quantities of water and induce vomiting. Do not make an unconscious person vomit.

Personal Protective Methods: Wear protective gloves and clothing to prevent any reasonable probability of dermal and/or eye contact. Safety equipment suppliers/manufacturers can provide recommendations on the most protective glove/clothing material for your operation. All protective clothing (suits, gloves, footwear, headgear) should be clean, available each day, and put on before work. Contact lenses should not be worn when working with this chemical. Wear dust-proof chemical goggles and face shield unless full facepiece respiratory protection is worn. Employees should wash immediately with soap when skin is wet or contaminated. Provide emergency showers and eyewash.

Respirator Selection: Where potential exists for exposures *over 5 mg/m^3*, use a NIOSH/MSHA- or European Standard EN149-approved full facepiece respirator with a pesticide cartridge. Greater protection is provided by a powered-air purifying respirator. *Where potential for high exposures exists*, use a NIOSH/MSHA- or European Standard EN149-approved supplied-air respirator with a full facepiece operated in the positive-pressure mode, or with a full facepiece hood, or helmet in the continuous-flow mode; or use a NIOSH/MSHA- or European Standard EN149-approved self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive-pressure mode.

Storage: Color Code-Blue: Health Hazard/Poison: Store in a secure poison location. Store in tightly closed containers in a cool, dry area. Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: Triazine pesticides, solid, toxic, require a shipping label of "poisonous materials." They usually fall in Hazard Class 6.1.

Spill Handling: First remove all sources of ignition. Evacuate persons not wearing protective equipment from area of spill or leak until clean up is complete. Collect powdered material in the most convenient and safe manner and deposit in sealed containers. Ventilate area after clean up is complete. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable.

Fire Extinguishing: Extinguish fire using an agent suitable for type of surrounding fire. Metribuzin itself does not burn. Hazardous decomposition includes nitrogen oxides and sulfur oxides. As an immediate precautionary measure, isolate spill or leak area in all directions for at least 50 meters/150 feet for liquids and at least 25 meters/75 feet for solids. *Fire involving storage or vehicular tanks:* isolate for 800 meters/0.5 mile in all directions;

also, consider initial evacuation for 800 meters/0.5 mile in all directions. *On a small fire:* use dry chemical, CO_2, water spray or regular foam. *On a large fire:* use water spray, fog or regular foam. Do not scatter spilled material with high-pressure streams of water. Move containers from fire area if you can do it without risk. Dike fire-control water for later disposal. *Fire involving tanks:* from a secure, explosion-proof location, use water spray to cool exposed containers. If cooling streams are ineffective (venting sound increases in volume and pitch, tank discolors, or shows any signs of deforming), withdraw immediately to a secure position. Always stay away from tanks engulfed in fire. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- EXTOXNET, Extension Toxicology Network, "Pesticide Information Profile, Metribuzin," Oregon State University, Corvallis, OR) June 1996). http://extoxnet.orst.edu/pips/metribuz.htm
- USEPA, Office of Pesticide Programs, Pesticide Residue Limits, "Metribuzin," ***40 CFR*** 180.332. http://www.epa.gov/pesticides/food/viewtols.htm
- USEPA, "Health Advisory: Metribuzin," Washington DC, Office of Drinking Water (August 1987)
- New Jersey Department of Health and Senior Services, "Hazardous Substance Fact Sheet: Metribuzin," Trenton, NJ (January 2001). http://www.state.nj.us/health/eoh/rtkweb/1302.pdf

Metsulfuron-methyl M:1345

Use Type: Herbicide
CAS Number: 74223-64-6
Formula: $C_{14}H_{15}N_5O_6S$
Synonyms: Benzoic acid, 2-[((((4-methoxy-6-methyl-1,3,5-triazin-2-yl)amino)carbonyl)amino)sulfonyl]-methyl ester; Methyl-2-[[(4-methoxy-6-methyl-1,3,5-triazyn-2-yl)aminocarbonyl]aminosulfonyl]benzoate; Methyl 2-[((((4-methoxy-6-methyl-1,3,5-triazin-2-yl)amino)carbonyl) amino) sulfonyl]benzoate; Methyl 2-[3-(4-methoxy-6-methyl-1,3,5-triazin-2-yl)ureidosulphonyl]benzoate
Trade Names: ALLIE®; ALLY®; ALLY-20DF®; ANSWER®; BRUSH-OFF®; CANVAS®; CIMARRON®; DMC® WEED CONTROL; DPD 63760H®; DPX 6376®; DPX-T 6376®; ESCORT®; FINESSE®; GROPPER®; NUP®; PARTISAN®; PASTURE® MD; RIVERDALE®; ROSULFURON®
Chemical class: Sulfonylurea
EPA/OPP PC Code: 122010
California DPR Chemical Code: 2222
HSDB Number: 6849
UN/NA & ERG Number: UN3077(solid)/171
RTECS® Number: DH3563000
EC Number: 616-063-8 [*Annex I Index No.:* 613-139-00-2]
Uses: Metsulfuron-methyl is a pre-emergence and post-emergence herbicide used to control annual grasses, brush, woody plants and broadleaf weeds. It can be applied to cereals including barley, rye and wheat and to pastures. It is primarily used to control brush, woody plants and broadleaf weeds on rights-of-way, fence rows, storage areas, highways and other non-crop areas.
U.S. Maximum Allowable Residue Levels for metsulfuron-methyl and its metabolite methyl 2-[[[[(4-methoxy-6-methyl-1-,3,5-triazin-2-yl)amino]carbonyl]amino]sulfonyl]-4-hydroxybenzoate. [40 CFR 180.428(a)(1)]: in or on the following raw material agricultural commodities: barley, grain 0.1 ppm; barley, hay 20.0 ppm; barley, straw 0.3 ppm; grass, fodder 15.0 ppm; grass, forage 15.0 ppm; grass, hay 15.0 ppm; sorghum, grain, forage 0.2 ppm; sorghum, grain, grain 0.1 ppm; sorghum, grain, stover 0.2 ppm; sugarcane, cane 0.05 ppm; wheat, forage 5.0 ppm; wheat, grain 0.1 ppm; wheat, hay 20.0 ppm; and wheat, straw 0.3 ppm. ***For metsulfuron-methyl [40 CFR 180.428(a)(2)]:*** in or on the following raw agricultural commodities: cattle, fat 0.1 ppm; cattle, kidney 0.5 ppm; cattle, meat 0.1 ppm; cattle, meat byproducts 0.1 ppm; goat, fat 0.1 ppm; goat, kidney 0.5 ppm; goat, meat 0.1 ppm; goat, meat byproducts 0.1 ppm; hog, fat 0.1 ppm; hog, kidney 0.5 ppm; hog, meat 0.1 ppm; hog, meat byproducts 0.1 ppm; horse, fat 0.1 ppm; horse, kidney 0.5 ppm; horse, meat 0.1 ppm; horse, meat byproducts 0.1 ppm; milk 0.05 ppm; sheep, fat 0.1 ppm; sheep, kidney 0.5 ppm; sheep, meat 0.1 ppm; and sheep, meat byproducts 0.1 ppm.
Human toxicity (long-term)[101]: Very low–1750.00 ppb, Health Advisory
Fish toxicity (threshold)[101]: Very low–31167.38603 ppb, MATC (Maximum Acceptable Toxicant Concentration)
Regulatory Authority and Advisory Information:
Carcinogenicity[83]: EPA, Not likely to be carcinogenic to humans
Acute Oral Category: 3, CAUTION
Health Advisory: Developmental/Reproductive Toxin
Marine pollutant: IMDG, some formulations
Environmental hazard: IATA, some formulations
European/International Regulations: Hazard Symbol: N; risk phrases: R50/53; safety phrases: S2; S60; S61 (see Appendix 1)
Description: White, off-white or pale yellow crystalline solid. Slight, sweet odor; ester-like. Molecular weight = 381.37; Specific gravity (H_2O:1) = 1.47; Freezing/Melting point = 158 °C; 163 °C; Vapor pressure = 3×10^{12} mmHg @ 25 °C. Soluble in water; solubility = 108 mg/L @ 25 °C.
Incompatibilities: Strong oxidizers. Stable in air to about 140 C. It is hydrolyzed in acid solutions.

Determination in Air: Filter; none; Gravimetric; NIOSH IV [Particulates NOR; #0500 (total), #0600 (respirable)][18].

Determination in Water: Log K_{ow} = <2.5. Unlikely to bioaccumulate in marine organisms.

Routes of Entry: Inhalation, dermal contact, ingestion.

Harmful Effects and Symptoms: Human health effects from the sulfonylurea herbicides at low environmental doses or at biomonitored levels from low environmental exposures are unknown. The sulfonylurea herbicides are generally of low toxicity in mammalian studies. Animal studies showed low acute toxicity and little chronic, reproductive, or developmental toxicity or teratogenic effects. Developmental or teratogenic effects tended only to occur at high or maternally toxic doses. At high sublethal, chronic oral doses, such nonspecific effects as weight loss and anemia were observed. Some chemical-specific effects were noted at high doses in animals[96].

Short Term Exposure: May cause skin and eye irritation. Moderately poisonous if ingested or inhaled. LD_{50} (oral, rat) = >5 g/kg; LD_{50} (dermal, rat) = >2 g/kg.

Long Term Exposure: May cause reproduction problems.

Points of Attack: Reproductive cells.

Medical Surveillance: Preliminary medical exam to detect chronic diseases of central nervous system, liver, heart, kidneys, lung and skin, as well as endocrinological or immunological disturbances, should protect susceptible individuals. Periodical medical exams of internal organs, skin and eyes are important to avoid chronic occupational intoxications. They should include lab and patch tests when necessary[83]. Comprehensive physical examination with emphasis on the genito-urinary tract analysis to include sperm count, motility and morphology. Other tests, such as serum testosterone, serum follicle stimulating hormone (FSH), and serum lutenizing hormone (LH), may be carried out if, in the opinion of a physician, they are indicated. Urinary levels of the sulfonylurea herbicides reflect recent exposure. There is very limited information on the biomonitoring of sulfonylurea herbicides or their metabolites. Detection of the metabolites may reflect exposure to more than one particular sulfonylurea herbicide or from exposure to environmental degradation products. The urinary metabolites dimethoxypyrimidine and dimethylpyrimidine can be used as nonspecific markers of exposure to the pyrimidinylsulfonylureas, a group that includes bensulfuron-methyl, halosulfuron, primisulfuron-methyl, and sulfosulfon. The urinary metabolite methoxymethyl triazine can be used as a nonspecific marker of exposure to the triazinylsulfonylureas, a group that includes chlorosulfuron, prosulfuron, and triasulfuron[96].

First Aid: If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least 15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately. If this chemical contacts the skin, remove contaminated clothing and wash immediately with soap and water. Seek medical attention immediately. If this chemical has been inhaled, remove from exposure, begin rescue breathing (using universal precautions) if breathing has stopped, and CPR if heart action has stopped. Transfer promptly to a medical facility. When this chemical has been swallowed, get medical attention. Give large quantities of water and induce vomiting. Do not make an unconscious person vomit.

Personal Protective Methods: Wear protective gloves and clothing to prevent any reasonable probability of dermal and/or eye contact. Safety equipment suppliers/manufacturers can provide recommendations on the most protective glove/clothing material for your operation. All protective clothing (suits, gloves, footwear, headgear) should be clean, available each day, and put on before work. Contact lenses should not be worn when working with this chemical. Wear dust-proof chemical goggles and face shield unless full facepiece respiratory protection is worn. Employees should wash immediately with soap when skin is wet or contaminated. Provide emergency showers and eyewash.

Respirator Selection: Wherever and whenever workplace conditions warrant respirator use, a respiratory protection program must be followed that meets one or more of the following government standards: OSHA's 29 CFR 1910.134, ANSI Z88.2, or European Standard EN 149.

Storage: Color Code-Blue: Health Hazard/Poison. Store in a secure poison location. Store in a refrigerator and protect from exposure to oxidizers or moisture[52]. A regulated, marked area should be established where this chemical is handled, used, or stored in compliance with OSHA Standard 1910.1045. Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: Environmentally hazardous substances, solid or liquid, usually fall in Hazard Class 9.

Spill Handling: Evacuate and restrict persons not wearing protective equipment from area of spill or leak until clean up is complete. If a spill occurs, clean it up promptly. Don't wash it away. Instead, sprinkle the spill with sawdust, vermiculite, or kitty litter. Sweep it into a plastic garbage bag, and dispose of it as directed on the pesticide product label. Ventilate area of spill or leak after clean up is complete. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable.

Fire Extinguishing: Hazardous decomposition includes oxides of nitrogen, sulfur, and carbon. As an immediate precautionary measure, isolate spill or leak area in all directions for at least 50 meters/150 feet for liquids and at least 25 meters/75 feet for solids. *Fire involving storage or vehicular tanks:* isolate for 800 meters/0.5 mile in all directions; also, consider initial evacuation for 800 meters/0.5 mile in all directions. *On a small fire:* use dry chemical, CO_2, water spray or regular foam. *On a large fire:* use water spray, fog or regular foam. Do not scatter spilled material with high-pressure streams of water. Move containers from fire area if you can do it without risk. Dike fire-control water for later disposal. *Fire involving tanks:* from a secure, explosion-proof location, use water spray to cool exposed containers. If cooling streams are ineffective (venting sound increases in volume and pitch, tank discolors, or shows any signs of deforming), withdraw immediately to a secure position. Always stay away from tanks engulfed in fire. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode.

Disposal Method Suggested: It is the responsibility of chemical waste generators to determine the toxicity and physical properties and of a discarded chemical and to properly identify its classification and certification as a hazardous waste and to determine the disposal method. U.S. EPA guidelines for the classification determination are listed in ***40 CFR*** Parts 261.3. Additionally, waste generators must consult and follow all regional, national, state and local hazardous waste laws to ensure complete and accurate classification and disposal methods. Recycle any unused portion of the material for its approved use or return it to the manufacturer or supplier. Offer surplus and non-recyclable solutions to a licensed disposal company. Dissolve or mix the pesticide with a combustible solvent and burn in a chemical incinerator equipped with an afterburner and scrubber.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- EXTOXNET, Extension Toxicology Network, "Pesticide Information Profile, Metsulfuron-methyl," Oregon State University, Corvallis, OR (October 1996). http://extoxnet.orst.edu/pips/metsulfu.htm

Mevinphos M:1350

Use Type: Insecticide, Acaricide

CAS Number: 7786-34-7

Formula: $C_7H_{13}O_6P$

Synonyms: 2-Butenoic acid, 3-[(dimethoxyphosphinyl) oxy]-, methyl ester; α-2-Carbomethoxy-1-methylvinyl dimethyl phosphate; 2-Carbomethoxy-1-methylvinyl dimethyl phosphate; α-(-2-Carbomethoxy-1-methylvinyl) dimethyl phosphate; 2-Carbomethoxy-1-methylvinyl dimethyl phosophate, α isomer; 2-Carbomethoxy-1-propen-2-yl dimethyl phosphate; CMDP; Crotonic acid, 3-hydroxy-, methyl ester, dimethyl phosphate; Crotonic acid, 3-hydroxy- methyl ester, dimethyl phosphate, *(E)*-; 3-[(Dimethoxy phosphinyl) oxy]-2-butenoic acid methyl ester; *O,O*-dimethyl-*O*-(2-carbomethoxy-1-methylvinyl) phosphate; *O,O*-Dimethyl 1-carbomethoxy-1-propen-2-yl phosphate; Dimethyl-1-carbomethoxy-1-propen-2-yl phosphate; Dimethyl (2-methoxycarbonyl-1-methylvinyl) phosphate; Dimethyl methoxycarbonylpropenyl phosphate; Dimethyl (1-methoxycarboxypropen-2-yl) phosphate; *O,O*-Dimethyl *O*-(1-methyl-2-carboxyvinyl) phosphate; Dimethyl phosphate of methyl 3-hydroxy-*cis*-crotonate; Duraphos; ENT 22,374; 3-hydroxycrotonic acid methyl ester dimethyl phosphate; Menite; *cis*-2-Methoxycarbonyl-1-methylvinyl dimethylphosphate; 2-Methoxycarbonyl-1-methylvinyl dimethyl phosphate; (*cis*-2-Methoxycarbonyl-1-methylvinyl) dimethyl phosphate; 1-Methoxycarbonyl-1-propen-2-yl dimethyl phosphate; Methyl-3-((dimethoxyphosphinyl)oxy)-2-butenoate, α-isomer; Methyl 3-[(dimethoxyphosphinyl) oxy]-2-butenoate; Methyl 3-(dimethoxyphosphinyloxy) crotonate; Methyl 3-hydroxy-α-crotonate dimethyl phosphate; Methyl-3-hydroxy-α-crotonate, dimethyl phosphate ester; Methyl 3-hydroxycrotonate dimethyl phosphate ester; NSC 46470; *cis*-Phosdrin; Phosfene; Phosphene; Phosphoric acid, dimethyl ester with methyl 3-hydroxycrotonate; Phosphoric acid, (1-methoxycarboxypropen-2-yl) dimethyl ester

Trade Names: AI3-22374®; APAVINPHOS®; CASWELL No. 160B®; CENTURY-CIDE®[C]; COMPOUND 2046®; DURHAM®[C]; EXCELCIDE®[C]; GESFID®; GESTID®; PD 5®; HELENA PHOSDRIN®[C]

Chemical class: Organophosphate

EPA/OPP PC Code: 015801

California DPR Chemical Code: 480

HSDB Number: 777

UN/NA & ERG Number: UN2783 (solid)/152; UN3018 (liquid)/152

RTECS® Number: GQ5250000

EC Number: 232-095-1 [*Annex I Index No.:* 015-020-00-5]

Uses: Mevinphos is an organophosphate insecticide used to control a broad spectrum of insects, including aphids, grasshoppers, leafhoppers, cutworms, caterpillars, and many other insects on a wide range of field, forage, vegetable, and fruit crops. It is also an acaricide that kills or controls mites and ticks. It acts quickly both as a contact insecticide, acting through direct contact with target pests, and as a systemic insecticide which becomes absorbed by plants on which insects feed. Not approved for use in EU countries[115]. Not registered for use in the U.S.

Human toxicity (long-term)[101]: High–1.75 ppb, Health Advisory

Fish toxicity (threshold)[101]: Extra high–0.96183 ppb, MATC (Maximum Acceptable Toxicant Concentration)

Regulatory Authority and Advisory Information:

Carcinogenicity[83]: ACGIH A4, not classified as a human carcinogen; EPA Deferred classification

Acute Oral Category: 1, DANGER–POISON

Health Advisory: Nerve Toxin. Mutagen

Classified for restricted use, limited to use by or under the direct supervision of a certified applicator. All emulsifiable concentrates and liquid concentrates. Psycodid filter fly formulations, and 2% dusts ***(40 CFR 162.31)***.

Clean Water Act: Section 311 Hazardous Substances/RQ 40CFR117.3 (same as CERCLA, see below)

Superfund/EPCRA 302 Extremely Hazardous Substances: TPQ = 500 lb (227 kg)

Superfund/EPCRA 40CFR302.4 RQ: CERCLA, 10 lb (4.54 kg)

EPCRA Section 313 Form R *de minimis* concentration reporting level: 1.0%

U.S. DOT 49CFR172.101, Inhalation Hazard Chemical as organophosphates

U.S. DOT Regulated Marine Pollutant (49CFR, Subchapter 172.101, Appendix B), severe pollutant

European/International Regulations: Hazard Symbol: T+, N; risk phrases: R27/28; R50/53; safety phrases: S1/2; S23; S28; S36/37; S45; S60; S61 (see Appendix 1)

WGK (German Aquatic Hazard Class): 3-Severe hazard to waters

Description: Mevinphos is a pale yellow to orange high-boiling liquid. Weak odor. Commercial products available as an emulsifiable concentrate. Molecular weight = 224.17; Specific gravity (H_2O:1) = 1.25 @ 20 °C; Boiling point = (decomposes) 243 °C; 280 °C; Freezing/Melting point = 6.7 °C (*trans-*); 21 °C (*cis-*); Vapor pressure: 0.0001 mmHg @ 20 °C; Flash point = 79.5 °C (oc). Hazard Identification (based on NFPA-704 M Rating System): Health 4, Flammability 1, Reactivity 0. Soluble in water. Physical and toxicological properties may be affected by carrier solvents in commercial formulations. Commercial product is a mixture of the *cis-* and *trans-*isomers. Insecticide may be absorbed on a dry carrier. Physical and toxicological properties may be affected by carrier solvents in commercial formulations.

Incompatibilities: Decomposes in heat, producing phosphoric acid and phosphorus oxides fumes. May react violently with antimony(V) pentafluoride. Incompatible with lead diacetate, magnesium, silver nitrate. In the presence of strong reducing agents such as hydrides, organophosphates form highly toxic and flammable phosphine gas. Contact with oxidizers can cause the release of toxic oxides of phosphorus. Corrosive to cast iron, some stainless steels and brass. Attacks some forms of plastics, rubber and coating.

Permissible Exposure Limits in Air: NIOSH IDLH: 4 ppm

Conversion factor: 1 ppm = 9.17 mg/m^3 @ 25 °C & 1 atm

OSHA PEL: 0.1 mg/m^3 TWA [skin]

NIOSH REL: 0.01 ppm/0.1 mg/m^3 TWA; 0.03 ppm/0.3 mg/m^3 STEL [skin]

ACGIH TLV®[1]: 0.01 mg/m^3 measured as inhalable fraction and vapor TWA [skin]; not classifiable as a human carcinogen; BEI$_A$ issued as Acetylcholinesterase inhibiting pesticides

Protective Action Criteria (PAC) Ver. 27[89]

PAC-1: 0.3 mg/m^3
PAC-2: 4 mg/m^3
PAC-3: 36.6 mg/m^3

DFG MAK: 0.01 ppm/0.093 mg/m^3 TWA; Peak Limitation Category II(2) [skin]

Determination in Air: OSHA versatile sampler-2; Toluene/Acetone; Gas chromatography/Flame photometric detection for sulfur, nitrogen, or phosphorus; NIOSH IV, Method #5600, Organophosphorus pesticides[18].

Permissible Concentration in Water: State Drinking Water Guidelines: Florida 1.8 μg/L

Determination in Water: Log K$_{ow}$ = <0.1.5. Unlikely to bioaccumulate in marine organisms.

Routes of Entry: Inhalation, skin absorption, ingestion, skin and/or eye contact.

Harmful Effects and Symptoms

Short Term Exposure: Cholinesterase inhibitor and fast-acting poison. Mevinphos may affect the nervous system, causing convulsions, respiratory failure. This material is super toxic; the probable oral lethal dose for humans is <5 mg/kg, or a taste (<7 drops) for a 150 lb person. It has direct and immediate effects whether it is swallowed, inhaled, or absorbed through the skin. Symptoms include nausea, vomiting, abdominal cramps, diarrhea, excessive salivation, headache, giddiness, dizziness, runny nose, tightness in the chest, blurring and dimming of vision, slurring of speech, twitching of muscles, mental confusion, disorientation, difficulty breathing, blueing of skin, convulsions, coma, and death. Delayed pulmonary edema may occur after inhalation. LD$_{50}$ (oral, rat) = 3.5 mg/kg; (dermal, rat) = >4000 mg/kg;.

Long Term Exposure: Cholinesterase inhibitor; cumulative effect is possible. A nerve toxin; mevinphos may damage the nervous system with repeated exposure, resulting in convulsions, respiratory failure. May cause liver damage. Neurotoxic.

Points of Attack: Respiratory system, lungs, central nervous system, cardiovascular system, skin, eyes, plasma and red blood cell cholinesterase.

Medical Surveillance: Medical observation is recommended for 24 to 48 hours following breathing overexposure, as pulmonary edema may be delayed. Routine biological monitoring of pesticide applicators and field workers includes testing of plasma and red blood cell acetylcholinesterase levels (for enzyme poisoned by this chemical). These tests are normally accurate only if done within about two hours of exposure. If exposure stops, plasma levels return to normal in 1–2 weeks while red blood cell levels may be reduced for 1–3 months. When acetylcholinesterase enzyme levels are reduced by 25% or more below preemployment levels, risk of poisoning is increased, even if results are in lower ranges of "normal." Reassignment to work not involving organophosphate pesticides is recommended until enzyme levels recover. Do not drink any alcoholic beverages before or during use as it promotes absorption of organophosphates.

First Aid: **Treatment for organophosphate poisoning consists of thorough decontamination, cardiorespiratory support, and administration of the antidotes atropine and pralidoxime. In cases of severe poisoning, diazepam, an anticonvulsant, should also be administered. Antidotes should be administered as prevention even if the diagnosis is in doubt**. Speed in removing material from eyes and skin is of extreme importance. *Eyes:*

Eye contact can cause dangerous amounts of these chemicals to be quickly absorbed through the mucous membrane into the bloodstream. Immediately and gently flush eyes with plenty of warm or cold water (NO hot water) for at least 15 minutes, occasionally lifting the upper and lower eyelids. Get medical aid immediately. *Skin:* Get medical aid. Dermal contact can cause dangerous amounts of these chemicals to be absorbed into the bloodstream. Wearing the appropriate PPE equipment and respirator for organophosphate pesticides, immediately flush skin with plenty of soap and water for at least 15 minutes while removing contaminated clothing and shoes. Shampoo hair promptly if contaminated. The removed, contaminated clothing and shoes should be double-bagged and left in Hot Zone for later disposal by hazardous materials experts. Skin may also be decontaminated with diluted hypochlorite solution. *Inhalation:* Get medical aid. Do not contaminate yourself. Wearing the appropriate PPE equipment and respirator for organophosphate pesticides, immediately remove the victim from the contaminated area to fresh air. If the victim is not breathing, administer artificial respiration. Do not use mouth-to-mouth method if victim ingested or inhaled the substance; give artificial respiration with the aid of a pocket mask equipped with a one-way valve or other proper respiratory medical device. If breathing is difficult, administer oxygen through bag/mask apparatus until medical help arrives. Do not leave victim unattended. *Ingestion:* Call poison control. Loosen all clothing. Never give anything by mouth to an unconscious person. If victim is *unconscious or having convulsions,* do nothing except keep victim warm. Get medical aid. Transfer promptly to a medical facility. In cases of ingestion, **do not induce vomiting**. If the victim is alert and asymptomatic, administer a slurry of activated charcoal at a dose of 1 g/kg (infant, child, and adult dose). A soda can and straw may be of assistance when offering charcoal to a child. *In some cases you may be specifically instructed by poison control to induce vomiting by way of 2 tablespoons of syrup of ipecac (adult) washed down with a cup of water*. Do NOT give activated charcoal before or with ipecac syrup

Note to physician or authorized medical personnel: Treat cases of respiratory compromise, coma, or excessive pulmonary secretions with respiratory support using protocols and techniques available and within the scope of training. Some cases may necessitate procedures such as endotracheal intubation or cricothyrotomy by properly trained and equipped personnel. When possible, atropine (see *Antidotes*, below) should be given under medical supervision. Patients who are comatose, hypotensive, or having seizures or cardiac arrhythmias should be treated according to advanced life support protocols. *Antidotes:* Two antidotes are administered to treat organophosphate poisoning. Atropine is a competitive antagonist of acetylcholine at muscarinic receptors and is used to control the excessive bronchial secretions which are often responsible for death. Pralidoxime relieves both the nicotinic and muscarine effects of organophosphate poisoning by regenerating acetylcholinesterase and can reduce both the bronchial secretions and the muscle weakness associated with poisoning. The initial intravenous dose of atropine in adults should be determined by the severity of symptoms: An initial adult dose of 1.0 to 2.0 mg or pediatric dose of 0.01 mg/kg (minimum 0.01 mg) should be administered intravenously. If intravenous access cannot be established, atropine may also be given intramuscularly, subcutaneously or via endotracheal tube. Doses should be repeated every 15 minutes until excessive secretions and sweating have been controlled. Once bronchial secretion has been controlled, atropine administration should be repeated whenever the secretions begin to recur. In seriously poisoned patients, very large doses may be required. Alterations of pulse rate and pupillary size should not be used as indicators of treatment adequacy. Pralidoxime should be administered as early in poisoning as possible as its efficacy may diminish when given more than 24 to 36 hours after exposure. Doses are as follows: adult 1.0 g; pediatric 25 to 50 mg/kg. The drug should be administered intravenously over 30 to 60 minutes, but in a life-threatening situation one-half of the total dose can be given per minute for a total administration time of 2 minutes. Treatment should begin to take effect within 40 minutes with a reduction in symptoms and the amount of atropine necessary to control bronchial secretion. The initial dose can be repeated in 1 hour and then every 8 to 12 hours until the patient is clinically well and no longer requires atropine. If intravenous access cannot be established, pralidoxime may also be given intramuscularly. Early administration of diazepam in addition to the combined atropine and pralidoxime treatment may help prevent the onset of seizures and potential brain and cardiac morphologic damage following high-level organophosphate poisoning.

Personal Protective Methods: Wear protective gloves and clothing to prevent any reasonable probability of dermal and/or eye contact. Safety equipment suppliers/manufacturers can provide recommendations on the most protective glove/clothing material for your operation. One recommendation is the use of DuPont™ Tychem® suit fabrics[88]. All protective clothing (suits, gloves, footwear, headgear) should be clean, available each day, and put on before work. Contact lenses should not be worn when working with this chemical. Wear splash-proof chemical goggles and face shield unless full facepiece respiratory protection is worn. Employees should wash immediately with soap when skin is wet or contaminated. Provide emergency showers and eyewash.

Respirator Selection: Engineering controls should be used wherever feasible to maintain airborne concentrations of this chemical below the prescribed exposure limit. Respirators and protective equipment are less effective than engineering controls, and should be used only in non-routine or emergency situations which may result in exposure concentrations in excess of the TWA environmental limit. *At any concentrations above the NIOSH REL, or where there is no REL, at any detectable concentration:* SCBAF: Pd,Pp (APF = 10,000) (any NIOSH/MSHA- or European

Standard EN 149-approved self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode); or SaF: Pd,Pp: ASCBA (APF = 10,000) (any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary, self-contained breathing apparatus operated in a pressure-demand or other positive-pressure mode).

Storage: Color Code-Blue: Health Hazard/Poison. Store in a secure poison location. Prior to working with this chemical you should be trained on its proper handling and storage. Where possible, automatically transfer material from other storage containers to process containers. Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: Organophosphorus pesticides, solid or liquid (nonflammable), require a "poisonous materials" label. This chemical falls in Hazard Class 6.1.

Spill Handling: First remove all sources of ignition. Evacuate persons not wearing protective equipment from area of spill or leak until clean up is complete. Stay upwind; keep out of low areas. Ventilate area of spill or leak. Remove and isolate contaminated clothing at the site. Do not touch spilled material; stop leak if you can do so without risk. Use water spray to reduce vapors. *Small spills:* absorb with sand or other noncombustible absorbent material and place into containers for later disposal. *Large spills:* dike far ahead of spill for later disposal. Collect powdered material in the most convenient and safe manner and deposit in sealed containers. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable. Seek professional environmental engineering assistance from the U.S. EPA Environmental Response Team at (908) 548-8730 (24-hour response line).

Fire Extinguishing: Hazardous decomposition includes oxides of phosphorus, and nitrogen. May be fatal if inhaled, ingested or absorbed through the skin. Inhalation or contact with some of these materials will irritate or burn skin and eyes. Vapors may cause dizziness or suffocation. *Small fires:* dry chemical, carbon dioxide; water spray; or foam. *Large fires:* water spray, fog, or foam. Stay upwind; keep out of low areas. Ventilate closed spaces before entering them. Firefighting gear (including SCBA) may not provide adequate protection. If exposure occurs, remove and isolate gear immediately and thoroughly decontaminate personnel. Wear positive-pressure breathing apparatus and special protective clothing. Remove and isolate contaminated clothing at the site. Move container from fire area if you can do so without risk. Fight fire from maximum distance. Dike fire-control water for later disposal; do not scatter the material. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies. From a secure, explosion-proof location, use water spray to cool exposed containers. If cooling streams are ineffective (venting sound increases in volume and pitch, tank discolors, or shows any signs of deforming), withdraw immediately to a secure position. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode.

Disposal Method Suggested: Destruction by alkali hydrolysis or incineration. Containers must be disposed of properly by following package label directions or by contacting your local or federal environmental control agency, or by contacting your regional EPA office. Extra care must be exercised as the material in an organic solvent is highly flammable.

References:

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- EXTOXNET, Extension Toxicology Network, "Pesticide Information Profile, Mevinphos," Oregon State University, Corvallis, OR (June 1996). http://extoxnet.orst.edu/pips/mevinpho.htm
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- New Jersey Department of Health and Senior Services, "Hazardous Substance Fact sheet, Mevinphos," Trenton, NJ (April 2001). http://www.state.nj.us/health/eoh/rtkweb/1509.pdf
- Sax, N. I., Ed., "Dangerous Properties of Industrial Materials Report" 6, No. 1, 97-101 (1986)
- Pohanish, R. P. and Greene, S. A., "Hazardous Substance Resource Guide, 2nd Ed., Gale Research, Detroit, MI (1977)
- USEPA, "Chemical Profile: Mevinphos," Washington DC, Chemical Emergency Preparedness Program (Nov.30, 1987)
- Agency for Toxic Substances and Disease Registry, U.S. Department of Health and Human Services, Public Health Service, "Managing Hazardous Materials Incidents," Atlanta, GA (June 2003)

Mexacarbate M:1360

Use Type: Insecticide, Molluscicide

CAS Number: 315-18-4

Formula: $C_{12}H_{18}N_2O_2$

Synonyms: Carbamate,4-dimethylamino-3,5-xylyln-methyl-; Carbamic acid, methyl-, methylcarbamate (ester); Carbamic acid, methyl-, 4-(dimethylamino)-3,5-xylyl ester; 4-(Dimethylamine)-3,5-xylyln-methylcarbamate; 4-(Dimethylamino)-3,5-dimethylphenol methylcarbamate (ester); 4-(Dimethylamino)-3,5-dimethylphenyl *N*-methylcarbamate; 4-(Dimethylamino)-3,5-xylenol,methylcarbamate (ester); 4-Dimethylamino-3,5-xylylmethylcarbamate; 4-Dimethylamino-3,5-xylyl *N*-methylcarbamate; 4-(*N,N*-Dimethylamino)-3,5-xylyl *N*-methylcarbamate; 5-Dimethylphenol methylcarbamate ester; ENT 25766; Methylcarbamic acid, 4-(dimethylamino)-3,5-xylyl ester; Methyl-4-dimethylamino-3,5-xylylcarbamate; Methyl-4-dimethylamino-3,5-xylyl ester of carbamic acid; NCI-C00544; OMS-47; Phenol, 4-(dimethylamino)-3,5-dimethyl-methylcarbamate (ester); 3,5-Xylenol, 4-(dimethylamino)-, methylcarbamate; Mexacarbato (Spanish)

Trade Names: DOWCO® 139)[C]; ZACTRAN®; ZECTANE®; ZECTRAN®; ZEXTRAN®

Chemical class: Carbamate (N-methyl)

EPA/OPP PC Code: 044201

California DPR Chemical Code: 623

HSDB Number: 1042

UN/NA & ERG Number: UN2757 (solid)/151

RTECS® Number: FC0700000

EC Number: 206-249-3 [*Annex I Index No.:* 006-054-00-1]

Uses: It is a insecticide and molluscicide for non-agricultural uses, e.g., lawn and turf, flowers, gardens, vines, forest lands, woody shrubs and trees. It is not used commercially in the U.S. Not listed for use in EU countries[115]. There are 14 global suppliers[97].

Fish toxicity (threshold)[101]: Intermediate–31.03658 ppb, MATC (Maximum Acceptable Toxicant Concentration)

Regulatory Authority and Advisory Information:

Carcinogenicity[83]: IARC, Group 3 not classifiable as to its carcinogenicity in human.

Poison (oral) Category: 1, DANGER-POISON

Health Advisory: Nerve Toxin, Tumorigen, Mutagen, Reproductive Toxin

Clean Water Act: Section 311 Hazardous Substances/RQ 40CFR117.3 (same as CERCLA, see below)

EPA Hazardous Waste Number (RCRA No.): P128

RCRA 40CFR268.48; 61FR15654, Universal Treatment Standards: Wastewater (mg/L), 0.056; Non-wastewater (mg/kg), 1.4

Superfund/EPCRA 302 Extremely Hazardous Substances: TPQ = 500/10,000 lb (227/4,540 kg)

Superfund/EPCRA 40CFR302.4 RQ: CERCLA, 1000 lb (454 kg)

U.S. DOT Regulated Marine Pollutant (49CFR172.101, Appendix B)

European/International Regulations: Hazard Symbol: T+, Xn, N; risk phrases: R21; R28; R50/53; safety phrases: S1/2; S36/37; S45; S60; S61 (see Appendix 1)

Description: Mexacarbate is a white to tan crystalline solid. It may be dissolved in a liquid solvent. Odorless. Molecular weight = 222.30; Boiling point = (decomposes); Freezing/Melting point = 85 °C; Vapor pressure = 6×10 ^{6}mmHg @ 25 °C. Hazard Identification (based on NFPA-704 M Rating System): Health 3, Flammability 1, Reactivity 0. Practically insoluble in water.

Incompatibilities: Decomposes (hydrolyzes) in alkaline media. Subject to photo-decomposition in the solid state[IARC]. Carbamates are incompatible with reducing agents, strong acids, oxidizing acids, peroxides, and bases. Contact with active metals or nitrides causes the release of flammable, and potentially explosive, hydrogen gas. May form explosive materials with phosphorus pentachloride.

Permissible Exposure Limits in Air: Protective Action Criteria (PAC) Ver. 27[89]

PAC-1: 1.3 mg/m^3
PAC-2: 14 mg/m^3
PAC-3: 14 mg/m^3

Permissible Concentration in Water: Runoff from spills or fire control may cause water pollution.

Determination in Water: Log K_{ow} = <2.7. Unlikely to bioaccumulate in marine organisms.

Routes of Entry: Inhalation, ingestion, skin, and/or contact. Absorbed through the skin.

Harmful Effects and Symptoms

Short Term Exposure: Extremely toxic: probable oral lethal dose for humans is 5–50 mg/kg; between 7 drops and 1 teaspoonful for a 70 kg person (150 lb). Poisonous; may be fatal if inhaled, swallowed, or absorbed through skin. Contact may cause burns to skin and eyes. Symptoms of carbamate poisoning resemble those of parathion. This material is similar to carbaryl; symptoms of carbaryl exposure include nausea, vomiting, abdominal cramps, diarrhea, excessive salivation, sweating, lassitude and weakness. Runny nose and sensation of tightness in chest may occur with inhalation exposures. Blurring or dimness of vision, tearing, eye muscle spasm, loss of muscle coordination, slurring of speech, and twitching of muscles may also occur. Carbamate insecticides inhibit the cholinesterase activity of enzymes, causing accumulation of acetylcholine at synapses and altering the way in which nervous impulses are transmitted. However, within several hours carbamates spontaneously detach from the enzymes. Acute effects: Narcotic; Cholinesterase toxin; Respiratory toxin, acute effects other than severe or moderate irritation; Eye other than irritation; Brain; Gastrointestinal tract; Nervous system toxin. LD_{50} (oral, rat) = <20 mg/kg; LD_{50} (dermal, rat) = >1500 mg/kg.

Long Term Exposure: Cholinesterase inhibitor; cumulative effect is possible. Mexacarbate may damage the nervous system with repeated exposure, resulting in convulsions, respiratory failure. May cause liver damage. Chronic effects: Developmental/Reproductive Toxin; Liver; Nervous system toxin.

Points of Attack: Respiratory system, lungs, central nervous system, cardiovascular system, skin, eyes, plasma and red blood cell cholinesterase.

Medical Surveillance: Routine biological monitoring of pesticide applicators and field workers includes testing of plasma and red blood cell acetylcholinesterase levels (for enzyme poisoned by this chemical). These tests are normally accurate only if done within about two hours of exposure. If exposure stops, plasma levels return to normal in 1–2 weeks while red blood cell levels may be reduced for 1–3 months. When acetylcholinesterase enzyme levels are reduced by 25% or more below preemployment levels, risk of poisoning is increased, even if results are in lower ranges of "normal." Reassignment to work not involving carbamate pesticides is recommended until enzyme levels recover. Do not drink any alcoholic beverages before or during use. Also consider complete blood count and chest x-ray following acute overexposure.

First Aid: Speed in removing material from eyes and skin is of extreme importance. *Eyes:* Eye contact can cause dangerous amounts of these chemicals to be quickly absorbed through the mucous membrane into the bloodstream. Immediately and gently flush eyes with plenty of warm or cold water (NO hot water) for at least 15 minutes, occasionally lifting the upper and lower eyelids. Get medical aid immediately. *Skin:* Get medical aid. Dermal contact can cause dangerous amounts of these chemicals to be absorbed into the bloodstream. Wearing the appropriate PPE equipment and respirator for carbamate pesticides, immediately flush skin with plenty of soap and water for at least 15 minutes while removing contaminated clothing and shoes. Shampoo hair promptly if contaminated; protect eyes. *Ingestion:* Call poison control. Loosen all clothing. Never give anything by mouth to an unconscious person. Get medical aid. Do NOT induce vomiting.* If conscious, alert, and able to swallow, rinse mouth and have victim drink 4 to 8 ounces of water. Check to see if poison control instructs you to use ipecac syrup, otherwise administer slurry of activated charcoal (2 oz in 8 oz of water). If victim is *UNCONSCIOUS OR HAVING CONVULSIONS,* do nothing except keep victim warm. **In some cases you may be specifically instructed by poison control to induce vomiting by way of 2 tablespoons of syrup of ipecac (adult) washed down with a cup of water.* Do NOT give activated charcoal before or with ipecac syrup. *Inhalation:* Get medical aid. Do not contaminate yourself. Wearing the appropriate PPE equipment and respirator for carbamate pesticides, immediately remove the victim from the contaminated area to fresh air. If the victim is not breathing, administer artificial respiration. Do not use mouth-to-mouth method if victim ingested or inhaled the substance; give artificial respiration with the aid of a pocket mask equipped with a one-way valve or other proper respiratory medical device. If breathing is difficult, administer oxygen through bag/mask apparatus until medical help arrives. Do not leave victim unattended. *Note to physician or authorized medical personnel.* Administer atropine, 2 mg (1/30 gr) intramuscularly or intravenously as soon as any local or systemic signs or symptoms of an intoxication are noted; repeat the administration of atropine every 3 to 8 minutes until signs of atropinization (mydriasis, dry mouth, rapid pulse, hot and dry skin) occur; initiate treatment in children with 0.05 mg/kg of atropine; repeat at 5 to 10 minute intervals. Watch respiration, and remove bronchial secretions if they appear to be obstructing the airway; intubate if necessary. *Medical note:* 2-PAMCI may be contraindicated in the case of some carbamate poisonings.

Personal Protective Methods: Wear protective gloves and clothing to prevent any reasonable probability of dermal and/or eye contact. Safety equipment suppliers/manufacturers can provide recommendations on the most protective glove/clothing material for your operation. DuPont^{TM} Tychem® suit fabrics[88]. All protective clothing (suits, gloves, footwear, headgear) should be clean, available each day, and put on before work. Contact lenses should not be worn when working with this chemical. Wear dust-proof chemical goggles and face shield unless full facepiece respiratory protection is worn. Employees should wash immediately with soap when skin is wet or contaminated. Provide emergency showers and eyewash.

Respirator Selection: *At concentrations above the NIOSH REL, or where there is no REL, at any detectable concentration:* SCBAF:Pd,Pp (APF = 10,000): (any self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode); or SaF:Pd,Pp:ASCBA (APF = 10,000) (any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary self-contained positive-pressure breathing apparatus). *Escape*: GmFOv100 (APF = 50) [any air-purifying, full facepiece respirator (gas mask) with a chin-style, front- or back-mounted organic vapor canister having an N100, R100, or P100 filter]; or SCBAE (any appropriate escape-type, self-contained breathing apparatus).

Storage: Color Code-Blue: Health Hazard/Poison. Store in a secure poison location. Prior to working with this chemical you should be trained on its proper handling and storage. Store in tightly closed containers in a cool, well-ventilated area away from strong alkalis (such as sodium hydroxide, sodium bicarbonate, etc.). Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: This is a solid toxic carbamate and should be labeled "poisonous materials." It falls into Hazard Class 6.1.

Spill Handling: For solids, isolate spill or leak area in all directions for at least 25 meters/75 feet. For liquids, isolate spill or leak area in all directions for at least 50 meters/150 feet. Increase, in the downwind direction, as necessary. Do not touch damaged containers or spilled material unless wearing appropriate protective clothing. Stop leak if you can do it without risk. Prevent entry into waterways, sewers, basements or confined areas. Cover with plastic sheet to prevent spreading. Absorb or cover with dry earth, sand or other non-combustible material and transfer to containers. Do not allow water to get inside containers.

Fire Extinguishing: Hazardous decomposition includes oxides of nitrogen and carbon. *On small fire:* use dry chemical powder, carbon dioxide, water spray, or foam. *On large fire:* use water spray, fog or alcohol resistant foam. Do not scatter material using straight water jet streams. Dike fire-control water for later disposal; do not scatter the material. Move containers from fire area if you can do it without risk. *Fire involving storage or vehicular tanks:* isolate for 800 meters/0.5 mile in all directions; also, consider initial evacuation for 800 meters/0.5 mile in all directions. Fight fire from maximum distance or use unmanned hose holders or monitor nozzles. Do not allow water to get inside containers. Cool containers with flooding quantities of water until well after fire is out. Withdraw immediately in the case of rising sound from venting safety devices or discoloration of tank. *Always* stay away from tanks engulfed in fire. For massive fire, use unmanned hose holders or monitor nozzles; if this is impossible, withdraw from area and let fire burn.

Disposal Method Suggested: Do not discharge into drains or sewers. Dispose of waste material as hazardous waste using a licensed disposal contractor to an approved landfill. Consult with environmental regulatory agencies for guidance on acceptable disposal practices. Generators of waste containing this contaminant (≥100 kg/mo) must conform with EPA regulations governing storage, transportation, treatment, and waste disposal. If allowed, incineration with effluent gas scrubbing is recommended. Containers must be disposed of properly by following package label directions or by contacting your local or federal environmental control agency, or by contacting your regional EPA office.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- USEPA, "Chemical Profile: Mexacarbate," Washington DC, Chemical Emergency Preparedness Program (Nov.30, 1987)
- New Jersey Department of Health and Senior Services, "Hazardous Substance Fact Sheet, Mexacarbate." Trenton, NJ (December 1999). http://www.state.nj.us/health/eoh/rtkweb/1304.pdf

Molinate M:1405

Use Type: Herbicide

CAS Number: 2212-67-1

Formula: $C_9H_{17}NOS$

Synonyms: 1*H*-Azepine-1-carbothioic acid, hexahydro-*S*-ethyl ester; Carbamic acid, hexamethylenethio-, *S*-ethyl ester; Carbamothioic acid, *N,N*-hexamethylene-, *S*-ethyl ester; Caswell No. 44; *S*-Ethyl azepane-1-carbothioate; *S*-Ethyl ester hexahydro-1*H*-azepine-1-carbothioioate; *S*-Ethyl hexahydro-1*H*-azepine-1-carbothioate; *S*-Ethyl hexahydro-1-carbothioic; ethyl 1-hexamethyleneiminecarbothiolate; *S*-Ethyl 1-hexamethyleneiminothiocarbamate; *S*-Ethyl *N,N*-hexamethyleneiminothiocarbamate; *S*-Ethyl *N*-hexamethyleneiminothiocarbamate; *S*-Ethyl perhydroazepin-1-carbothioate;*S*-Ethylperhydroazepine-1-thiocarboxylate

Trade Names: ARROSOLO®; FELAN®; HIGALNATE®; HYDRAM®; JALAN®; MALERBANE-GIAVONI-L®; ORDAM®; ORDRAM®; R-4572®; RICECO; SAKKIMOL®; STAUFFER R 4,572®; YALAN®; YULAN®

Chemical class: Thiocarbamate

EPA/OPP PC Code: 041402

California DPR Chemical Code: 449

HSDB Number: 873

UN/NA & ERG Number: UN2902/151

RTECS® Number: CM2625000

EC Number: 218-661-0 [*Annex I Index No.:* 613-051-00-4]

Uses: Molinate is a selective herbicide used on rice for the control of water grass and other weeds.

U.S. Maximum Allowable Residue Levels for Molinate (40 CFR 180.228): rice and rice straw 0.1 ppm.

Human toxicity (long-term)[101]: High–1.40 ppb, Health Advisory

Fish toxicity (threshold)[101]: Very low–568.94463 ppb, MATC (Maximum Acceptable Toxicant Concentration)

Regulatory Authority and Advisory Information:

Carcinogenicity[83]: EPA, Suggestive evidence of carcinogenicity, but not sufficient to assess human potential; EU GHS Category 2: Suspected human carcinogen

Health Advisory: Nerve Toxin, Mutagen, Developmental/Reproductive Toxin (TRI)

Acute Oral Category: 4, Caution, not acutely toxic

Potential Ground Water Pollutant [California FAC Section 13145(d)/12811, inactive)

EPA Hazardous Waste Number (RCRA No.): U365

RCRA Universal Treatment Standards: Wastewater (mg/L), 0.003; Non-wastewater (mg/kg), 1.4

EPCRA Section 313 Form R *de minimis* concentration reporting level: 1.0%

European/International Regulations: Hazard Symbol: Xn, Xi, N; risk phrases: R20/22; R36/38; R40; R43; R48/22; R50/53; R63; safety phrases: S2; S36/37; S46; S60; S61 (see Appendix 1)

Description: Clear or amber liquid. Aromatic, spicy odor. Molecular weight = 187.32; Specific gravity (H_2O:1) = 1.065 @ 20 °C; 1.5156 @ 30 °C; Boiling point = 202 °C @ 10 mm; Freezing/Melting point = –25 °C; Vapor pressure = 5.7×10^{3} mmHg @ 25 °C; Flash point = >140 °C. Soluble in water; solubility = 970 mg/L @ 21 °C.

Incompatibilities: Reacts violently with powerful oxidizers such as calcium hypochlorite. Photosensitivity; unstable in light. Stable at temperatures <200 °C. Corrosive to black iron, drum steel, stainless steel 304 and brass, but not to glass, aluminum, or stainless steel 316. Flammable gases are generated by the combination of thiocarbamates with aldehydes, nitrides, and hydrides. Thiocarbamates are incompatible with acids, peroxides, and acid halides.

Permissible Concentration in Water: State Drinking Water Standards: California 20 μg/L; State Drinking Water Guidelines: Florida 14 μg/L. Runoff from spills or fire control may cause water pollution.

Determination in Water: Log K_{ow} = >3.0. Values above 3.0 are likely to bioaccumulate in marine organisms.

Harmful Effects and Symptoms

Short Term Exposure: Some thiocarbamates may react with recently ingested alcohol or alcohol-containing products including wine, medications, and cold remedies such as cough-syrups. Concentrated solutions are slightly corrosive to eyes and mucous membranes. Dust inhalation can cause irritation of the respiratory system with sneezing. Eye contact can cause irritation, watering, pain, and inflammation of the eyelids. Dermal contact can cause irritation and minor ulceration. Ingestion can cause nausea, vomiting, fever, muscle twitching, seizure, rapid respiration, slow heart beat. Severe exposure may cause respiratory failure, resulting in death. LD_{50} (oral, rat) = 350–450 mg/kg; (dermal, rat) = >5000 mg/kg.

Long Term Exposure: Cholinesterase inhibitor; cumulative effect is possible. This chemical may damage the nervous system with repeated exposure, resulting in convulsions, respiratory failure. May cause liver damage. May cause personality changes with depression, anxiety, irritability.

Points of Attack: Respiratory system, central nervous system, cardiovascular system, skin, eyes.

Medical Surveillance: Preliminary medical exam to detect chronic diseases of central nervous system, liver, heart, kidneys, lung and skin, as well as endocrinological or immunological disturbances, should protect susceptible individuals. Periodical medical exams of internal organs, skin and eyes are important to avoid chronic occupational intoxications. They should include lab and patch tests when necessary[83]. Medical observation is recommended for 24 to 48 hours following breathing overexposure, as pulmonary edema may be delayed. Cigarette smoking may exacerbate pulmonary injury and should be discouraged for at least 72 hours following exposure. Before employment and at regular times after that, the following are recommended: If symptoms develop or overexposure occurs, repeat the above tests as soon as possible and get an exam of the nervous system. Also consider complete blood count and chest x-ray following acute overexposure. Evaluation by a qualified allergist, including exposure history and testing, may help diagnose allergy.

First Aid: If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least 15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately. If this chemical contacts the skin, remove contaminated clothing and wash immediately with soap and water. Seek medical attention immediately. If this chemical has been inhaled, remove from exposure, begin rescue breathing (using universal precautions) if breathing has stopped, and CPR if heart action has stopped. Transfer promptly to a medical facility. When this chemical has been swallowed, get medical attention. If victim is conscious and able to swallow, have victim drink 4 to 8 ounces of water. Do not induce vomiting. *Note to physician or authorized medical personnel*: Medical observation is recommended for 24 to 48 hours following breathing overexposure, as pulmonary edema may be delayed. As first aid for pulmonary edema, a doctor or authorized paramedic might consider administering a corticosteroid spray. Cigarette smoking may exacerbate pulmonary injury and should be discouraged for at least 72 hours following exposure.

Personal Protective Methods: Reacts with the following absorbent materials: Cellulose-Based; Mineral- and Clay-Based; Dirt/Earth[88]. Wear protective gloves and clothing to prevent any reasonable probability of dermal and/or eye contact. Safety equipment suppliers/manufacturers can provide recommendations on the most protective glove/clothing material for your operation. All protective clothing (suits, gloves, footwear, headgear) should be clean, available each day, and put on before work. Contact lenses should not be worn when working with this chemical. Wear splash-proof chemical goggles and face shield unless full facepiece respiratory protection is worn. Employees should wash immediately with soap when skin is wet or contaminated. Provide emergency showers and eyewash.

Respirator Selection: Wherever and whenever workplace conditions warrant respirator use, a respiratory protection program must be followed that meets one or more of the following government standards: OSHA's 29 CFR 1910.134, ANSI Z88.2, or European Standard EN 149.

Storage: Color Code-Blue: Health Hazard/Poison. Store in a dark, secure poison location. Prior to working with this chemical you should be trained on its proper handling and storage. Store in tightly closed containers in a cool, well-ventilated area away from strong alkalis (such as sodium hydroxide, sdium bcarbonate, etc.). Stable when stored in glass or polyethylene containers. Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: Pesticides, liquid, toxic, n.o.s., require a shipping label of "poisonous materials." This material falls in DOT Hazard Class 6.1. Technical name required.

Spill Handling: For solids, isolate spill or leak area in all directions for at least 25 meters/75 feet. For liquids, isolate spill or leak area in all directions for at least 50 meters/150 feet. Increase, in the downwind direction, as necessary. Do not touch damaged containers or spilled material unless wearing appropriate protective clothing. Stop leak if you can do it without risk. Prevent entry into waterways, sewers, basements or confined areas. Cover with plastic sheet to prevent spreading. Absorb or cover with dry earth, sand or other non-combustible material and transfer to containers. Do not allow water to get inside containers.

Fire Extinguishing: Hazardous decomposition includes oxides of nitrogen, sulfur, and carbon. *On a small fire:* use dry chemical, CO_2 or water spray. *On a large fire:* use water spray, fog or regular foam. Move containers from fire area if you can do it without risk. Dike fire-control water for later disposal; do not scatter the material. Use water spray or fog; do not use straight streams. *Fire involving storage or vehicular tanks:* isolate for 800 meters/0.5 mile in all directions; also, consider initial evacuation for 800 meters/0.5 mile in all directions. Fight fire from maximum distance or use unmanned hose holders or monitor nozzles. Do not get water inside containers. Cool containers with flooding quantities of water until well after fire is out. Withdraw immediately in the case of rising sound from venting safety devices or discoloration of tank. ALWAYS stay away from tanks engulfed in fire. For massive fire, use unmanned hose holders or monitor nozzles; if this is impossible, withdraw from area and let fire burn. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies.

Disposal Method Suggested: Do not discharge into drains or sewers. Dispose of waste material as hazardous waste using a licensed disposal contractor to an approved landfill. Consult with environmental regulatory agencies for guidance on acceptable disposal practices. Generators of waste containing this contaminant (≥100 kg/mo) must conform with EPA regulations governing storage, transportation, treatment, and waste disposal. If allowed, incineration with effluent gas scrubbing (carbon dioxide may be released) is recommended. Containers must be disposed of properly by following package label directions or by contacting your local or federal environmental control agency, or by contacting your regional EPA office.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- USEPA, Office of Pesticide Programs, Pesticide Residue Limits, "Molinate," ***40 CFR 180.228***. http://www.epa.gov/pesticides/food/viewtols.htm
- EXTOXNET, Extension Toxicology Network, "Pesticide Information Profile, Molinate," Oregon State University, Corvallis, OR (June 1996). http://ace.orst.edu/cgi-bin/mfs/01/pips/molinate.htm

Myclobutanil M:1470

Use Type: Fungicide

CAS Number: 88671-89-0

Formula: $C_{15}H_{17}ClN_4$

Synonyms: α-Butyl-α-(4-chlorophenyl)-1*H*-1,2,4-triazole-1-propanenitrile; Caswell No. 723 K; 2-(4-Chlorophenyl)-2-(1*H*-1,2,4-triazole-1-ylmethyl)hexanenitrile; 2-*p*-Chlorophenyl-2-(1*H*-1,2,4-triazole-1-ylmethyl)hexanenitrile; 1*H*-1,2,4-Triazole-1-propanenitrile, α-butyl-α-(4-chlorophenyl)

Trade Names: EAGLE®; NOVA®; NU-FLOW®; RALLY®; LAREDO®; RH 3866®; SYSTHANE® TECHNICAL

Chemical class: Azole; Triazole

EPA/OPP PC Code: 128857

California DPR Chemical Code: 2245

HSDB Number: 6708

UN/NA & ERG Number: UN3082 (liquid)/171

RTECS® Number: XZ5257000

EC Number: 410-400-0

Uses: Widely used to control powdery mildew, rust, sclerotina, spot blight, rot, black rot and similar fungi on a variety of food and non-food crops.

U.S. Maximum Allowable Residue Levels for Myclobutanil [40 CFR 180.443(a)]: almond 0.1 ppm; almond, hulls 2.0 ppm; apple 0.5 ppm; apple, dry pomace 5.0 ppm; apple, wet pomace 5.0 ppm; asparagus 0.02 ppm; banana, postharvest 4.0 ppm; bean, snap, succulent 1.0 ppm; caneberry subgroup 13A, 2.0 ppm; cattle, fat 0.05 ppm; cattle, liver 1.0 ppm; cattle, meat 0.1 ppm; cattle, meat byproducts, except liver 0.02 ppm; cherry, sweet 5.0 ppm; cherry, tart 5.0 ppm; cotton, undelinted seed 0.02 ppm; currant 3.0 ppm; egg 0.02 ppm; fruit, stone (except cherry) 2.0 ppm; goat, fat 0.05 ppm; goat, liver 1.0 ppm; goat, meat 0.1 ppm; goat, meat byproducts, except liver 0.2 ppm; gooseberry 2.0 ppm; grain, aspirated fractions 35 ppm; grape pomace (wet and dry) 10.0 ppm; grape 1.0 ppm; grape, raisin 10.0 ppm; grape, raisin, waste 25.0 ppm; hog, fat 0.05 ppm; hog, liver 1.0 ppm; hog, meat 0.1 ppm; hog, meat byproducts, except liver 0.2 ppm; hop, dried cones 10 ppm; horse, fat 0.05 ppm; horse, liver 1.0 ppm; horse, meat 0.1 ppm; horse, meat byproducts, except liver 0.2 ppm; mayhaw 0.70 ppm; milk 0.2 ppm; peppermint, tops 3.0 ppm; plum, prune, dried 8.0 ppm; poultry, fat 0.02 ppm; poultry, meat 0.02 ppm; poultry, meat byproducts 0.02 ppm; sheep, fat 0.05 ppm; sheep, liver 1.0 ppm; sheep, meat 0.1 ppm; sheep, meat byproducts, except liver 0.2 ppm; soybean, forage 3.5 ppm; soybean, hay 15 ppm; soybean, refined oil 0.40 ppm; soybean, seed 0.25 ppm; spearmint, tops 3.0 ppm; strawberry 0.50 ppm; tomato 0.30 ppm; tomato, puree 0.50 ppm; tomato, paste 1.0 ppm; vegetable, cucurbit, group 9, 0.20 ppm; ***[40 CFR 180.443(d)]:*** Animal feed, nongrass, group 18, 0.03 ppm; grain, cereal, forage, fodder and straw, group 16, 0.03 ppm; grain, cereal, group 15, 0.03 ppm; vegetable, brassica, leafy, group 5, 0.03 ppm; vegetable, foliage of legume, group 7, 0.03 ppm; vegetable, fruiting, group 8, 0.03 ppm; vegetable, leafy, except brassica, group 4, 0.03 ppm; vegetable, leaves of root and tuber, group 2, 0.03 ppm; vegetable, legume, group 6, 0.03 ppm; vegetable, root and tuber, group 1, 0.03 ppm.

Regulatory Authority and Advisory Information:

Carcinogenicity[83]: EPA Group E, evidence of non-carcinogenicity for human

California Proposition 65 Chemical: Developmental/Reproductive toxin (male)

Health Advisory: Developmental/Reproductive Toxin

Acute Oral Category: 3, CAUTION (human, fatal >30 gm)

EPCRA Section 313 Form R *de minimis* concentration reporting level: 1.0%

European/International Regulations: Hazard Symbol: Xi, Xn, N; risk phrases: R22; R36; R50/53; R63; safety phrases: S2; S26; S36/37; S46; S60; S61 (see Appendix 1)

Description: White to pale yellow crystalline solid. Molecular weight = 288.78; Specific gravity (H_2O:1) = 1.24; Boiling point = 391 °C; 465 °C; Freezing/Melting point = 65 °C; Vapor pressure = 10^{8} mmHg @ 25 °C; Vapor pressure = 1.57×10^{6} mmHg @ 0 °C; Flash point = 235 °C. Soluble in water; solubility = 142 mg/L @ 25 °C.

Incompatibilities: Decomposes on exposure to strong light. Incompatible with oxidizers. The triazoles are sensitive to heat, friction, and impact. Sensitivity varies with the type substitution to the triazole ring. Metal chelated and halogen substitution of the triazol ring make for a particularly heat sensitive material. Azido and nitro derivatives have been employed as high explosives. No matter the derivative these materials should be treated as explosives[88].

Permissible Concentration in Water: Runoff from spills or fire control may cause water pollution.

Determination in Water: Method: USGS-NWQL O-2002-01; Procedure: gas chromatography/mass spectrometry; Matrix: filtered natural-water; Detection limit: 0.0011 μg/L. Log K_{ow} = >2.5. Values above 3.0 are likely to bioaccumulate in aquatic organisms.

Routes of Entry: Ingestion, inhalation, dermal and eye contact.

Harmful Effects and Symptoms

Short Term Exposure: Corrosive. Causes irreversible eye damage. Harmful when inhaled, swallowed, or absorbed through skin. Poisonous if swallowed. Contact may irritate skin and cause eye irritation and possible severe injury. Avoid inhalation. LD_{50} (oral, rat) = 1600 mg/kg; (dermal, rat) = >2 g/kg.

Long Term Exposure: Evidence of reproductive and developmental effects.

Points of Attack: Eyes, skin. This chemical may damage the male reproductive glands.

Medical Surveillance: Comprehensive physical examination with emphasis on the genito-urinary tract analysis to include sperm count, motility and morphology. Other tests, such as serum testosterone, serum follicle stimulating hormone (FSH), and serum lutenizing hormone (LH), may be carried out if, in the opinion of a physician, they are indicated. Production of effects on the reproductive system.

First Aid: If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least 15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately. If this chemical contacts the skin, remove contaminated clothing and wash immediately with soap and water. If this chemical has been inhaled, remove from exposure, begin rescue breathing (using universal precautions) if breathing has stopped, and CPR if heart action has stopped. Transfer promptly to a medical facility. When this chemical has been swallowed, get medical attention. Give large quantities of water and induce vomiting. Do not make an unconscious person vomit.

Personal Protective Methods: Wear positive-pressure self-contained breathing apparatus (SCBA). Wear chemical protective clothing that is specifically recommended by the manufacturer. DuPont™ Tychem® Suit Fabrics is recommended by one government source[88]. It may provide little or no thermal protection. Structural firefighters' protective clothing provides limited protection in fire situations ONLY; it is not effective in spill situations where direct contact with the substance is possible.

Respirator Selection: Where the neat (undiluted) test chemical is weighed and diluted, wear a NIOSH-approved half-face respirator equipped with a combination filter cartridge, i.e. organic vapor/acid gas/HEPA (specific for organic vapors, HCl, acid gas, SO_2 and a high-efficiency particulate filter)[88]. Wherever and whenever workplace conditions warrant respirator use, a respiratory protection program must be followed that meets one or more of the following government standards: OSHA's 29 CFR 1910.134, ANSI Z88.2, or European Standard EN 149.

Storage: Color Code-White: Corrosive or Contact Hazard; Store separately in a corrosion-resistant location. Prior to working with this chemical you should be trained on its proper handling and storage. Store in tightly closed containers in a cool, well-ventilated area. Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: This material may be classified as Environmentally hazardous substances, liquid or solid, n.o.s. It usually falls in Hazard Class 9.

Spill Handling: For solids, isolate spill or leak area in all directions for at least 25 meters/75 feet. Increase, in the downwind direction, as necessary. First remove all sources of ignition. Evacuate persons not wearing protective equipment from area of spill or leak until clean up is complete. Do not touch damaged containers or spilled material unless wearing appropriate protective clothing. Stop leak if you can do it without risk. Prevent entry into waterways, sewers, basements or confined areas. Cover with plastic sheet to prevent spreading. Absorb or cover with dry earth, sand or other non-combustible material and transfer to containers. If you spill this chemical, you should dampen the solid spill material with water, then transfer the dampened material to a suitable container. Use absorbent paper dampened with water to pick up any remaining material. Seal your contaminated clothing and the absorbent paper in a vapor-tight plastic bag for eventual disposal. Wash all contaminated surfaces with a soap and water solution. Do not reenter the contaminated area until the Safety Officer (or other responsible person) has verified that the area has been properly cleaned. Do not allow water to get inside containers. Ventilate area after clean up is complete. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable.

Fire Extinguishing: See "Incompatibilities" section. Hazardous decomposition includes toxic oxides of nitrogen and hydrogen chloride gas. As an immediate precautionary measure, isolate spill or leak area in all directions for at least 50 meters/150 feet for liquids and at least 25 meters/75 feet for solids. *Fire involving storage or vehicular tanks:* isolate for 800 meters/0.5 mile in all directions;

also, consider initial evacuation for 800 meters/0.5 mile in all directions. *On a small fire:* use dry chemical, CO_2, water spray or regular foam. *On a large fire:* use water spray, fog or regular foam. Do not scatter spilled material with high-pressure streams of water. Move containers from fire area if you can do it without risk. Dike fire-control water for later disposal. *Fire involving tanks:* from a secure, explosion-proof location, use water spray to cool exposed containers. If cooling streams are ineffective (venting sound increases in volume and pitch, tank discolors, or shows any signs of deforming), withdraw immediately to a secure position. Always stay away from tanks engulfed in fire. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode.

Disposal Method Suggested: Consult with environmental regulatory agencies for guidance on acceptable disposal practices. Contact a licensed disposal facility about surplus and non-recyclable solutions. Burn in a chemical incinerator equipped with an afterburner and scrubber. Extra care must be exercised as the material in an organic solvent is highly flammable. In accordance with 40CFR165, follow recommendations for the disposal of pesticides and pesticide containers. Containers must be disposed of properly by following package label directions or by contacting your local or federal environmental control agency, or by contacting your regional EPA office. Incineration or permanganate oxidation.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- USEPA, Office of Pesticide Programs, Pesticide Residue Limits, “Myclobutanil,” ***40 CFR 180.443***. http://www.epa.gov/pesticides/food/viewtols.htm

N

Nabam N:0050

Use Type: Fungicide, Algaecide, Herbicide, Microbiocide
CAS Number: 142-59-6
Formula: $C_4H_6N_2Na_2S_4$
Synonyms: Carbamodithioic acid, 1,2-ethanediylbis-, disodium salt; Carbamic acid, ethylenebis (dithio-), disodium salt; Disodium ethylenebis(dithiocarbamate); DSE; EBDC, disodium salt; EBDC, Sodium salt; 1,2-ethanediylbis(carbamodithioic acid), disodium salt; Ethylenebis(dithiocarbamic acid), disodium salt; Nabame; Nabasam (obsolete)
Trade Names: AMA-30®, Kemira Chemical (Finland); CAMBELL'S® NABAM SOIL FUNGICIDE; CARBON D®; NALCO D-62C44®; CHEM-BAM®; DITHANE A-40®; DITHANE A-46®; DITHANE D-14®[C]; NAFUN-IPO®; NALCO® D-62C44; PARZATE®; SPRING-BAK®
Chemical class: Dithiocarbamate
EPA/OPP PC Code: 014503
California DPR Chemical Code: 417
HSDB Number: 1170
UN/NA & ERG Number: UN3077(solid)/171; UN2771 (solid)/151
RTECS® Number: FA6825000
EC Number: 205-547-0 [*Annex I Index No.:* 006-014-00-3]
Uses: Nabam is a broad-spectrum fungicide/bactericide/algaecide used to prevent crop damage by fungi, to protect harvested products from deterioration, and as an industrial microbiocide. As a result of the U.S. EPA review of nabam in 1989, all food uses were voluntarily canceled by the manufacturers except for one FDA-regulated food use on sugar mill grinding, crusher and/or diffuser systems, e.g., processing water systems. Registered only for non-food application. Not approved for use in EU countries[115]. Registered for use in the U.S. and Canada.

Regulatory Authority and Advisory Information:
California Proposition 65 Chemical: Developmental/Reproductive toxin (3/30/1999)
Acute Oral Category: 2, WARNING
Health Advisory: Mutagen, Developmental/Reproductive Toxin
47 FR 47669 (10/27/82); 54 FR 50020 (12/04/89); (55 FR 7935 (03) 06/90) [Environmental Protection]
California Chemical List of Lists (February 1997)
EPA Hazardous Waste Number (RCRA No.): U114
EPCRA Section 313 Form R *de minimis* concentration reporting level: 1.0%
Marine pollutant (49CFR, Subchapter 172.101, Appendix B)
European/International Regulations: Hazard Symbol: Xi, Xn, N; risk phrases: R22; R37; R43; R50/53; safety phrases: S2; S8; S24/26; S46; S60; S61 (see Appendix 1)

Description: Colorless crystalline solid (when pure). Light amber crystalline solid or 22% wettable powder solution. Slight odor of sulfide. Molecular weight = 256.34; Specific gravity (H_2O:1) = 1.14 @ 20 °C; Boiling point = (decomposes); Freezing/Melting point = decomposes before melting @ 196 °C; Vapor pressure = very low; negligible. Hazard Identification (based on NFPA-704 M Rating System): Health Hazards (Blue): 2; Flammability (Red): 0; Reactivity (Yellow): 0. Molecular weight = 256.34; Boiling point = decomposes; Freezing/Melting point = decomposes when heated, without melting; Specific gravity: 1.14 @ 20 °C (solid). Highly soluble in water; solubility = $>2\times10^5$ mg/L.
Incompatibilities: Combustible material. Dust may form explosive mixture in air. Water, acid, oxidizing materials. Heat, or contact with moisture or acids causes rapid decomposition and the generation of toxic and flammable hydrogen sulfide and carbon disulfide. Flammable gases are generated by reaction with aldehydes, nitrides, and hydrides. Incompatible with oxidizers including peroxides, acids, acid halides, mercury[88]. Corrosive to iron, copper brass and zinc metals, especially in the presence of moisture. Heat alkalies (lime), moisture can cause decomposition. Decomposes on prolonged storage; by moisture, light, and heat. Degradation produces ethylene thiourea.
Determination in Water: EPA EMSLC Method 630. The Determination of Dithiocarbamate Pesticides in Municipal and Industrial Wastewater by UV-VIS Spectrophotometry. Log K_{ow} = Negative; dissociates in water –4.24 (est)[83]. Unlikely to bioaccumulate in marine organisms.

Harmful Effects and Symptoms
Short Term Exposure: Low levels of toxicity. Concentrated solutions are slightly corrosive to eyes and mucous membranes. Dust inhalation can cause irritation of the respiratory system with sneezing. Eye contact can cause irritation, watering, pain, and inflammation of the eyelids. Dermal contact can cause irritation and minor ulceration. Ingestion can cause nausea, vomiting, fever, muscle twitching, seizure, rapid respiration, slow heart beat. Severe exposure may result in death. Unlike carbamates the dithiocarbamates are not cholinesterase inhibitors, but some of them may react with recently ingested alcohol or alcohol-containing products including wine, medications, and cold remedies such as cough-syrups. Exposure may cause skin sensitization. LD_{50} (oral, rat) = 395 mg/kg[86]; 1400 mg/kg[83].
Long Term Exposure: Evidence of reproductive and developmental effects. May cause skin sensitization.
Points of Attack: Respiratory system, central nervous system, cardiovascular system, skin, eyes. Repeated or prolonged contact with skin may result in dermatitis (red inflamed skin).

Medical Surveillance: Comprehensive physical examination with emphasis on the genito-urinary tract analysis to include sperm count, motility and morphology. Other tests, such as serum testosterone, serum follicle stimulating hormone (FSH), and serum lutenizing hormone (LH), may be carried out if, in the opinion of a physician, they are indicated. Production of effects on the reproductive system. Medical observation is recommended for 24 to 48 hours following breathing overexposure, as pulmonary edema may be delayed. Cigarette smoking may exacerbate pulmonary injury and should be discouraged for at least 72 hours following exposure. Before employment and at regular times after that, the following are recommended: If symptoms develop or overexposure occurs, repeat the above tests as soon as possible and get an exam of the nervous system. Also consider complete blood count and chest x-ray following acute overexposure. Evaluation by a qualified allergist, including exposure history and testing, may help diagnose allergy.

First Aid: If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least 15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately. If this chemical contacts the skin, remove contaminated clothing and wash immediately with soap and water. Seek medical attention immediately. If this chemical has been inhaled, remove from exposure, begin rescue breathing (using universal precautions) if breathing has stopped, and CPR if heart action has stopped. Transfer promptly to a medical facility. When this chemical has been swallowed, get medical attention. If victim is conscious and able to swallow, have victim drink 4 to 8 ounces of water. Do not induce vomiting. *Note to physician or authorized medical personnel*: Medical observation is recommended for 24 to 48 hours following breathing overexposure, as pulmonary edema may be delayed. As first aid for pulmonary edema, a doctor or authorized paramedic might consider administering a corticosteroid spray. Cigarette smoking may exacerbate pulmonary injury and should be discouraged for at least 72 hours following exposure.

Personal Protective Methods: Reacts with the following absorbent materials: Cellulose-Based; Mineral- and Clay-Based; Dirt/Earth[88]. Wear protective gloves and clothing to prevent any reasonable probability of dermal and/or eye contact. Safety equipment suppliers/manufacturers can provide recommendations on the most protective glove/clothing material for your operation. All protective clothing (suits, gloves, footwear, headgear) should be clean, available each day, and put on before work. Contact lenses should not be worn when working with this chemical. Wear splash-proof chemical goggles and face shield unless full facepiece respiratory protection is worn. Employees should wash immediately with soap when skin is wet or contaminated. Provide emergency showers and eyewash. As first aid for pulmonary edema, a doctor or authorized paramedic might consider administering a corticosteroid spray.

Respirator Selection: *At any detectable concentration:* SCBAF: Pd,Pp (APF = 10,000) (any NIOSH/MSHA- or European Standard EN 149-approved self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode); or SaF: Pd,Pp: ASCBA (APF = 10,000) (any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary, self-contained breathing apparatus operated in a pressure-demand or other positive- pressure mode). *Escape:* 100F (APF = 50) (any air-purifying, full facepiece respirator with an N100, R100, or P100 filter k-mounted organic vapor canister having a high-efficiency particulate filter); or SCBAE (any appropriate escape-type, self-contained breathing apparatus).

Storage: Color Code-Blue: Health Hazard/Poison: Store in a tightly closed container in a dry, well-ventilated and secure poison location. Prior to working with this chemical you should be trained on its proper handling and storage. Where possible, automatically transfer material from other storage containers to process containers. Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: Thiocarbamate and dithiocarbamate pesticides, solid, toxic require a label of "poisonous materials." They usually fall in Hazard Class 6.1.

Spill Handling: First remove all sources of ignition. Evacuate persons not wearing protective equipment from area of spill or leak until clean up is complete. Collect powdered material in the most convenient and safe manner and deposit in sealed containers. Ventilate area after clean up is complete. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable.

Fire Extinguishing: Hazardous decomposition includes oxides of nitrogen, carbon, and sulfur. As an immediate precautionary measure, isolate spill or leak area in all directions for at least 50 meters/150 feet for liquids and at least 25 meters/75 feet for solids. *Fire involving storage or vehicular tanks:* isolate for 800 meters/0.5 mile in all directions; also, consider initial evacuation for 800 meters/0.5 mile in all directions. *On a small fire:* use dry chemical, CO_2, water spray or regular foam. *On a large fire:* use water spray, fog or regular foam. Do not scatter spilled material with high-pressure streams of water. Move containers from fire area if you can do it without risk. Dike fire-control water for later disposal. *Fire involving tanks:* from a secure, explosion-proof location, use water spray to cool exposed containers. If cooling streams are ineffective (venting sound increases in volume and pitch, tank discolors, or shows any signs of deforming), withdraw immediately to a secure position. Always stay away from tanks engulfed in fire. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode.

Disposal Method Suggested: Do not discharge into drains or sewers. Dispose of waste material as hazardous waste using a licensed disposal contractor to an approved landfill. Consult with environmental regulatory agencies for guidance on acceptable disposal practices. Generators of waste containing this contaminant (≥100 kg/mo) must conform with EPA regulations governing storage, transportation, treatment, and waste disposal. A potential candidate for liquid injection incineration at a temperature range of 650 to 1,600 °C and a residence time 0.1 to 2 seconds. Also, a potential candidate for rotary kiln incineration at a temperature range of 820 to 1,600 °C and residence times of seconds for liquids and gases, and hours for solids[83].

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- USEPA, "Reregistration Eligibility Decision (RED), Nabam," Office of Prevention, Pesticides and Toxic Substances, Washington DC (January 1996). http://www.epa.gov/REDs/0641.pdf

Naled N:0100

Use Type: Insecticide, Fungicide, Bactericide, Acaricide

CAS Number: 300-76-5

Formula: $C_4H_7Br_2Cl_2O_4P$

Synonyms: BRP; 1,2-Dibromo-2,2-dichloroethyl dimethyl phosphate; *O,O*-dimethyl-*O*-(1,2-dibromo-2,2- dichloroethyl)phosphate; Dimethyl 1,2-dibromo-2,2-dichloroethyl phosphate; *O,O*-Dimethyl *O*-2,2-dichloro-1,2-dibromoethyl phosphate; ENT 24,988; Ethanol, 1,2-dibromo-2,2-dichloro-, dimethyl phosphate; OMS 75; Phosphoric acid, 1,2-dibromo-2,2-dichloroethyl dimethyl ester

Trade Names: AI3-24988®; ARTHODIBROM®; BROMCHLOPHOS®; BROMEX®; DIBROM®; FLYKILLER®; LUCANAL®; HIBROM®; ORTHO® 4355; ORTHODIBROM®; ORTHODIBROMO®; PROKIL® Naled; TRUMPET®

Chemical class: Organophosphate

EPA/OPP PC Code: 034401

California DPR Chemical Code: 418

HSDB Number: 1148

UN/NA & ERG Number: UN3018 (liquid)/152; UN2783 (solid)/152

RTECS® Number: TB9450000

EC Number: 206-098-3 [*Annex I Index No.:* 015-055-00-6]

Uses: Naled is a fast-acting, nonsystemic contact and stomach insecticide used to control aphids, mites, mosquitoes, and flies on crops and in greenhouses, mushroom houses, animal and poultry houses, kennels, food-processing plants, and aquaria and in outdoor mosquito control. Liquid formulations can be applied to greenhouse heating pipes to kill insects by vapor action. It has been used by veterinarians to kill parasitic worms (other than tapeworms) in dogs. Naled may no longer be used in and around the home by residents or professional applicators. Naled is available in dust, emulsion concentrate, liquid, and ULV formulations. Also used in cooling towers, veterinary medicine, pulp and paper mill systems, hospitals, swimming pools, and bathrooms. A U.S. EPA restricted Use Pesticide (RUP). Not approved for use in EU countries[115]. Registered for use in the U.S.

U.S. Maximum Allowable Residue Levels for Naled and its conversion product 2,2-dichlorovinyl dimethyl phosphate, expressed as naled, resulting from the application of the pesticide to growing crops or from direct application to livestock and poultry [40 CFR 180.215 (a) (1)]: in or on the following raw agricultural commodities: almond, hulls 0.5 ppm; almond 0.5 ppm; bean (dry) 0.5 ppm; bean, succulent 0.5 ppm; beet, sugar, roots 0.5 ppm, beet, sugar, tops 0.5 ppm; broccoli 1 ppm; Brussels sprouts 1 ppm; cabbage 1 ppm; cauliflower 1 ppm; celery 3 ppm; collards 3 ppm; cotton, undelinted seed 0.5 ppm; cucumber 0.5 ppm; eggplant 0.5 ppm; grapefruit 3 ppm; grape 0.5 ppm; grass, forage 10 ppm; hop 0.5 ppm; kale 3 ppm; legume, forage 10 ppm; lemon 3 ppm; lettuce 1 ppm; melon 0.5 ppm; orange, sweet 3 ppm; peach 0.5 ppm; pea (succulent) 0.5 ppm; pepper 0.5 ppm; pumpkin 0.5 ppm; safflower, seed 0.5 ppm; spinach 3 ppm; squash, summer 0.5 ppm; squash, winter 0.5 ppm; strawberry 1 ppm; Swiss chard 3 ppm; tangerine 3 ppm; tomato 0.5 ppm; turnip, greens 3 ppm; and walnut 0.5 ppm. ***[40 CFR 180.215 (a) (2)]:*** in or on all raw agricultural commodities, except those otherwise listed in this section, from use of the pesticide for area pest (mosquito and fly) control: 0.5 ppm.

Regulatory Authority and Advisory Information:

Carcinogenicity[83]: EPA Group E, evidence of non-carcinogenicity for humans; ACGIH A4, not classified as a human carcinogen

Health Advisory: Nerve toxin, Mutagen, Skin irritant/sensitizer, Developmental/Reproductive Toxin (TRI)

Acute Oral Category: 2, WARNING

Clean Water Act: Section 311 Hazardous Substances/RQ 40CFR117.3 (same as CERCLA, see below)

Superfund/EPCRA 40CFR302.4 RQ: CERCLA, 10 lb (4.54 kg)

EPCRA Section 313 Form R *de minimus* concentration reporting level: 1.0%

U.S. DOT 49CFR172.101, Inhalation Hazard Chemical as organophosphates

U.S. DOT Regulated Marine Pollutant (49CFR172.101, Appendix B)

European/International Regulations: Hazard Symbol: Xi, Xn, N; risk phrases: R21/22; R36/38; R50; safety phrases: S2; S36/37; S60; S61 (see Appendix 1)

Description: Naled is a white crystalline solid (when pure) or light straw-colored liquid (above 26.7 °C). Slightly pungent insecticide odor. Molecular weight = 380.79; Specific gravity (H_2O:1) = 1.96 @ 25 °C; Boiling point = (decomposes) 110 °C; 273 °C; Freezing/Melting point = 26.7 °C; Vapor pressure = 2×10^{-4} mm @ 20 °C; flash point = >100 °C. Hazard Identification (based on NFPA-704 M Rating System): Health 1, Flammability 0, Reactivity 1. Soluble in water; solubility = 1.5 mg/L (no temperature specified)[83,USDA]. Hydrolyzed in water.

Incompatibilities: Reacts with alkaline media. May react violently with antimony(V) pentafluoride. Incompatible with lead diacetate, magnesium, silver nitrate. In the presence of strong reducing agents such as hydrides, organophosphates form highly toxic and flammable phosphine gas. Contact with oxidizers can cause the release of toxic oxides of phosphorus. Hydrolyzed in presence of water. Degraded by sunlight. Decomposes when heated, on contact with acids, acid fumes, bases, producing fumes of hydrogen chloride, hydrogen bromide, phosphorus oxides. Reacts with acids, strong oxidizers in sunlight. Corrosive to metals; attacks some forms of plastics, rubber, and coating.

Permissible Exposure Limits in Air:

NIOSH IDLH: 200 mg/m^3

OSHA PEL: 3 mg/m^3 TWA

NIOSH REL: 3 mg/m^3 TWA [skin]

ACGIH TLV®[1]: 0.1 mg/m^3 inhalable fraction and vapor [skin, sensitizer]; not classifiable as a human carcinogen; BEI_A issued as Acetylcholinesterase inhibiting pesticide.

No Protective Action Criteria (PAC) available.

DFG MAK: 1 mg/m^3, measured as the, inhalable fraction TWA; Peak Limitation Category II(2); [skin] danger of skin sensitization; Pregnancy Risk Group C.

Determination in Air: No method available.

Permissible Concentration in Water: State Drinking Water Guidelines: Florida 14 μg/L.

Determination in Water: Log K_{ow} = <2.5. Unlikely to bioaccumulate in marine organisms.

Routes of Entry: Inhalation, skin absorption, ingestion, eye and/or dermal and/or eye contact.

Harmful Effects and Symptoms

Short Term Exposure: Corrosive. Irritates the eyes, skin, and respiratory tract. May affect the nervous system, causing convulsions, respiratory failure. Organic phosphorus insecticides are absorbed by the skin, as well as by the respiratory and gastrointestinal tracts. They are cholinesterase inhibitors. Symptoms of exposure include headache, giddiness, blurred vision, nervousness, weakness, nausea, cramps, diarrhea, and discomfort in the chest. Signs include sweating, tearing, salivation, vomiting, cyanosis, convulsions, coma, loss of reflexes and loss of sphincter control. High exposure can result in death. Highly toxic; a probable human lethal dose may be between 1 teaspoon and 1 ounce. Delayed pulmonary edema may occur after inhalation. LD_{50} (oral, rat) = 80–450 mg/kg; (dermal, rat) = 800 mg/kg[83].

Long Term Exposure: May cause skin allergy. Cholinesterase inhibitor; cumulative effect is possible. This chemical may damage the nervous system with repeated exposure, resulting in convulsions, respiratory failure. May cause liver damage and testicular degeneration. Neurotoxic.

Points of Attack: Respiratory system, central nervous system, cardiovascular system, skin, eyes, blood cholinesterase, testicles.

Medical Surveillance: Medical observation is recommended for 24 to 48 hours following breathing overexposure, as pulmonary edema may be delayed. Routine biological monitoring of pesticide applicators and field workers includes testing of plasma and red blood cell acetylcholinesterase levels (for enzyme poisoned by this chemical). These tests are normally accurate only if done within about two hours of exposure. If exposure stops, plasma levels return to normal in 1–2 weeks while red blood cell levels may be reduced for 1–3 months. When acetylcholinesterase enzyme levels are reduced by 25% or more below preemployment levels, risk of poisoning is increased, even if results are in lower ranges of "normal." Reassignment to work not involving organophosphate pesticides is recommended until enzyme levels recover. Do not drink any alcoholic beverages before or during use as it promotes absorption of organophosphates. Also consider complete blood count and chest x-ray following acute overexposure. Evaluation by a qualified allergist.

First Aid: **Treatment for organophosphate poisoning consists of thorough decontamination, cardiorespiratory support, and administration of the antidotes atropine and pralidoxime. In cases of severe poisoning, diazepam, an anticonvulsant, should also be administered. Antidotes should be administered as prevention even if the diagnosis is in doubt**. Speed in removing material from eyes and skin is of extreme importance. *Eyes:* Eye contact can cause dangerous amounts of these chemicals to be quickly absorbed through the mucous membrane into the bloodstream. Immediately and gently flush eyes with plenty of warm or cold water (NO hot water) for at least 15 minutes, occasionally lifting the upper and lower eyelids. Get medical aid immediately. *Skin:* Get medical aid. Dermal contact can cause dangerous amounts of these chemicals to be absorbed into the bloodstream. Wearing the appropriate PPE equipment and respirator for organophosphate pesticides, immediately flush skin with plenty of soap and water for at least 15 minutes while removing contaminated clothing and shoes. Shampoo hair promptly if contaminated. The removed, contaminated clothing and shoes should be double-bagged and left in Hot Zone for later disposal by hazardous materials experts. Skin may also be decontaminated with diluted hypochlorite solution. *Inhalation:* Get medical aid. Do not contaminate yourself. Wearing the appropriate PPE equipment and respirator for organophosphate pesticides, immediately remove the victim from the contaminated area to fresh air. If the victim is not breathing, administer artificial respiration. Do not use mouth-to-mouth method if victim ingested or inhaled the substance; give artificial respiration with the aid of a pocket mask equipped with a one-way valve or other proper respiratory medical device. If breathing is difficult, administer oxygen through bag/mask apparatus until medical help arrives. Do not leave victim unattended. *Ingestion:* Call poison control. Loosen all clothing. Never give anything by mouth to an unconscious person. If victim is *unconscious or having convulsions,* do nothing except keep victim warm. Get medical aid. Transfer promptly to a medical facility. In cases of ingestion, **do not induce vomiting**. If the victim is alert and asymptomatic, administer a slurry of activated charcoal at a dose of 1 g/kg (infant, child, and adult dose). A soda can and straw may be of assistance when offering charcoal to a child. *In some cases you may be specifically instructed by poison control to induce vomiting by way of 2 tablespoons of syrup of ipecac (adult) washed down with a cup of water*. Do NOT give activated charcoal before or with ipecac syrup.

Note to physician or authorized medical personnel: Treat cases of respiratory compromise, coma, or excessive pulmonary secretions with respiratory support using protocols and techniques available and within the scope of training. Some cases may necessitate procedures such as endotracheal intubation or cricothyrotomy by properly trained and equipped personnel. When possible, atropine (see *Antidotes*, below) should be given under medical supervision. Patients who are comatose, hypotensive, or having seizures or cardiac arrhythmias should be treated according to advanced life support protocols. *Antidotes:* Two antidotes are administered to treat organophosphate poisoning. Atropine is a competitive antagonist of acetylcholine at muscarinic receptors and is used to control the excessive bronchial secretions which are often responsible for death. Pralidoxime relieves both the nicotinic and muscarine effects of organophosphate poisoning by regenerating acetylcholinesterase and can reduce both the bronchial secretions and the muscle weakness associated with poisoning. The initial intravenous dose of atropine in adults should be determined by the severity of symptoms: An initial adult dose of 1.0 to 2.0 mg or pediatric dose of 0.01 mg/kg (minimum 0.01 mg) should be administered intravenously. If intravenous access cannot be established, atropine may also be given intramuscularly, subcutaneously or via endotracheal tube. Doses should be repeated every 15 minutes until excessive secretions and sweating have been controlled. Once bronchial secretion has been controlled, atropine administration should be repeated whenever the secretions begin to recur. In seriously poisoned patients, very large doses may be required. Alterations of pulse rate and pupillary size should not be used as indicators of treatment adequacy. Pralidoxime should be administered as early in poisoning as possible as its efficacy may diminish when given more than 24 to 36 hours after exposure. Doses are as follows: adult 1.0 g; pediatric 25 to 50 mg/kg. The drug should be administered intravenously over 30 to 60 minutes, but in a life-threatening situation one-half of the total dose can be given per minute for a total administration time of 2 minutes. Treatment should begin to take effect within 40 minutes with a reduction in symptoms and the amount of atropine necessary to control bronchial secretion. The initial dose can be repeated in 1 hour and then every 8 to 12 hours until the patient is clinically well and no longer requires atropine. If intravenous access cannot be established, pralidoxime may also be given intramuscularly. Early administration of diazepam in addition to the combined atropine and pralidoxime treatment may help prevent the onset of seizures and potential brain and cardiac morphologic damage following high-level organophosphate poisoning.

Personal Protective Methods: Wear protective gloves and clothing to prevent any reasonable probability of dermal and/or eye contact. Safety equipment suppliers/manufacturers can provide recommendations on the most protective glove/clothing material for your operation. One recommendation is the use of DuPont™ Tychem® suit fabrics[88]. All protective clothing (suits, gloves, footwear, headgear) should be clean, available each day, and put on before work. Contact lenses should not be worn when working with this chemical. Wear splash-proof chemical goggles and face shield unless full facepiece respiratory protection is worn. Employees should wash immediately with soap when skin is wet or contaminated. Provide emergency showers and eyewash.

Respirator Selection: Engineering controls should be used wherever feasible to maintain airborne concentrations of this chemical below the prescribed exposure limit. Respirators and protective equipment are less effective than engineering controls, and should be used only in non-routine or emergency situations which may result in exposure concentrations in excess of the TWA environmental limit. *At any concentrations above the NIOSH REL, or where there is no REL, at any detectable concentration:* SCBAF: Pd,Pp (APF = 10,000) (any NIOSH/MSHA- or European Standard EN 149-approved self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode); or SaF: Pd,Pp: ASCBA (APF = 10,000) (any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary, self-contained breathing apparatus operated in a pressure-demand or other positive-pressure mode).

Storage: Color Code-White: Corrosive or Contact Hazard; Store separately in a corrosion-resistant location. Prior to working with this chemical you should be trained on its proper handling and storage. Store in tightly closed containers in a cool, well-ventilated area. Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: Organophosphorus pesticides, solid or liquid (nonflammable), require a "poisonous materials" label. This chemical falls in Hazard Class 6.1.

Spill Handling: First remove all sources of ignition. Evacuate persons not wearing protective equipment from area of spill or leak until clean up is complete. Stay upwind; keep out of low areas. Ventilate area of spill or leak. Remove and isolate contaminated clothing at the site. Do not touch spilled material; stop leak if you can do so without risk. Use water spray to reduce vapors. *Small spills:* absorb with sand or other noncombustible absorbent material and place into containers for later disposal. *Large spills:* dike far ahead of spill for later disposal. Collect powdered material in the most convenient and safe manner and deposit in sealed containers. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable. Seek professional environmental engineering assistance from the U.S. EPA Environmental Response Team at (908) 548-8730 (24-hour response line).

Fire Extinguishing: Hazardous decomposition includes hydrogen chloride, hydrogen bromide and oxides of phosphorus, sulfur, and nitrogen. May be fatal if inhaled, ingested or absorbed through skin. Inhalation or contact with some of these materials will irritate or burn skin and eyes. Vapors may cause dizziness or suffocation. *Small fires:* dry chemical, carbon dioxide; water spray; or foam. *Large fires:* water spray, fog, or foam. Stay upwind; keep out of low areas. Ventilate closed spaces before entering them. Firefighting gear (including SCBA) may not provide adequate protection. If exposure occurs, remove and isolate gear immediately and thoroughly decontaminate personnel. Wear positive-pressure breathing apparatus and special protective clothing. Remove and isolate contaminated clothing at the site. Move container from fire area if you can do so without risk. Fight fire from maximum distance. Dike fire control water for later disposal; do not scatter the material. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies. From a secure, explosion-proof location, use water spray to cool exposed containers. If cooling streams are ineffective (venting sound increases in volume and pitch, tank discolors, or shows any signs of deforming), withdraw immediately to a secure position. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode.

Disposal Method Suggested: Destruction by alkali hydrolysis or incineration. Containers must be disposed of properly by following package label directions or by contacting your local or federal environmental control agency, or by contacting your regional EPA office.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- EXTOXNET, Extension Toxicology Network, "Pesticide Information Profile, Naled," Oregon State University, Corvallis, OR (June 1996). http://extoxnet.orst.edu/pips/naled.htm
- USEPA, Office of Pesticide Programs, Pesticide Residue Limits, "Naled," 40 CFR 180.215. http://www.epa.gov/pesticides/food/viewtols.htm
- New Jersey Department of Health and Senior Services, "Hazardous Substance Fact Sheet: Dimethyl-1,2-Dibromo-2,2-Dichloroethyl Phosphate," Trenton, NJ (December 1998). http://www.state.nj.us/health/eoh/rtkweb/0751.pdf
- USEPA, Investigation of Selected Potential Environmental Contaminants: Haloalkyl Phosphates, Report EPA 560/2/76-007, Washington DC (Aug.1976)
- Agency for Toxic Substances and Disease Registry, U.S. Department of Health and Human Services, Public Health Service, "Managing Hazardous Materials Incidents," Atlanta, GA (June 2003)
- Sax, N. I., Ed., "Dangerous Properties of Industrial Materials Report" 5, No. 3, 44-47 (1985)

1-Naphthaleneacetamide N:0105

Use Type: Plant growth regulator

CAS Number: 86-86-2

Formula: $C_{12}H_{11}NO$

Synonyms: *N*-Acetyl-1-naphthylamine; NAAM; NAD; Naphthalene-acetamide(1-); 2-(1-Naphthyl)acetamide; α-Naphthaleneacetamide; α-Naphthylacetamide; 1-Naphthylacetamide

Trade Names: AMACTONE®; AMID-THIN W®; FRUITONE®; ROOTONE® (component, with Indole-3-butyric acid and 1-Naphthaleneacetic acid); ROSETONE®; TRANSPLANTONE® (component, with 1-Naphthaleneacetic acid)

Chemical class: Botanical; Auxin

EPA/OPP PC Code: 056001

California DPR Chemical Code: 422

RTECS® Number: QJ0590000

EC Number: 201-704-1

Uses: 1-Naphthaleneacetamide is an agent for thinning fruit sets in apples and pear. Not currently registered for use in EU countries[115] (pending). Registered for use in the U.S.

U.S. Maximum Allowable Residue Levels for indole-3-butyric acid: An exemption from the requirement of a tolerance is established for residues of auxins [40 CFR 180.1158]: in or on all food commodities when used as plant regulators on plants, seeds, or cuttings and on all food commodities after harvest in accordance with good agricultural practices.

Regulatory Authority and Advisory Information:

Acute Oral Category: 3, CAUTION

European/International Regulations: Hazard Symbol: Xn, Xi; risk phrases: R22; R36/37/38; safety phrases: S1/2; S24/25; S26; S37/39; S45 (see Appendix 1)

Description: White needles or crystalline solid. Odorless. Molecular weight = 185.23; Boiling point = (decomposes); Freezing/Melting point = sublimes @ 181 ºC. Soluble in water; solubility >15 ppm.

Incompatibilities: Incompatible with oxidizers and alkaline materials. Slowly hydrolyzes in water, releasing ammonia and forming acetate salts. Decomposes in temperatures above 180 °C.

Determination in Air: Filter; none; Gravimetric; NIOSH IV [Particulates NOR; #0500 (total), #0600 (respirable)][18].

Determination in Water: Log K_{ow} = <2.0. Unlikely to bioaccumulate in marine organisms.

Routes of Entry: Ingestion, inhalation, eye contact.

Harmful Effects and Symptoms

Short Term Exposure: An eye irritant. May cause irritation to the skin and respiratory tract. May be harmful if swallowed. LD_{50} (oral, rat) = 1700 mg/kg; (dermal, rat) = >2 g/kg.

Long Term Exposure: May affect liver and kidney function.

Points of Attack: Liver, kidneys, eyes.

First Aid: If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least 15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately. If this chemical contacts the skin, remove contaminated clothing and wash immediately with soap and water. Seek medical attention immediately. If this chemical has been inhaled, remove from exposure, begin rescue breathing (using universal precautions) if breathing has stopped, and CPR if heart action has stopped. Transfer promptly to a medical facility. When this chemical has been swallowed, get medical attention. Give large quantities of water and induce vomiting. Do not make an unconscious person vomit. Do not induce vomiting when formulations containing petroleum solvents are ingested.

Personal Protective Methods: Wear protective gloves and clothing to prevent any reasonable probability of dermal and/or eye contact. Safety equipment suppliers/manufacturers can provide recommendations on the most protective glove/clothing material for your operation. All protective clothing (suits, gloves, footwear, headgear) should be clean, available each day, and put on before work. Contact lenses should not be worn when working with this chemical. Wear dust-proof chemical goggles and face shield unless full facepiece respiratory protection is worn. Employees should wash immediately with soap when skin is wet or contaminated. Provide emergency showers and eyewash.

Respirator Selection: Wherever and whenever workplace conditions warrant respirator use, a respiratory protection program must be followed that meets one or more of the following government standards: OSHA's 29 CFR 1910.134, ANSI Z88.2, or European Standard EN 149.

Storage: Color Code-Blue: Health Hazard/Poison. Store in a secure poison location. Prior to working with this chemical you should be trained on its proper handling and storage. Store in tightly closed containers in a cool, well-ventilated area. Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: Not regulated.

Spill Handling: First remove all sources of ignition. Evacuate persons not wearing protective equipment from area of spill or leak until clean up is complete. Ventilate area of spill or leak. Use water spray to reduce vapor. Absorb liquids in vermiculite, dry sand, earth, or a similar material and deposit in sealed containers. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable.

Fire Extinguishing: Hazardous decomposition includes oxides of nitrogen and carbon. May be combustible at high temperatures. Use dry chemical, carbon dioxide; or alcohol-resistant foam extinguishers. Notify local health and fire officials and pollution control agencies. From a secure, explosion-proof location, use water spray to cool exposed containers. If cooling streams are ineffective (venting sound increases in volume and pitch, tank discolors, or shows any signs of deforming), withdraw immediately to a secure position. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode.

Disposal Method Suggested: If allowed, incineration with effluent gas scrubbing is recommended. In accordance with 40CFR165, follow recommendations for the disposal of pesticides and pesticide containers. Containers must be disposed of properly by following package label directions or by contacting your local or federal environmental control agency, or by contacting your regional EPA office.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- USEPA, Office of Pesticide Programs, Pesticide Residue Limits, "1-Naphthaleneacetamide," 40 CFR 180.309. http://www.epa.gov/pesticides/food/viewtols.htm

1-Naphthaleneacetic acid N:0108

Use Type: Plant growth regulator

CAS Number: 86-87-3

Formula: $C_{12}H_{10}O_2$

Synonyms: ANA; NAA; Naphthaleneacetic acid(1-); α-Naphthaleneacetic acid; Naphthalene-1-acetic acid; α-Naphthylacetic; Naphthylacetic acid; α-Naphthylacetic acid; 1-Naphthylacetic acid; α-Naphthyleneacetic acid

Trade Names: AGRONAA®; ALCO® NAA; ALPHA-SPRA®; AMCOTONE® APPL-SET®; CELMONE®; DESTRUXOL®; DIP'N GROW®; FRUITONE®; GOLDENGRO®; HORMEX®; KLINGTITE®; LIQUI-STIK®; NAA 800®; NAFUSAKU®; NIAGARA-STIK®; NU-TONE®; PARMONE®; PHYMONE®; PIMACOL-SOL®; PLANOFIX®; PLUCKER®; PRIMACOL®; RHIZOPON B ROOTING POWDER; ROOTONE® (component, with Indole-3-butyric acid and 1-Naphthaleneacetamide); STAFAST®; STIK®; STOP-DROP®; TEKKAM®; TIPOFF®; TRANSPLANTONE® (component, with 1-Naphthaleneacetamide); TRE-HOLD®; VARDHAK®

Chemical class: Botanical; Auxin

EPA/OPP PC Code: 056002

California DPR Chemical Code: 423

HSDB Number: 2038

RTECS® Number: QJ0875000

EC Number: 201-705-8

Uses: An agent for thinning fruit sets in apples, pears, olives and some citrus. Induces root formation on cuttings and transplants. Inhibits fruit drops. Not currently registered in EU countries[115] (pending). Registered for use in the U.S. and Canada.

U.S. Maximum Allowable Residue Levels for 1-Naphthaleneacetic Acid [40 CFR 180.155 (a)]: apple 1.0 ppm; cherry, sweet 0.1 ppm; olive 0.1 ppm; orange 0.1 ppm; pear 1.0 ppm; pineapple 0.05 ppm; quince 1.0 ppm; tangerine 0.1 ppm.

Human toxicity (long-term)[101]: Very low–350.00 ppb, Health Advisory

Fish toxicity (threshold)[101]: Very low–4918.96611 ppb, MATC (Maximum Acceptable Toxicant Concentration)

Regulatory Authority and Advisory Information:

Health Advisory: Mutagen, Skin irritant/sensitizer

Acute Oral Category: 3, CAUTION

Description: White crystals, needles, powder, or colorless liquid. Odorless. Molecular weight = 186.21; Boiling point = (decomposes) 322 °C; 352 °C; Freezing/Melting point = 134 °C; vapor pressure = very low; negligible. Soluble in water.

Incompatibilities: Incompatible with oxidizers, chlorates nitrates, peroxides, sulfuric acid, caustics, ammonia, aliphatic amines, alkanolamines, isocyanates, alkylene oxides, epichlorohydrin.

Determination in Water: Log K_{ow} = 2.6. Unlikely to bioaccumulate in marine organisms.

Routes of Entry: Inhalation, ingestion.

Harmful Effects and Symptoms

Short Term Exposure: Dusts may cause skin, and respiratory tract irritation. Eye irritation may be severe. Ingestion may cause upset stomach and affect central nervous system. LD_{50} (oral, rat) = 1000–>1750 mg/kg; (dermal, rat) = >2 g/kg.

Long Term Exposure: Possible blood toxin; may cause lower blood cell count. May be a developmental and reproductive toxin.

Points of Attack: Blood, central nervous system, eyes.

Medical Surveillance: Complete blood count.

First Aid: If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least 15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately. If this chemical contacts the skin, remove contaminated clothing and wash immediately with soap and water. Seek medical attention immediately. If this chemical has been inhaled, remove from exposure, begin rescue breathing (using universal precautions) if breathing has stopped, and CPR if heart action has stopped. Transfer promptly to a medical facility. When this chemical has been swallowed, get medical attention. Give large quantities of water and induce vomiting. Do not make an unconscious person vomit. Do not induce vomiting when formulations containing petroleum solvents are ingested.

Personal Protective Methods: Wear protective gloves and clothing to prevent any reasonable probability of dermal and/or eye contact. Safety equipment suppliers/manufacturers can provide recommendations on the most protective glove/clothing material for your operation. All protective clothing (suits, gloves, footwear, headgear) should be clean, available each day, and put on before work. Contact lenses should not be worn when working with this chemical. Wear dust-proof chemical goggles and face shield unless full facepiece respiratory protection is worn. Employees should wash immediately with soap when skin is wet or contaminated. Provide emergency showers and eyewash.

Respirator Selection: Wherever and whenever workplace conditions warrant respirator use, a respiratory protection program must be followed that meets one or more of the following government standards: OSHA's 29 CFR 1910.134, ANSI Z88.2, or European Standard EN 149.

Storage: Color Code-Blue: Health Hazard/Poison. Store in a secure poison location. Prior to working with this chemical you should be trained on its proper handling and storage. Store in tightly closed containers in a cool, well-ventilated area. Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: Not regulated.

Spill Handling: First remove all sources of ignition. Evacuate persons not wearing protective equipment from area of spill or leak until clean up is complete. Ventilate area of spill or leak. Use water spray to reduce vapor. Absorb liquids in vermiculite, dry sand, earth, or a similar material and deposit in sealed containers. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable.

Fire Extinguishing: Hazardous decomposition includes oxides of carbon. Use dry chemical, carbon dioxide; or alcohol-resistant foam extinguishers. Vapors are heavier than air and will collect in low areas. Vapors may travel long distances to ignition sources and flashback. Vapors in confined areas may explode when exposed to fire. Storage containers and parts of containers may rocket great distances, in many directions. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies. From a secure, explosion-proof location, use water spray to cool exposed containers. If cooling streams are ineffective (venting sound increases in volume and pitch, tank discolors, or shows any signs of deforming), withdraw immediately to a secure position. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode.

Disposal Method Suggested: Incineration. In accordance with 40CFR165, follow recommendations for the disposal of pesticides and pesticide containers.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- USEPA, Office of Pesticide Programs, Pesticide Residue Limits, "1-Naphthaleneacetic Acid," 40 CFR 180.155. http://www.epa.gov/pesticides/food/viewtols.htm
- Pesticide Management Education Program, "1-Naphthaleneacetic Acid (NAA) Herbicide Profile 3/85," Cornell University, Ithaca, NY (March 1985). http://pmep.cce.cornell.edu/profiles/herb-growthreg/naa-rimsulfuron/naa/herb-prof-naa.html

Napropamide N:0173

Use Type: Herbicide

CAS Number: 15299-99-7

Formula: $C_{17}H_{21}NO_2$

Synonyms: *N,N*-Diethyl-2-(1-naphthalenyloxy)propanamide; 2-(1-Naphthoxy)-*N,N*-diethylpropionamide; 2-(α-Naphthoxy)-*N,N*-diethylpropionamide

Trade Names: COLZOR TRIO® (dimethachlor+napropamide+clomazone); DEVRINOL®; NAPROGUARD®; WAYLAY®; R-7165®

Chemical class: Amide Herbicide; Alkanamide

EPA/OPP PC Code: 103001

California DPR Chemical Code: 1728

HSDB Number: 6710

UN/NA & ERG Number: UN3082 (liquid)/171

RTECS® Number: UE3600000

EC Number: 239-333-3

Uses: A General Use Pesticide (GUP) that is compatible with many other fungicides and herbicides. Used to control broadleaf weeds and annual grasses on a variety of crops including vegetables, fruit trees, fruit bushes, oil seed rape, vines, sunflowers, olives, tobacco and mint.

U.S. Maximum Allowable Residue Levels for negligible residues (N) of the herbicide N,N-Diethyl-2-(1-naphthalenyloxy)propionamide [40 CFR 180.328(a)]: in or on the following raw agricultural commodities: almond, hulls 0.1(N) ppm; artichokes 0.1 ppm; asparagus 0.1 ppm; avocados 0.1 ppm; basil 0.1 ppm; brassica (cole) leafy vegetables 0.1 ppm; coffee beans 0.1(N) ppm; cucurbits vegetables 0.1 ppm; figs 0.1(N) ppm; fruits, citrus 0.1(N) ppm; fruits, pome 0.1(N) ppm; fruits, small 0.1(N) ppm; fruits, stone 0.1(N) ppm; kiwifruit 0.1 ppm; marjoram 0.1 ppm; mint 0.1 ppm; nuts 0.1(N) ppm; olives 0.1 ppm; persimmons 0.1 ppm; pistachio nuts 0.1 ppm; rhubarb 0.1 ppm; rosemary 0.1 ppm; savory, summer 0.1 ppm; savory, winter 0.1 ppm; sweet potato 0.1 ppm and vegetables, fruiting, 0.1(N) ppm. ***Regional registration, as defined in section 180.1(n) [40 CFR 180.328(b)]:*** in or on the following raw agricultural commodities: pomegranates 0.1 ppm. (N) = negligible amount of residue.

Regulatory Authority and Advisory Information:

Acute Oral Category: 3, CAUTION

Potential Ground Water Pollutant [California FAC Section 13145(d)/12811, active]

European/International Regulations: Hazard Symbol: N; risk phrases: R51/53; safety phrases: S2; S61 (see Appendix 1)

Description: Colorless crystalline solid (pure). Technical form is tan to brown solid. Molecular weight = 271.35; Specific gravity (H2O:1) = 1.18; Boiling point = 317 °C; Freezing/Melting point = 73.5 °C; Vapor pressure = 1.72×10^{-7} mm @ 20 °C[83,USDA]. Soluble in water; solubility = 73 mg/L @ 20 °C.

Incompatibilities: Slowly hydrolyzes in water, releasing ammonia and forming acetate salt.

Permissible Exposure Limits in Air:

Determination in Air: Filter; none; Gravimetric; NIOSH IV [Particulates NOR; #0500 (total), #0600 (respirable)][18].

Permissible Concentration in Water: Federal Drinking Water Guidelines: 800 ppb[14].

Determination in Water: Log K_{ow} = >3.0. Values above 3.0 are likely to bioaccumulate in aquatic organisms.

Routes of Entry: Inhalation, dermal and eye contact.

Harmful Effects and Symptoms

Short Term Exposure: Irritates the respiratory tract. LD_{50} (oral, rat) = >4500 mg/kg; (dermal, rat) = >2 g/kg.

Long Term Exposure: Possible liver and kidney toxin.

Points of Attack: Liver, kidneys.

Medical Surveillance: Preliminary medical exam to detect chronic diseases of central nervous system, liver, heart, kidneys, lung and skin, as well as endocrinological or immunological disturbances, should protect susceptible individuals. Periodical medical exams of internal organs, skin and eyes are important to avoid chronic occupational intoxications. They should include lab and patch tests when necessary[83]. Liver and kidney function tests.

First Aid: If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least 15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately. If this chemical contacts the skin, remove contaminated clothing and wash immediately with soap and water. Seek medical attention immediately. If this chemical has been inhaled, remove from exposure, begin rescue breathing (using universal precautions) if breathing has stopped, and CPR if heart action has stopped. Transfer promptly to a medical facility. When this chemical has been swallowed, get medical attention. Give large quantities of water and induce vomiting. Do not make an unconscious person vomit. Do not induce vomiting when formulations containing petroleum solvents are ingested.

Personal Protective Methods: Wear protective gloves and clothing to prevent any reasonable probability of dermal and/or eye contact. Safety equipment suppliers/manufacturers can provide recommendations on the most protective glove/clothing material for your operation. All protective clothing (suits, gloves, footwear, headgear) should be clean, available each day, and put on before work. Contact lenses should not be worn when working with this chemical. Wear dust-proof chemical goggles and face shield unless full facepiece respiratory protection is worn. Employees should wash immediately with soap when skin is wet or contaminated. Provide emergency showers and eyewash.

Respirator Selection: Where potential for exposure to amides exists, use a NIOSH/MSHA- or European Standard EN149-approved supplied-air respirator with a full facepiece operated in the positive-pressure mode, or with a full facepiece, hood, or helmet in the continuous-flow mode; or use a NIOSH/MSHA- or European Standard EN149-approved self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive-pressure mode.

Storage: Color Code-Blue: Health Hazard/Poison. Store in a secure poison location. Color Code-White: Corrosive or Contact Hazard; Store separately in a corrosion-resistant location. Prior to working with this chemical you should be trained on its proper handling and storage. Store in tightly closed containers in a cool, well-ventilated area away from strong oxidizers; strong acids; strong alkalies. Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: The name of this material is not on the DOT list of materials[19] for label and packaging standards. However, based on regulations, it may be classified as an Environmentally hazardous substances, solid, n.o.s. This chemical requires a shipping label of "CLASS 9." It usually falls in Hazard Class 9.

Spill Handling: First remove all sources of ignition. Evacuate persons not wearing protective equipment from area of spill or leak until clean up is complete. Collect powdered material in the most convenient and safe manner and deposit in sealed containers. Ventilate area after clean up is complete. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable.

Fire Extinguishing: Napropamide decomposes forming toxic and corrosive gases, including oxides of nitrogen and carbon. This chemical is a combustible solid. As an immediate precautionary measure, isolate spill or leak area in all directions for at least 50 meters/150 feet for liquids and at least 25 meters/75 feet for solids. *Fire involving storage or vehicular tanks:* isolate for 800 meters/0.5 mile in all directions; also, consider initial evacuation for 800 meters/0.5 mile in all directions. *On a small fire:* use dry chemical, CO_2, water spray or regular foam. *On a large fire:* use water spray, fog or regular foam. Do not scatter spilled material with high-pressure streams of water. Move containers from fire area if you can do it without risk. Dike fire-control water for later disposal. *Fire involving tanks:* from a secure, explosion-proof location, use water spray to cool exposed containers. If cooling streams are ineffective (venting sound increases in volume and pitch, tank discolors, or shows any signs of deforming), withdraw immediately to a secure position. Always stay away from tanks engulfed in fire. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode.

Disposal Method Suggested: Small amounts may be destroyed by alkaline hydrolysis. Admixture with alkali can be followed by soil burial. Larger quantities can be disposed of by incineration in admixture with acetone or xylene and using effluent gas scrubbing.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- EXTOXNET, Extension Toxicology Network, "Pesticide Information Profile, Napropamide," Oregon State University, Corvallis, OR (June 1996). http://extoxnet.orst.edu/pips/napropam.htm

Naptalam N:0175

Use Type: Herbicide

CAS Number: 132-66-1; 132-67-2 (Na salt)

Formula: $C_{18}H_{13}NO_3$; $C_{18}H_{12}NNaO_3$ (Na salt)

Synonyms: Benzoic acid, 2-[(1-naphthalenylamino) carbonyl]-; Benzoic acid, 2-[(α-naphthalenylamino) carbonyl]-; Naftalame; 2-[(1-Naphthalenylamino) carbonyl] benzoic acid; *N*-1-Naphthylphthalamate; α-Naphthylphthalamic acid; *N*-1-Naphthylphthalamic acid; Naptalame; NPA; Phthalamic acid, *N*-1-naphthyl-

Trade Names: ALANAP®[C]; ALANAPE®; ANCRACK®; DYANAP®; GRELUTIN®; MORCRAN®; NAPTRO®; NIP-A-THIN®; PEACH-THIN®; RESCUE®[C]; 6Q8®; SOLO®

Chemical class: Amide Herbicide; Phthalamate

EPA/OPP PC Code: 030702; 030703 (Na salt)

California DPR Chemical Code: 2998

HSDB Number: 1742; 5619 (Na salt)

UN/NA & ERG Number: UN3077 (solid)/171; UN3082 (liquid)/171

RTECS® Number: TH7351000 (Na salt)

EC Number: 205-073-4 [*Annex I Index No.:* 607-248-00-4] (Na salt)]

Uses: Used as a selective pre-emergence herbicide to control broadleaf weeds and grasses in soybeans, cucumbers, melons, peanuts and woody ornamentals. Not currently registered for use in the U.S. or EU countries[115]. There are 25 global suppliers[97].

U.S. Maximum Allowable Residue Levels for Naptalam from application of its sodium salt [40 CFR 180.297]: in or on the following agricultural commodities: peanut hulls 0.1 ppm; and cantaloups, cranberries, cucumbers, muskmelons, peanuts, peanut hay, soybeans, soybean hay, and watermelons 0.1 ppm (negligible residues).

Regulatory Authority and Advisory Information:

Carcinogenicity[83]: EPA Group D, Not classifiable as a human carcinogen (includes Na salt)

Potential Ground Water Pollutant [California FAC Section 13145(d)/12811, inactive, sodium salt]

European/International Regulations: Hazard Symbol: Xn; N risk phrases: R20; R50; safety phrases: S2; S22; S24/25 (see Appendix 1)

Description: Purple crystalline solid or powder. Commercial product is usually an aqueous solution. Unpleasant odor. Molecular weight = 291.32; 313.29 (Na salt); Specific gravity (H_2O:1) = 1.37 @ 20 °C; 1.386 (Na salt); Freezing/Melting point = 185 °C; 202 °C; Vapor pressure = <3 mmHg @ 0 °C; Autoignition temperature = 560 °C (Na salt). Soluble in water.

Incompatibilities: Incompatible with oxidizers, chlorates nitrates, peroxides, sulfuric acid, caustics, ammonia, aliphatic amines, alkanolamines, isocyanates, alkylene oxides, epichlorohydrin.

Determination in Air: Filter; none; Gravimetric; NIOSH IV [Particulates NOR; #0500 (total), #0600 (respirable)][18].

Determination in Water: Log K_{ow} = <1.0. Unlikely to bioaccumulate in marine organisms.

Routes of Entry: Absorbed through the unbroken skin, inhalation, ingestion.

Harmful Effects and Symptoms

Short Term Exposure: May be toxic if absorbed through the skin. Corrosive, can cause serious eye damage; can cause irritation to the eyes, skin and respiratory tract. High levels of exposure may cause pulmonary edema, a medical emergency that may be delayed for several hours. Harmful if swallowed; may cause burns to the digestive tract, mouth, throat and stomach. LD_{50} (oral, rat) = 1770 mg/kg[83]; (dermal, rat) = >2 g/kg.

Long Term Exposure: Eye problems may develop.

Medical Surveillance: Preliminary medical exam to detect chronic diseases of central nervous system, liver, heart, kidneys, lung and skin, as well as endocrinological or immunological disturbances, should protect susceptible individuals. Periodical medical exams of internal organs, skin and eyes are important to avoid chronic occupational intoxications. They should include lab and patch tests when necessary[83].

First Aid: If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least 15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately. If this chemical contacts the skin, remove contaminated clothing and wash immediately with soap and water. Seek medical attention immediately. If this chemical has been inhaled, remove from exposure, begin rescue breathing (using universal precautions) if breathing has stopped, and CPR if heart action has stopped. Transfer promptly to a medical facility. When this chemical has been swallowed, get medical attention. Give large quantities of water and induce vomiting. Do not make an unconscious person vomit.

Personal Protective Methods: Applicators and other handlers must wear: Coveralls worn over long-sleeved shirt and long pants; Chemical-resistant gloves such as DuPont™ Tychem® suit fabrics, barrier laminate, or Viton®; Chemical-resistant footwear plus socks; Protective eye wear; Chemical-resistant headgear for overhead exposure; Chemical-resistant apron when cleaning equipment, mixing, or loading[83]. Agricultural Use/Engineering Controls: When handlers use closed systems, enclosed cabs, or aircraft in a manner that meets the requirements listed in the Worker Protection Standard (WPS) for agricultural pesticides, ***40 CFR 170.240(d)(4-6)***, the handler PPE

Respirator Selection: Wherever and whenever workplace conditions warrant respirator use, a respiratory protection program must be followed that meets one or more of the following government standards: OSHA's 29 CFR 1910.134, ANSI Z88.2, or European Standard EN 149.

Storage: Color Code-White: Corrosive or Contact Hazard; Store separately in a corrosion-resistant location. Prior to working with this chemical you should be trained on its proper handling and storage. Store in tightly closed containers in a cool, well-ventilated area. Color Code-Blue: Health Hazard/Poison: Store in a tightly closed container in a dry, well-ventilated and secure poison location. Prior to working with this chemical you should be trained on its proper handling and storage. Where possible, automatically transfer material from other storage containers to process containers.

Spill Handling: If a spill occurs, clean it up promptly. Don't wash it away. Instead, sprinkle the spill with sawdust,

vermiculite, or kitty litter. Sweep it into a plastic garbage bag, and dispose of it as directed on the pesticide product label. Wash all contaminated surfaces with a soap and water solution. Do not reenter the contaminated area until and expert verifies that the area has been properly cleaned.
Fire Extinguishing: Hazardous decomposition includes oxides of nitrogen and carbon. As an immediate precautionary measure, isolate spill or leak area in all directions for at least 50 meters/150 feet for liquids and at least 25 meters/75 feet for solids. *Fire involving storage or vehicular tanks:* isolate for 800 meters/0.5 mile in all directions; also, consider initial evacuation for 800 meters/0.5 mile in all directions. *On a small fire:* use dry chemical, CO_2, water spray or regular foam. *On a large fire:* use water spray, fog or regular foam. Do not scatter spilled material with high-pressure streams of water. Move containers from fire area if you can do it without risk. Dike fire-control water for later disposal. *Fire involving tanks:* from a secure, explosion-proof location, use water spray to cool exposed containers. If cooling streams are ineffective (venting sound increases in volume and pitch, tank discolors, or shows any signs of deforming), withdraw immediately to a secure position. Always stay away from tanks engulfed in fire. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode.
Disposal Method Suggested: Do not discharge into drains or sewers. Dispose of waste material as a hazardous waste in a landfill approved and licensed for the disposal of pesticides. Consult with environmental regulatory agencies for guidance on acceptable disposal practices. Incineration with effluent gas scrubbing is recommended. Containers must be disposed of properly by following package label directions or by contacting your local or federal environmental control agency, or by contacting your regional EPA office.
References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- Pesticide Management Education Program, "Naptalam (Alanap) Herbicide Profile 3/85," Cornell University, Ithaca, NY (March 1985). http://pmep.cce.cornell.edu/profiles/herb-growthreg/naa-rimsulfuron/naptalam/herb-prof-naptalam.html

Nicosulfuron N:0295

Use Type: Herbicide
CAS Number: 111991-09-4
Formula: $C_{15}H_{18}N_6O_6S$
Synonyms: 2-[((((4,6-Dimethoxy-2-pyrimidinyl)amino)carbonyl)amino)sulfonyl]-*N,N*-dimethyl-3-pyridinecarboxamide; 3-Pyridinecarboxamide, 2-[((((4,6-dimethoxy-2-pyrimidinyl)amino)carbonyl)amino)sulfonyl]-*N,N*-dimethyl-
Trade Names: ACCENT®; BASIS®; CELEBRITY®; CHALLENGER®; DASUL®; DPX 79406® Herbicide (with Rimsulfuron); DPX-V9636®; GHIBLI®; LAMA®; MATRIX® Herbicide (with Rimsulfuron); MILAGRO®; MISTRAL®; MOTIVEL®; NISSHIN®; SAMSON®; STEADFAST® (nicosulfuron+rimsulfuron)
Chemical class: Sulfonylurea
EPA/OPP PC Code: 129008
California DPR Chemical Code: 3829
HSDB Number: 7950
UN/NA & ERG Number: UN3082 (liquid)/171
RTECS® Number: US4615000
EC Number: Not assigned
Uses: Used as a post-emergence herbicide to control a variety of weeds on field corn and popcorn crops. Some formulations may be U.S. EPA restricted Use Pesticides (RUP). Approved for use in EU countries[115].
U.S. Maximum Allowable Residue Levels for Nicosulfuron [40 CFR 180.454 (a)]: cattle, fat 0.01 ppm; cattle, meat 0.01 ppm; cattle, meat byproducts 0.05 ppm; corn, field, forage 0.1 ppm; corn, field, grain 0.1 ppm; corn, field, stover 0.1 ppm; corn, pop, grain 0.1 ppm; corn, pop, stover 0.1 ppm; corn, sweet, forage 0.1 ppm; corn, sweet, kernel plus cob with husks removed 0.1 ppm; corn, sweet, stover 0.1 ppm; goat, fat 0.01 ppm; goat, meat 0.01 ppm; goat, meat byproducts 0.05 ppm; grass, forage 9.0 ppm; grass, hay 25.0 ppm; horse, fat 0.01 ppm; horse, meat 0.01 ppm; horse, meat byproducts 0.05 ppm; milk 0.01 ppm; sheep, fat 0.01 ppm; sheep, meat 0.01 ppm; sheep, meat byproducts 0.05 ppm.
Regulatory Authority and Advisory Information:
Carcinogenicity[83]: EPA Group E, evidence of non-carcinogenicity for humans
Acute Oral Category: 4, Caution
Description: White crystalline solid or powder. Phenolic odor. Molecular weight = 410.41; Specific gravity (H_2O:1) = 1.45 @ 20 °C; Boiling point = (decomposes) 165 °C; Freezing/Melting point = 141–144° C; 172 °C; Henry's Law constant = 4.13×10^{-18} atm-m^3/mol @ 25 °C[83,USDA]. Hazard Identification (based on NFPA-704 M Rating System): Health 2, Flammability 0, Reactivity 0. Highly soluble in water; solubility = 0.25 g/L @ 25 °C; 1.2×10^4 mg/L @ 25 °C[83,USDA].
Incompatibilities: Slowly hydrolyzes in water, releasing ammonia and forming acetate salts. Decomposed >165 °C.
Determination in Water: Log K_{ow} = <1.0. Unlikely to bioaccumulate in marine organisms.
Routes of Entry: Inhalation, dermal contact, ingestion.
Harmful Effects and Symptoms: Human health effects from the sulfonylurea herbicides at low environmental doses or at biomonitored levels from low environmental exposures are unknown. The sulfonylurea herbicides are generally of low toxicity in mammalian studies. Animal studies showed low acute toxicity and little chronic,

reproductive, or developmental toxicity or teratogenic effects. Developmental or teratogenic effects tended only to occur at high or maternally toxic doses. At high sublethal, chronic oral doses, such nonspecific effects as weight loss and anemia were observed. Some chemical-specific effects were noted at high doses in animals[96].

Short Term Exposure: May cause skin, eye and respiratory tract irritation. Moderately poisonous if ingested or inhaled. LD_{50} (oral, rat) = >5 g/kg; LD_{50} (dermal, rat) = >2 g/kg.

Medical Surveillance: Preliminary medical exam to detect chronic diseases of central nervous system, liver, heart, kidneys, lung and skin, as well as endocrinological or immunological disturbances, should protect susceptible individuals. Periodical medical exams of internal organs, skin and eyes are important to avoid chronic occupational intoxications. They should include lab and patch tests when necessary[83]. Urinary levels of the sulfonylurea herbicides reflect recent exposure. There is very limited information on the biomonitoring of sulfonylurea herbicides or their metabolites. Detection of the metabolites may reflect exposure to more than one particular sulfonylurea herbicide or from exposure to environmental degradation products. The urinary metabolites dimethoxypyrimidine and dimethylpyrimidine can be used as nonspecific markers of exposure to the pyrimidinylsulfonylureas, a group that includes bensulfuron-methyl, halosulfuron, primisulfuron-methyl, and sulfosulfon. The urinary metabolite methoxymethyl triazine can be used as a nonspecific marker of exposure to the triazinylsulfonylureas, a group that includes chlorosulfuron, prosulfuron, and triasulfuron[96].

First Aid: If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least 15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately. If this chemical contacts the skin, remove contaminated clothing and wash immediately with soap and water. Seek medical attention immediately. If this chemical has been inhaled, remove from exposure, begin rescue breathing (using universal precautions) if breathing has stopped, and CPR if heart action has stopped. Transfer promptly to a medical facility. When this chemical has been swallowed, get medical attention. Give large quantities of water and induce vomiting. Do not make an unconscious person vomit. Do not induce vomiting when formulations containing petroleum solvents are ingested

Personal Protective Methods: Applicators and other handlers must wear: Coveralls worn over long-sleeved shirt and long pants; Chemical-resistant gloves such as DuPont™ Tychem® suit fabrics, barrier laminate, or Viton®; Chemical-resistant footwear plus socks; Protective eye wear; Chemical-resistant headgear for overhead exposure; Chemical-resistant apron when cleaning equipment, mixing, or loading[83]. Agricultural Use/Engineering Controls: When handlers use closed systems, enclosed cabs, or aircraft in a manner that meets the requirements listed in the Worker Protection Standard (WPS) for agricultural pesticides, ***40 CFR 170.240(d)(4-6),*** the handler PPE requirements may be reduced or modified as specified in the Worker Protection Standard. Firefighters should wear NIOSH-approved self-contained breathing apparatus and full protective clothing.

Respirator Selection: Wherever and whenever workplace conditions warrant respirator use, a respiratory protection program must be followed that meets one or more of the following government standards: OSHA's 29 CFR 1910.134, ANSI Z88.2, or European Standard EN 149.

Storage: Color Code-Blue: Health Hazard/Poison. Store in a secure poison location. Prior to working with this chemical you should be trained on its proper handling and storage. Store in tightly closed containers in a cool, well-ventilated area. Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: Environmentally hazardous substances, solid or liquid, usually fall in Hazard Class 9 and Packing Group III.

Spill Handling: First remove all sources of ignition. Evacuate persons not wearing protective equipment from area of spill or leak until clean up is complete. Ventilate area of spill or leak. Use water spray to reduce vapor. Absorb liquids in vermiculite, dry sand, earth, or a similar material and deposit in sealed containers. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable.

Fire Extinguishing: Hazardous decomposition includes fluorine and nitrogen oxides. As an immediate precautionary measure, isolate spill or leak area in all directions for at least 50 meters/150 feet for liquids and at least 25 meters/75 feet for solids. *Fire involving storage or vehicular tanks:* isolate for 800 meters/0.5 mile in all directions; also, consider initial evacuation for 800 meters/0.5 mile in all directions. *On a small fire:* use dry chemical, CO_2, water spray or regular foam. *On a large fire:* use water spray, fog or regular foam. Do not scatter spilled material with high-pressure streams of water. Move containers from fire area if you can do it without risk. Dike fire-control water for later disposal. *Fire involving tanks:* from a secure, explosion-proof location, use water spray to cool exposed containers. If cooling streams are ineffective (venting sound increases in volume and pitch, tank discolors, or shows any signs of deforming), withdraw immediately to a secure position. Always stay away from tanks engulfed in fire. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode.

Disposal Method Suggested: It is the responsibility of chemical waste generators to determine the toxicity and physical properties of a discarded chemical and to properly identify its classification and certification as a hazardous waste and to determine the disposal method. U.S. EPA guidelines for the classification determination are listed in 40 CFR Parts 261.3. Additionally, waste generators must consult and follow all regional, national, state and local hazardous waste laws to ensure complete and accurate classification and disposal methods.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- USEPA, Office of Pesticide Programs, Pesticide Residue Limits, “Nicosulfuron, ” 40 CFR 180.454. http://www.epa.gov/pesticides/food/viewtols.htm
- EXTOXNET, Extension Toxicology Network, “Pesticide Information Profile, Nicosulfuron,” Oregon State University, Corvallis, OR (May 1995). http://extoxnet.orst.edu/pips/nicosulf.htm

Nicotine N:0300

Use Type: Insecticide

CAS Number: 54-11-5

Formula: $C_{10}H_{14}N_2$

Synonyms: ENT 3,424; 1-Methyl-2-(3-pyridyl)pyrrolidine; 3-(*N*-Methylpyrrolidino)pyridine; 3-(1-Methyl-2- pyrrolidinyl)pyridine; (s)-3-(1-Methyl-2-pyrrolidinyl)pyridine; 1-3-(1-Methyl-2-pyrrolidyl)pyridine; (-)-3-(1-Methyl-2-pyrrolidyl)pyridine; Nicotina (Spanish); 1-Nicotine; Nicotine alkaloid; Pyridine, 3-(1-methyl-2-pyrrolidinyl)-; Pyridine, (s)-3-(1-methyl-2-pyrrolidinyl)-and salts; Pyridine, 3-(tetrahydro-1-methylpyrrol-2-yl); β-Pyridyl-α-*N*-methylpyrrolidine; 3-(1-Methyl-2-pyrrolidyl) pyridine; Di-tetrahydronicotyrine

Trade Names: BLACK LEAF®; CAMPBELL'S NICO-SOAP®; DESTRUXOL ORCHARD SPRAY®; EMONIB®; FLUX MAAG®; FUMETO-TENDUST®; BAC®; MACH-NIC®; NIAGARA P. A. DUST®; NICODUST®; NICOFUME®; NICOCIDE®; ORTHO N-4 DUST®; XL ALL INSECTICIDE®

Chemical class: Botanical; Alkaloid

EPA/OPP PC Code: 056702

California DPR Chemical Code: 75

HSDB Number: 1107

UN/NA & ERG Number: UN1654/151

RTECS® Number: QS5250000

EC Number: 200-193-3 [*Annex I Index No.:* 614-001-00-4]

Uses: Nicotine is used in some drugs and insecticides. Classified for restricted use as an insecticide, limited to use by or under the direct supervision of a certified applicator. Not listed for use in EU countries[115]. Registered for use in the U.S. and Canada. A U.S. EPA restricted Use Pesticide (RUP).

U.S. Maximum Allowable Residue Levels for Nicotine (40 CFR 180.167): cucumber 2 ppm; lettuce 2 ppm; tomato 2 ppm.

Regulatory Authority and Advisory Information:

Health Advisory: Agricultural Chemical; Mutagen, Developmental/Reproductive Toxin, as nicotine and salts

California Proposition 65 Chemical: Listed; Developmental/Reproductive Toxin (4/1/1990)

Acute Oral Category: 1, DANGER–POISON

AB 2588-Air Toxics “Hot Spots” Chemicals (CAL)EPA

Hazardous Waste Number (RCRA No.): No. P075

Superfund/EPCRA 302 Extremely Hazardous Substances: TPQ = 100 lb (45.4 kg)

Superfund/EPCRA 40CFR302.4 RQ: CERCLA, 100 lb (45.4 kg)

EPCRA Section 313 Form R *de minimis* concentration reporting level: 1.0%

European/International Regulations: Hazard Symbol: T+, N; risk phrases: R25; R27; R51/53; safety phrases: S1/2; S36/37; S45; S61 (see Appendix 1)

Description: Nicotine is a pale yellow to dark brown, oily liquid. Slight, fishy odor when warm. It is also available as a powder. Molecular weight = 162.23; Specific gravity (H_2O:1) = 1.01 @ 20 °C; Boiling point = 249 °C; Freezing/Melting point = –78.9 °C; Vapor pressure = 0.08 mmHg @ 20 °C; Flash point = 95 °C (cc); Autoignition temperature = 244 °C[17]. Explosive limits: LEL = 0.7%; UEL = 4.0%. Hazard Identification (based on NFPA-704 M Rating System): Health 4, Flammability 1, Reactivity 0. Soluble in water; solubility = 10^6 mg/L @ 25 °C.

Incompatibilities: Strong oxidizers and strong acids. Attacks some forms of plastics and rubbers.

Permissible Exposure Limits in Air:

OSHA PEL: 0.5 mg/m^3 TWA [skin]

NIOSH REL: 0.5 mg/m^3 TWA [skin]

ACGIH TLV®[1]: 0.5 mg/m^3 TWA [skin]

NIOSH IDLH: 5 mg/m^3

Protective Action Criteria (PAC) Ver. 27[89]

PAC-1: 0.5 mg/m^3

PAC-2: 3.5 mg/m^3

PAC-3: 35 mg/m^3

DFG MAK: [skin]

Determination in Air: XAD-2; workup with ethyl acetate, analysis by gas chromatography/NPD; NIOSH IV, Method #2544[18].

Permissible Concentration in Water: Runoff from spills or fire control may cause water pollution.

Determination in Water: Log K_{ow} = <1.5. Unlikely to bioaccumulate in marine organisms.

Routes of Entry: Inhalation, ingestion, skin and/or eye contact.

Harmful Effects and Symptoms

Short Term Exposure: Irritates the eyes and skin. Even small exposures can cause increased heart rate, increased blood fat levels, and change vital hormone levels. May affect the cardiovascular system and central nervous system, resulting in convulsions and respiratory failure. Nicotine is classified as super toxic. There is a fundamental difference between acute toxicity from use of nicotine as insecticide or from ingestion, and chronic toxicity that may be caused by prolonged exposure to small doses as occurs in smoking. Maternal smoking during pregnancy is associated with increased risk of spontaneous abortion, low birth weight and still-birth. Acute exposure to nicotine may result in headache, dizziness, confusion, agitation, restlessness, lethargy, seizures, a coma. Victims may experience hypertension (high blood pressure), tachycardia (rapid heart rate), and tachypnea (rapid respirations), followed by hypotension (low blood pressure), bradycardia (slow heart rate), and respiratory depression. Cardiac arrhythmias may also occur. Gastrointestinal effects include nausea, vomiting, abdominal pain or burning sensation, and diarrhea. Increased salivation, lacrimation (tearing), and sweating may be noted. High levels, far above the OEL, may result in death. LD_{50} (oral, rat) = 188 mg/kg; (dermal, rat) = 25–140 mg/kg[83].

Long Term Exposure: Animal tests show that this substance possibly causes toxic effects upon human reproduction. Nicotine was found as a co-carcinogen in animal.

Points of Attack: Central nervous system, cardiovascular system, lungs, GI tract and reproduction system. Has been shown to be a teratogen in animals; may be a teratogen in humans. Causes fat deposits in the arteries (reducing blood supply to many body organs). This increases the risk of heart attack, stroke, and many other poor circulation problems. Chronic high blood pressure can also result.

Medical Surveillance: Before beginning employment and at regular times after that, the following is recommended: Blood test for nicotine (only accurate shortly after exposure); consider test to evaluate typical exposures as well as for suspected overexposure or if symptoms are present. Even those who have smoked for a long time can reduce the risk of developing health problems by stopping.

First Aid: If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least 15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately. If this chemical contacts the skin, remove contaminated clothing and wash immediately with soap and water. Seek medical attention immediately. If this chemical has been inhaled, remove from exposure, begin rescue breathing (using universal precautions) if breathing has stopped, and CPR if heart action has stopped. Transfer promptly to a medical facility. When this chemical has been swallowed, get medical attention. Give large quantities of water and induce vomiting. Do not make an unconscious person vomit. *Note to physician or authorized medical personnel:* The use of atropine might be considered, depending on symptom.

Personal Protective Methods: Wear protective gloves and clothing to prevent any reasonable probability of dermal and/or eye contact. Safety equipment suppliers/manufacturers can provide recommendations on the most protective glove/clothing material for your operation. All protective clothing (suits, gloves, footwear, headgear) should be clean, available each day, and put on before work. Contact lenses should not be worn when working with this chemical. Wear splash-proof chemical goggles and face shield unless full facepiece respiratory protection is worn. Employees should wash immediately with soap when skin is wet or contaminated. Provide emergency showers and eyewash. Possibility of dermal and/or eye contact. Wear eye protection to prevent any possibility of eye contact. Employees should wash immediately when skin is wet or contaminated. Remove nonimpervious clothing immediately if wet or contaminated. Provide emergency showers and eyewash.

Respirator Selection: *5 mg/m^3:* Sa (APF = 10) (any supplied-air respirator); or SCBAF (APF = 50) (any self-contained breathing apparatus with a full facepiece). *Emergency or planned entry into unknown concentrations or IDLH conditions:* SCBAF: Pd,Pp (APF = 10,000) (any self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode); or SaF: Pd,Pp: ASCBA (APF = 10,000) (any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary self-contained breathing apparatus operated in a pressure-demand or other positive-pressure mode). *Escape:* GmFOv (APF = 50) [any air-purifying, full facepiece respirator (gas mask) with a chin-style, front- or back-mounted acid gas canister]; or SCBAE (any appropriate escape-type, self-contained breathing apparatus).

Note: Substance reported to cause eye irritation or damage; may require eye protection.

Storage: Color Code-Blue: Health Hazard/Poison. Store in a secure poison location. Prior to working with this chemical you should be trained on its proper handling and storage. Before entering confined space where this chemical may be present, check to make sure that an explosive concentration does not exist. Nicotine must be stored to avoid contact with strong oxidizers (such as chlorine, bromine and fluorine), strong acids (such as hydrochloric, sulfuric and nitric), since violent reactions occur. If this material contains a flammable carrier, sources of ignition, such as smoking and open flames, are prohibited where this chemical is handled, used, or stored. Metal containers involving the transfer of 5 gallons or more of this chemical should be grounded and bonded. Drums must be equipped with self-closing valves, pressure vacuum bungs, and flame arresters. Use only non-sparking tools and equipment, especially when opening and closing containers of this chemical. Wherever this chemical is used, handled, manufactured, or stored, use explosion-proof electrical equipment and fittings. Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: This compound requires a shipping label of "poisonous materials." It usually falls in Hazard Class 6.1 and Packing Group II.

Spill Handling: Evacuate and restrict persons not wearing protective equipment from area of spill or leak until clean up is complete. Establish forced ventilation to keep levels below explosive limit. Absorb liquids in vermiculite, dry sand, earth, peat, carbon, or a similar material and deposit in sealed containers. Keep this chemical out of a confined space, such as a sewer, because of the possibility of an explosion, unless the sewer is designed to prevent the build-up of explosive concentrations. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable.

Fire Extinguishing: A combustible liquid. Hazardous decomposition includes oxides of nitrogen and carbon as well as other highly toxic fumes. Nicotine is a combustible liquid. Extinguish with foam, dry chemical, or carbon dioxide extinguishers. Water may cause frothing if it gets below surface of liquid and turns to steam. However, water fog gently applied to surface will cause frothing which will extinguish the fire. Vapors are heavier than air and will collect in low areas. Vapors may travel long distances to ignition sources and flashback. Vapors in confined areas may explode when exposed to fire. Containers may explode in fire. Storage containers and parts of containers may rocket great distances, in many directions. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies. From a secure, explosion-proof location, use water spray to cool exposed containers. If cooling streams are ineffective (venting sound increases in volume and pitch, tank discolors, or shows any signs of deforming), withdraw immediately to a secure position. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode.

Disposal Method Suggested: Dissolve or mix the material with a combustible solvent and burn in a chemical incinerator equipped with an afterburner and scrubber. All federal, state, and local environmental regulations must be observed. Generators of waste containing this contaminant (≥100 kg/mo) must conform with EPA regulations governing storage, transportation, treatment, and waste disposal. Containers must be disposed of properly by following package label directions or by contacting your local or federal environmental control agency, or by contacting your regional EPA office. Consult with environmental regulatory agencies for guidance on acceptable disposal practices.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- USEPA, Office of Pesticide Programs, Pesticide Residue Limits, “Nicotine,” 40 CFR 180.167. http://www.epa.gov/pesticides/food/viewtols.htm
- New Jersey Department of Health and Senior Services, "Hazardous Substance Fact Sheet: Nicotine,” Trenton, NJ (January 1988, rev. March 2000). http://www.state.nj.us/health/eoh/rtkweb/1349.pdf
- Sax, N. I., Ed., “Dangerous Properties of Industrial Materials Report,” 1, No. 8, 84-85 (1981) and 5, No. 4, 82-85 (1985)
- USEPA, “Chemical Profile: Nicotine,” Washington DC, Chemical Emergency Preparedness Program (Nov.30, 1987)

Nicotine sulfate N:0310

Use Type: Insecticide, Miticide, Veterinary medicine

CAS Number: 65-30-5

Formula: $C_{10}H_{18}N_2O_8S_2$; $C_{10}H_{14}N_2 \cdot 2H_2SO_4$

Synonyms: ENT 2,435; 1-1-Methyl-2-(3-pyridyl)-pyrrolidine sulfate; (*S*)-3-(1-Methyl-2-pyrrolidinyl)pyridine sulfate (2:1); 1-3-(1-Methyl-2-pyrrolidinyl)pyridine sulfate; Nicotine sulfate (2:1); Nicotine sulphate; Nicotine sulphate (2:1); Pyridine, 3-(1-methyl-2-pyrrolidinyl)-, (*S*)-, sulfate (2:1); Pyrrolidine, 1-methyl-2-(3-pyridyl)-, sulfate; Sulfato de nicotina (Spanish)

Chemical class: Botanical; Alkaloid

EPA/OPP PC Code: 056703

California DPR Chemical Code: 430

HSDB Number: 805

UN/NA & ERG Number: UN1658 (solution)/151; UN3445 (solid)/151

RTECS® Number: QS9625000

EC Number: 200-606-7[*Annex I Index No.:* 614-002-00-X]

Uses: Nicotine sulphate is an insecticide of plant origin and is effective against a wide variety of insect pests. It is also used in veterinary medicine as an anthelmintic and external parasiticide. It is used to kill aphids, thrips, bugs, worms, leaf-hoppers and similar sucking insects which attack and destroy fruit, vegetables, crops and even flowers. It is also effective against lice, mites, and ticks. No longer registered in the U.S. or in European countries. There are more than 20 global suppliers[97].

Regulatory Authority and Advisory Information:

Superfund/EPCRA 302 Extremely Hazardous Substances: TPQ = 100/10,000 lb (45.4/4,540 kg)

Health Advisory: Developmental/Reproductive Toxin

Superfund/EPCRA 40CFR302.4 RQ: EHS, 1 lb (0.454 kg)

EPCRA Section 313 Form R *de minimis* concentration reporting level: 1.0%

European/International Regulations (*nicotine salts*): Hazard Symbol: T+, N; risk phrases: R26/27/28; safety phrases: S1/2; S13; S28; S45 (see Appendix 1)

Description: Nicotine sulfate is a white crystalline solid or powder. Odorless. Commercial product may be an aqueous solution. It is usually clear and colorless. Molecular weight = 418.56; 422.55[HSDB,EPA]; Specific gravity

(H_2O:1) = 1.15 @ 20 °C; Freezing/Melting point = (decomposes); Vapor pressure = 10^{-5} mmHg @ 25 °C; Autoignition temperature = 244 °C. Hazard Identification (based on NFPA-704 M Rating System): Health 3, Flammability 0, Reactivity 0. Soluble in water.

Incompatibilities: Incompatible with oxidizing materials. Keep away from heat.

Permissible Exposure Limits in Air:

OSHA PEL: 0.5 mg/m^3 TWA [skin], as nicotine
NIOSH REL: 0.5 mg/m^3 TWA [skin], as nicotine
ACGIH TLV®[1]: 0.5 mg/m^3 TWA [skin], as nicotine
NIOSH IDLH: 5 mg/m^3
Protective Action Criteria (PAC) Ver. 27[89]
PAC-1: 0.82 mg/m^3
PAC-2: 9 mg/m^3
PAC-3: 9 mg/m^3

Permissible Concentration in Water: Runoff from spills or fire control may cause water pollution.

Routes of Entry: Inhalation, ingestion, skin and/or eye contact.

Harmful Effects and Symptoms

Short Term Exposure: Very toxic by inhalation, dermal and/or eye contact, ingestion. The liquid irritates the eyes and skin. Inhalation irritates nose and throat. May affect the central nervous system, causing convulsions and respiratory failure. Exposure at high concentrations may result in death. Onset of acute poisoning is rapid. Symptoms include nausea, salivation, abdominal pain, vomiting, diarrhea, cold sweat, headache, dizziness, disturbed hearing and vision, mental confusion, marked weakness, faintness and prostration, lowered blood pressure, difficult breathing, and weak, rapid and irregular pulse. It is classified as super toxic. Death is possible from respiratory failure caused by paralysis of the respiratory muscles. LD_{50} (oral, rat) = 90 mg/kg; (dermal, rat) = 285 mg/kg.

Long Term Exposure: Animal tests show that this substance possibly causes toxic effects upon human reproduction. LD_{50} (mouse, oral) = 8.54 mg/kg.

First Aid: If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least 15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately. If this chemical contacts the skin, remove contaminated clothing and wash immediately with soap and water. Seek medical attention immediately. If this chemical has been inhaled, remove from exposure, begin rescue breathing (using universal precautions) if breathing has stopped, and CPR if heart action has stopped. Transfer promptly to a medical facility. When this chemical has been swallowed, get medical attention. Give large quantities of water and induce vomiting. Do not make an unconscious person vomit.

Personal Protective Methods: Wear protective gloves and clothing to prevent any reasonable probability of dermal and/or eye contact. Safety equipment suppliers/manufacturers can provide recommendations on the most protective glove/clothing material for your operation. All protective clothing (suits, gloves, footwear, headgear) should be clean, available each day, and put on before work. Contact lenses should not be worn when working with this chemical. Wear dust-proof chemical goggles and face shield unless full facepiece respiratory protection is worn. Employees should wash immediately with soap when skin is wet or contaminated. Provide emergency showers and eyewash.

Respirator Selection: SCBA >0.82 mg/m^3. Follow regulations in OSHA 29CFR1910.134 or European Standard EN149. Use a NIOSH/MSHA- or European Standard EN149-approved respirator; or use an approved supplied-air respirator with a full facepiece operated in the positive-pressure mode, or with a full facepiece, hood, or helmet in the continuous-flow mode; or use a NIOSH/MSHA- or European Standard EN149-approved self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive-pressure mode.

Storage: Color Code-Blue: Health Hazard/Poison. Store in a secure poison location. Prior to working with this chemical you should be trained on its proper handling and storage. Store in tightly closed containers in a cool, well-ventilated area away from oxidizers. Metal containers involving the transfer of 5 gallons or more of this chemical should be grounded and bonded. Drums must be equipped with self-closing valves, pressure vacuum bungs, and flame arresters. Use only non-sparking tools and equipment, especially when opening and closing containers of this chemical. Wherever this chemical is used, handled, manufactured, or stored, use explosion-proof electrical equipment and fittings. Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: This compound requires a shipping label of "poisonous materials." It usually falls in Hazard Class 6.1 and Packing Group II.

Spill Handling: *Solid:* First remove all sources of ignition. Evacuate persons not wearing protective equipment from area of spill or leak until clean up is complete. Use HEPA vacuum or wet method to reduce dust during clean up. Do not dry sweep. Collect powdered material in the most convenient and safe manner and deposit in sealed containers. Ventilate area after cleanup is complete. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable.

Solution: Evacuate and restrict persons not wearing protective equipment from area of spill or leak until clean up is complete. Ventilate area of spill or leak. To clean up, do not touch spilled material; stop leak if possible. Use water spray to reduce vapors. *Small spills*: take up with sand or other noncombustible absorbent material and place into containers for disposal. Small dry spill: with clean shovel place material into clean, dry container and cover; move containers from spill area. *Large spills*: dike far ahead of spill for later disposal. Keep this chemical out of a confined space, such as a sewer, because of the possibility of an explosion, unless the sewer is designed to prevent the build-up of explosive concentrations. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable.

Fire Extinguishing: Decomposition includes oxides of nitrogen, sulfur, carbon, and other toxic fumes. As for nicotine, extinguish with alcohol foam, dry chemical, or carbon dioxide. Large fires can be extinguished with water spray, fog, or foam. Wear positive-pressure breathing apparatus and special protective clothing. Dike fire-control water; do not scatter the material. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies. From a secure, explosion-proof location, use water spray to cool exposed containers. If cooling streams are ineffective (venting sound increases in volume and pitch, tank discolors, or shows any signs of deforming), withdraw immediately to a secure position. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode.

Disposal Method Suggested: Do not discharge into drains or sewers. Dispose of waste material as hazardous waste using a licensed disposal contractor to an approved landfill. Consult with environmental regulatory agencies for guidance on acceptable disposal practices. If allowed, incineration with effluent gas scrubbing is recommended. Containers must be disposed of properly by following package label directions or by contacting your local or federal environmental control agency, or by contacting your regional EPA office.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- New Jersey Department of Health and Senior Services, "Hazardous Substance Fact Sheet, Nicotine Sulfate," Trenton, NJ (April 2002). http://www.state.nj.us/health/eoh/rtkweb/1352.pdf
- Sax, N. I., Ed., "Dangerous Properties of Industrial Materials Report," 5, No. 4, 88-90 (1985)
- USEPA, "Chemical Profile: Nicotine Sulfate," Washington DC, Chemical Preparedness Program (Nov.30, 1987)

Norflurazon N:07100

Use Type: Herbicide

CAS Number: 27314-13-2

Formula: $C_{12}H_9ClF_3N_3O$

Synonyms: Caswell No. 195AA; 4-Chloro-5-(methylamino)-2-[3-(trifluoromethyl)phenyl]-3(2H)-pyridazinone; 4-Chloro-5-methylamino-2-(3-trifluoromethylphenyl) pyridazin-3-one; 4-Chloro-5-(methylamino)-2-(α,α,α-trifluoro-m-tolyl)-3(2H)-pyridazinone; 4-Chloro-5-methylamino-2-(α,α,α-trifluoro-*m*-tolyl) pyridazinone-3(2H)-one; 4-Chloro-5-(methylamino)-2-[3-(trifluoromethyl)phenyl]-3(2H)-pyridazinone; Dodecylbenzenesulfonic acid, triethanolamine salt; Monomethflurazone; Norflurazon pyridazine herbicide; 3(2H)-Pyridazinone, 4-chloro-5-(methylamino)-2-[3-(trifluoromethyl)phenyl]-; 3(2H)-Pyridazinone, 4-chloro-5-(methylamino)-2-(α,α,α-trifluoro-*m*-tolyl)-; Triethanolamine dodecylbenzenesulfonate

Trade Names: EVITAL®; H 9789®; SAN 9789 H®; SAN 97895®; SOLICAM®; TELOK®[C]; TRIETHANOLAMINE DBS®; ZORIAL®

Chemical class: Pyridazinone (fluorinated)

EPA/OPP PC Code: 105801

California DPR Chemical Code: 2019

HSDB Number: 6845

UN/NA & ERG Number: UN3077(solid)/171

RTECS® Number: UR6150000

EC Number: 248-397-1

Uses: Norflurazon is a selective preemergent herbicide used to control germinating annual grasses, sedges, rushes and broadleaf weeds in fruits (cranberries, citrus, cherries, nectarines, apricots), grape vines, vegetables, nuts, cotton, peanuts, soybeans, and various nonagricultural and industrial areas. Forbidden for use in the EU after 7/25/2003. Registered for use in the U.S. Manufactured in the US by Clariant Corporation, North Carolina.

U.S. Maximum Allowable Residue Levels for Norflurazon (40 CFR 180.356): alfalfa, forage 3.0 ppm; alfalfa, hay 5.0 ppm; alfalfa, seed 0.1 ppm; almond 0.1 ppm; almond, hulls 1.0 ppm; apple 0.1 ppm; apricot 0.1 ppm; asparagus 0.05 ppm; avocado 0.2 ppm; blackberry 0.1 ppm; blueberry 0.2 ppm; cattle, fat 0.1 ppm; cattle, liver 0.25 ppm; cattle, meat 0.1 ppm; cattle, meat byproducts 0.1 ppm; cattle, meat byproducts except liver 0.1 ppm; cherry 0.1 ppm; citrus, dried pulp 0.4 ppm; citrus, molasses 1.0 ppm; cottonseed 0.1 ppm; cotton, undelinted seed 0.1 ppm; cranberry 0.1 ppm; dried citrus pulp 0.4 ppm; filbert 0.1 ppm; goat, fat 0.1 ppm; goat, liver 0.25 ppm; goat, meat 0.1 ppm; goat, meat byproducts 0.1 ppm; goat, meat byproducts except liver 0.1 ppm; grape 0.1 ppm; hog, fat 0.1 ppm; hog, liver 0.25 ppm; hog, meat 0.1 ppm; hog, meat byproducts 0.1 ppm; hog, meat byproducts except liver 0.1 ppm; hop, fresh 1.0 ppm; horse, fat 0.1 ppm; horse, liver 0.25 ppm; horse, meat 0.1 ppm; horse, meat byproducts 0.1 ppm; horse, meat byproducts 0.1 ppm; milk 0.1 ppm; nectarine 0.1 ppm; peach 0.1 ppm; peanut 0.05 ppm; peanut,vines

1.5 ppm; Peanut, hay 5.5 ppm; pear 0.1 ppm; pecan 0.1 ppm; plums (fresh prunes) 0.1 ppm; poultry, fat 0.1 ppm; poultry, meat 0.1 ppm; poultry, meat byproducts 0.1 ppm; raspberry 0.1 ppm; sheep, fat 0.1 ppm; sheep, liver 0.25 ppm; sheep, meat 0.1 ppm; sheep, meat byproducts 0.1 ppm; sheep, meat byproducts except liver 0.1 ppm; soybean 0.1 ppm; soybean, forage 1.0 ppm; soybean, hay 1.0 ppm; walnut 0.1 ppm.

Regulatory Authority and Advisory Information:

Carcinogenicity[83]: EPA Group C, Possible human carcinogen

Potential Ground Water Pollutant [California FAC Section 13149]

Acute Oral Category: 4, Caution, not acutely toxic

EPCRA Section 313 Form R *de minimis* concentration reporting level: 1.0%

Description: White to gray-brown crystalline solid or powder. Odorless. Molecular weight = 303.67; Specific gravity (H_2O:1) = 1.45; Freezing/Melting point = 184 °C; Vapor pressure = 2.3×10^{-8} mm @ 20 °C. Slightly soluble in water; solubility = 30 mg/L.

Incompatibilities: Rapidly degraded by strong light; UV. Incompatible with oxidizers, chlorates nitrates, peroxides.

Permissible Concentration in Water: Federal Drinking Water Guidelines: 10 ppb[14].

Determination in Water: Log K_{ow} = <2.5. Unlikely to bioaccumulate in marine organisms.

Routes of Entry: Ingestion, dermal and/or eye contact.

Harmful Effects and Symptoms

Short Term Exposure: Contact may irritate skin and cause eye irritation and possible severe injury. Inhalation should be avoided; use NIOSH- or CEN (UK)-approved air-purifying respirators for pesticides. Poisonous if swallowed. LD_{50} (oral, rat) = >5 g/kg; (dermal, rat) = >7.5 g/kg.

Long Term Exposure: May cause liver cancer. Fluorides may cause bone disease (pain and tenderness of the bones); mottled teeth in children.

Points of Attack: Liver, ovary, uterus, thyroid; central nervous system, bones.

Medical Surveillance: Preliminary medical exam to detect chronic diseases of central nervous system, liver, heart, kidneys, lung and skin, as well as endocrinological or immunological disturbances, should protect susceptible individuals. Periodical medical exams of internal organs, skin and eyes are important to avoid chronic occupational intoxications. They should include lab and patch tests when necessary[83]. This chemical is a suspected or known human carcinogen. Exposed persons should contact a physician for advice regarding the possible long term health effects and advice for medical monitoring. Liver function tests. See medical help if poisoning is suspected or if redness, itching, burning of skin or eyes develop.

First Aid: If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least 15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately. If this chemical contacts the skin, remove contaminated clothing and wash immediately with soap and water. If this chemical has been inhaled, remove from exposure, begin rescue breathing (using universal precautions) if breathing has stopped, and CPR if heart action has stopped. Transfer promptly to a medical facility. When this chemical has been swallowed, get medical attention. Give large quantities of water and induce vomiting. Do not make an unconscious person vomit.

Personal Protective Methods: Applicators and other handlers must wear: Coveralls worn over long-sleeved shirt and long pants; Chemical-resistant gloves such as DuPont™ Tychem® suit fabrics, barrier laminate, or Viton®; Chemical-resistant footwear plus socks; Protective eye wear; Chemical-resistant headgear for overhead exposure; Chemical-resistant apron when cleaning equipment, mixing, or loading[83]. Agricultural Use/Engineering Controls: When handlers use closed systems, enclosed cabs, or aircraft in a manner that meets the requirements listed in the Worker Protection Standard (WPS) for agricultural pesticides, ***40 CFR 170.240(d)(4-6)***, the handler PPE requirements may be reduced or modified as specified in the Worker Protection Standard. Firefighters should wear NIOSH-approved self-contained breathing apparatus and full protective clothing.

Respirator Selection: *At any detectable concentration:* SCBAF: Pd,Pp (APF = 10,000) (any NIOSH/MSHA- or European Standard EN 149-approved self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode); or SaF: Pd,Pp: ASCBA (APF = 10,000) (any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary, self-contained breathing apparatus operated in a pressure-demand or other positive-pressure mode). *Escape:* 100F (APF = 50) (any air-purifying, full facepiece respirator with an N100, R100, or P100 filter k-mounted organic vapor canister having a high-efficiency particulate filter); or SCBAE (any appropriate escape-type, self-contained breathing apparatus).

Storage: Color Code-Blue: Health Hazard/Possible Human Carcinogen: Store in a tightly closed container in a dry, well-ventilated and secure poison location. Prior to working with this chemical you should be trained on its proper handling and storage. Where possible, automatically transfer material from other storage containers to process containers. Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: Environmentally hazardous substances, solid or liquid, usually fall in Hazard Class 9.

Spill Handling: Careful, a possible carcinogen. For solids, *small spill*, isolate spill or leak area in all directions for at least 25 meters/75 feet. Increase, in the downwind direction, as necessary. For a *large spill* evacuate downwind at least 100 meters/330 feet. Do not touch damaged containers or spilled material unless wearing appropriate protective clothing. Stop leak if you can do it without risk. Keep combustibles (wood, paper, oil, etc.) away from spilled material. Do not allow water to get inside containers. *Small dry spill*: with clean shovel place material into clean, dry container and cover loosely; move containers from spill area. *Large spill*: dike far ahead of liquid spill for later disposal. Following product recovery, flush area with water. Prevent entry into waterways, sewers, basements or confined areas. Cover with plastic sheet to prevent spreading. Absorb or cover with dry earth, sand or other non-combustible material and transfer to containers. Do not allow water to get inside containers. Prevent entry into waterways, sewers, basements or confined areas. Cover with plastic sheet to prevent spreading. Absorb or cover with dry earth, sand or other noncombustible material and transfer to containers.

Fire Extinguishing: Hazardous decomposition includes toxic gases, including oxides of nitrogen, carbon, hydrogen fluoride and hydrogen chloride gases. As an immediate precautionary measure, isolate spill or leak area in all directions for at least 50 meters/150 feet for liquids and at least 25 meters/75 feet for solids. *Fire involving storage or vehicular tanks:* isolate for 800 meters/0.5 mile in all directions; also, consider initial evacuation for 800 meters/0.5 mile in all directions. *On a small fire:* use dry chemical, CO_2, water spray or regular foam. *On a large fire:* use water spray, fog or regular foam. Do not scatter spilled material with high-pressure streams of water. Move containers from fire area if you can do it without risk. Dike fire-control water for later disposal. *Fire involving tanks:* from a secure, explosion-proof location, use water spray to cool exposed containers. If cooling streams are ineffective (venting sound increases in volume and pitch, tank discolors, or shows any signs of deforming), withdraw immediately to a secure position. Always stay away from tanks engulfed in fire. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode.

Disposal Method Suggested: It is the responsibility of chemical waste generators to determine the toxicity and physical properties of a discarded chemical and to properly identify its classification and certification as a hazardous waste and to determine the disposal method. U.S. EPA guidelines for the classification determination are listed in 40 CFR Parts 261.3. Additionally, waste generators must consult and follow all regional, national, state and local hazardous waste laws to ensure complete and accurate classification and disposal methods. Follow recommendations for the disposal of pesticides and pesticide containers. Containers must be disposed of properly by following package label directions or by contacting your local or federal environmental control agency, or by contacting your regional EPA office.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- USEPA, Office of Pesticide Programs, Pesticide Residue Limits, "Norflurazon," 40 CFR 180.356. http://www.epa.gov/pesticides/food/viewtols.htm
- USEPA, "Reregistration Eligibility Decision (RED), Norflurazon," Office of Prevention, Pesticides and Toxic Substances, Washington DC
- Pesticide Management Education Program, "Norflurazon (Zorial, Solicam Herbicide profile 12/84," Cornell University, Ithaca, NY (December 1984). http://pmep.cce.cornell.edu/profiles/herb-growthreg/naa-rimsulfuron/norflurazon/herb-prof-norflurazon.html

O

Oryzalin O:0138

Use Type: Herbicide
CAS Number: 19044-88-3
Formula: $C_{12}H_{18}N_4O_6S$
Synonyms: Benzenesulfonamide, 4-(dipropylamino)-3,5-dinitro-; Caswell No. 623A; 3,5-Dinitro-N^4,N^4-dipropyl sulfanilamide; 3,5-Dinitro-N^4,N^4-dipropylsulfanilamide; 3,5-Dinitro-N^4,N^4-dipropyl sulphanilamide; 4-(Dipropylamino)-3,5-dinitrobenzene sulfonamide; Sulfanilamide, 3,5-dinitro-N^4,N^4-dipropyl-
Trade Names: AGVALUE®; COMPOUND 67019®; DIRIMAL®; EL-119®; EXCEL-S-PLUS®; EXPEDITE®; FLEXLAN®; NATIONS AG II®; ORYZA®; PRO-TECK®; ROUT®; RYCELAN®; RYZELAN®; SNAPSHOT®; SURFLAN®; TURF FERTILIZER®; XL 2G®
Chemical class: 2,6-Dinitroaniline
EPA/OPP PC Code: 104201
California DPR Chemical Code: 1868
HSDB Number: 6858
UN/NA & ERG Number: UN1596 (Dinitroanilines)/153; UN3077(solid)/171
RTECS® Number: WO9350000
EC Number: 242-777-0
Uses: Oryzalin is used to control annual grasses, herbaceous plants, woody shrubs, vines and broadleaf weeds on fruit and nut trees, soya beans, peas, sweet potatoes, berries, vine and crops, cotton, Christmas tree plantations, commercial/industrial and recreation area lawns, golf course turf, residential lawns and turf, ornamental and/or shade trees, nonagricultural rights-of-way, nonagricultural uncultivated and industrial areas, power stations, paths/patios and paved areas.
U.S. Maximum Allowable Residue Levels for Oryzalin [40 CFR 180.304 (a)]: in or on the following raw agricultural commodities: almond, hulls 0.05 ppm; avocados 0.05 ppm; citrus fruits 0.05 ppm; fig 0.05 ppm; kiwifruit 0.05 ppm; nut, tree, group 0.05 ppm; olive 0.05 ppm; pistachio 0.05 ppm; pome fruits 0.05 ppm; pomegranates 0.05 ppm; small fruits 0.05 ppm; and stone fruits 0.05 ppm. ***[40 CFR 180.304 (b)]:*** in or on the following raw agricultural commodities: guava 0.05 ppm; and papayas 0.05 ppm.
Regulatory Authority and Advisory Information:
U.S. EPA Carcinogens, Likely to be a human carcinogen
Health Advisory: Mutagen.
Acute Oral Category: 4, Caution
Potential Ground Water Pollutant [California FAC Section 13145(d)/12811, active]
EPCRA Section 313 Form R *de minimis* concentration reporting level: 1.0%
Regulations: Hazard Symbol: Xn, N; risk phrases: R40; R43; safety phrases: S2; S50/53 (see Appendix 1).

Description: Yellow-orange crystalline solid or powder. Odorless. Molecular weight = 346.36; Specific gravity (H_2O:1) = 1.2; Boiling point = (decomposes); Freezing/Melting point = 138 °C; Vapor pressure = 1.2×10^{-8} mm @ 20 °C. Low solubility in water; solubility = 2.49 mg/L.
Incompatibilities: Incompatible with oxidizers and alkaline materials. Slowly hydrolyzes in water, releasing ammonia and forming acetate salts. Decomposes at 265 °C releasing toxic oxides of nitrogen, sulfur and carbon. Decomposed by strong ultraviolet light.
Permissible Concentration in Water: Runoff from spills or fire control may cause water pollution. State Drinking Water Guidelines: Florida 350 μg/L.
Determination in Water: Log K_{ow} = >3.5. Values above 3.0 are likely to bioaccumulate in aquatic organisms.

Harmful Effects and Symptoms
Short Term Exposure: Slight irritant to skin, eyes and mucous membranes. Dermatitis may develop. Potential liver, kidney, and spleen toxin. LD_{50} (oral, rat) = >7 g/kg; (dermal, rat) = >2 g/kg.
Long Term Exposure: May cause skin sensitization. This chemical can bio-accumulate. A potential human carcinogen.
Points of Attack: Liver, kidney, spleen, skin.
Medical Surveillance: Preliminary medical exam to detect chronic diseases of central nervous system, liver, heart, kidneys, lung and skin, as well as endocrinological or immunological disturbances, should protect susceptible individuals. Periodical medical exams of internal organs, skin and eyes are important to avoid chronic occupational intoxications. They should include lab and patch tests when necessary[83]. Kidney, spleen, and liver function tests. Evaluation by a qualified allergist, including exposure history and testing, may help diagnose allergy.
First Aid: If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least 15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately. If this chemical contacts the skin, remove contaminated clothing and wash immediately with soap and water. Seek medical attention immediately. If this chemical has been inhaled, remove from exposure, begin rescue breathing (using universal precautions) if breathing has stopped, and CPR if heart action has stopped. Transfer promptly to a medical facility. When this chemical has been swallowed, get medical attention. Give large quantities of water and induce vomiting. Do not make an unconscious person vomit.
Personal Protective Methods: Dinitroanilines react with cellulose-based and expanded polymeric absorbents[88]. Reacts with the following absorbent materials: Cellulose-Based; Mineral- and Clay-Based; Expanded Polymeric[88]. Wear

protective gloves and clothing to prevent any reasonable probability of dermal and/or eye contact. Safety equipment suppliers/manufacturers can provide recommendations on the most protective glove/clothing material for your operation. All protective clothing (suits, gloves, footwear, headgear) should be clean, available each day, and put on before work. Contact lenses should not be worn when working with this chemical. Wear dust-proof chemical goggles and face shield unless full facepiece respiratory protection is worn. Employees should wash immediately with soap when skin is wet or contaminated. Provide emergency showers and eyewash.

Respirator Selection: *At any detectable concentration:* SCBAF: Pd,Pp (APF = 10,000) (any NIOSH/MSHA- or European Standard EN 149-approved self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode); or SaF: Pd,Pp: ASCBA (APF = 10,000) (any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary, self-contained breathing apparatus operated in a pressure-demand or other positive-pressure mode). *Escape:* 100F (APF = 50) (any air-purifying, full facepiece respirator with an N100, R100, or P100 filter k-mounted organic vapor canister having a high-efficiency particulate filter); or SCBAE (any appropriate escape-type, self-contained breathing apparatus).

Storage: (1) Color Code-Yellow Stripe: Reactivity Hazard; Store separately in an area isolated from flammables, combustibles, or other yellow-coded materials. (2) Color Code-Blue: Health Hazard/Poison. Store in a secure poison location. Prior to working with this chemical you should be trained on its proper handling and storage. Before entering confined space where this chemical may be present, check to make sure that an explosive concentration does not exist. Store in tightly closed containers in a cool, well-ventilated area away from oxidizers, strong acids, strong bases and other incompatible materials listed above. Metal containers involving the transfer of this chemical should be grounded and bonded. Drums must be equipped with self-closing valves, pressure vacuum bungs, and flame arresters. Use only non-sparking tools and equipment, especially when opening and closing containers of this chemical. If this material contains a flammable carrier, sources of ignition, such as smoking and open flames, are prohibited where this chemical is used, handled, or stored in a manner that could create a potential fire or explosion hazard. Wherever this chemical is used, handled, manufactured, or stored, use explosion-proof electrical equipment and fittings. Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: Environmentally hazardous substances, solid or liquid, usually fall in Hazard Class 9. Dinitroanilines require a label of "poisonous materials." They usually fall into Hazard Group 6.1.

Spill Handling: First remove all sources of ignition. Evacuate persons not wearing protective equipment from area of spill or leak until clean up is complete. Do not dry sweep. Collect powdered material in the most convenient and safe manner and deposit in sealed containers. Ventilate area after clean up is complete. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable.

Fire Extinguishing: Decomposes above 250°C releasing toxic oxides of nitrogen, sulfur and carbon. As an immediate precautionary measure, isolate spill or leak area in all directions for at least 50 meters/150 feet for liquids and at least 25 meters/75 feet for solids. *Fire involving storage or vehicular tanks:* isolate for 800 meters/0.5 mile in all directions; also, consider initial evacuation for 800 meters/0.5 mile in all directions. *On a small fire:* use dry chemical, CO_2, water spray or regular foam. *On a large fire:* use water spray, fog or regular foam. Do not scatter spilled material with high pressure streams of water. Move containers from fire area if you can do it without risk. Dike fire-control water for later disposal. *Fire involving tanks:* from a secure, explosion-proof location, use water spray to cool exposed containers. If cooling streams are ineffective (venting sound increases in volume and pitch, tank discolors, or shows any signs of deforming), withdraw immediately to a secure position. Always stay away from tanks engulfed in fire. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode.

Disposal Method Suggested: Do not discharge into drains or sewers. Dispose of waste material as hazardous waste using a licensed disposal contractor to an approved landfill. Consult with environmental regulatory agencies for guidance on acceptable disposal practices. Incineration with effluent gas scrubbing is recommended. Containers must be disposed of properly by following package label directions or by contacting your local or federal environmental control agency, or by contacting your regional EPA office.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- USEPA, "Reregistration Eligibility Decision (RED), Oryzalin," Office of Prevention, Pesticides and Toxic Substances, Washington DC (September 1994). http://www.epa.gov/REDs/0186.pdf
- USEPA, Office of Pesticide Programs, Pesticide Residue Limits, "Oryzalin," ***40 CFR 180.304***. http://www.epa.gov/pesticides/food/viewtols.htm

- EXTOXNET, Extension Toxicology Network, "Pesticide Information Profile, Oryzalin," Oregon State University, Corvallis, OR (June 1996). http://extoxnet.orst.edu/pips/oryzalin.htm

Oxadiazon O:0154

Use Type: Herbicide

CAS Number: 19666-30-9

Formula: $C_{15}H_{18}Cl_2N_2O_3$

Synonyms: 2-*tert*-Butyl-4-(2,4-dichloro-5-isopropoxyphenyl-δ(sup2)-1,3,4-oxadiazoline-5-one; 5-*tert*-Butyl-3-(2,4-dichloro-5-isopropoxyphenyl)-1,3,4-oxadiazol-2(3*H*)-one; 2-*tert*-Butyl-4-(2,4-dichloro-5-isopropoxyphenyl)-δ(*sup2*)-1,3,4-oxadiazolin-5-one; 2-*tert*-Butyl-4-(2,4-dichloro-5-isopropyloxyphenyl)-1,3,4-oxadiazolin-5-one; CASWELL No. 624A; 3-(2,4-Dichloro-5-isopropyloxy-phenyl)-δ(sup4)4-5-(*tert*-butyl)-1,3,4-oxadiaz oline-2-one; 3-(2,4-Dichloro-5-(1-methylethoxy)phenyl)-5-(1,1-dimethylethyl)-1,3,4-oxadiazol-2(3*H*)-one; δ(sup2)2-1,3,4-Oxadiazolin-5-one, 2-*tert*-butyl-4-(2,4-dichloro-5-isopropyloxyphenyl)-; 1,3,4-Oxadiazol-2(3*H*)-one, 3-(2,4-dichloro-5-(1-methylethoxy)phenyl)-5-(1,1-dimethylethyl)-; Oxadiazone; 1,3,4-Oxazol-2(3*H*)-one, 3-[2,4-dichloro-5-(1-methylethoxy)phenyl]-5-(1,1-dimethylethyl)-

Trade Names: CARPETMAKER®; CHIP SHOT®[C]; GOLD KIST®; PAR EX®; PRO GROW®; REGAL O-O®; REGALSTAR®; RONSTAR®; RP-17623®; TURFIC®; VERTAGREEN®; WILBRO®

Chemical class: Oxadiazolinone; Oxidiazole

EPA/OPP PC Code: 109001; (597900 old EPA code number)

California DPR Chemical Code: 2017

HSDB Number: 6936

UN/NA & ERG Number: UN3077(solid)/171

RTECS® Number: RO0874000

EC Number: 243-215-7 [*Annex I Index No.:* 606-045-00-8]

Uses: A pre-emergence and early post-emergence control for annual grasses, sedges and broadleaf weeds. Originally registered for use on turf and ornamentals and has wide use on golf courses.

U.S. Maximum Allowable Residue Levels for Oxidiazon its metabolites (2-tert-butyl-4-(2,4-dichloro-5-hydroxyphenyl)delta2-1,3,4-oxadiazolin-5-one) and 2-carboxy isopropyl-4-(2,4-dichloro-5-isopropoxyphenyl)delta2-1,3,4-oxadiazolin-5-one) [40 CFR 180.346]: in or on raw agricultural commodities as follows: (N) negligible residues milk fat 0.1 ppm; (N) negligible residue in the meat, fat, and meat byproducts of cattle: goats, hogs, horses, and sheep 0.01 ppm. (N) = negligible amount of residue.

Regulatory Authority and Advisory Information:

Carcinogenicity[83]: EPA Group C, Possible human carcinogen

California Proposition 65 Chemical: Carcinogen (7/1/1991) and developmental toxin (5/15/1998)

Health Advisory: Mutagen

Acute Oral Category: 3, CAUTION

EPCRA Section 313 Form R *de minimis* concentration reporting level: 1.0%

European/International Regulations: Hazard Symbol: N; risk phrases: R50/53; safety phrases: S2; S60; S61 (see Appendix 1)

Description: Colorless crystalline solid. Odorless. Molecular weight = 345.22; Boiling point = 281.5 °C; Freezing/Melting point = 89 °C; Vapor pressure = 1.15×10^{-7} mm @ 20 °C[83,USDA]. Low solubility in water; solubility = 0.7 mg/L @ 20 °C.

Incompatibilities: Dust forms explosive mixture in air. Incompatible with oxidizers.

Determination in Air: Filter; none; Gravimetric; NIOSH IV [Particulates NOR; #0500 (total), #0600 (respirable)][18].

Determination in Water: Log K_{ow} = >4.5. Values above 3.0 are likely to bioaccumulate in aquatic organisms.

Routes of Entry: Inhalation, dermal and/or eye contact.

Harmful Effects and Symptoms

Short Term Exposure: May irritate the eyes and skin. LD_{50} (oral, rat) = >3 g/kg[83]; (dermal, rat) = >2 g/kg.

Long Term Exposure: Frequent or prolonged exposure may cause cancer. Fluorides may cause bone disease (pain and tenderness of the bones); mottled teeth in children. May cause liver problems. Repeated exposure may cause weight loss and reduced red blood cell count. May be mutagenic.

Points of Attack: Liver, blood, bones; may affect fetus.

Medical Surveillance: Preliminary medical exam to detect chronic diseases of central nervous system, liver, heart, kidneys, lung and skin, as well as endocrinological or immunological disturbances, should protect susceptible individuals. Periodical medical exams of internal organs, skin and eyes are important to avoid chronic occupational intoxications. They should include lab and patch tests when necessary[83]. This chemical is a suspected or known human carcinogen. Exposed persons should contact a physician for advice regarding the possible long term health effects and advice for medical monitoring. Test for anemia, liver function tests. In addition to comprehensive initial medical and work histories emphasizing reproductive experience and menstrual history, patient should have physical examination and testing of genito-urinary tract, sperm count, motility and morphology. If required, other tests, such as serum testosterone, serum follicle stimulating hormone (FSH), and serum lutenizing hormone (LH), may be indicated.

First Aid: If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least 15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately. If this chemical contacts the skin, remove contaminated clothing and wash immediately with soap and water. Seek medical attention immediately. If this chemical has been inhaled, remove from exposure, begin rescue breathing (using universal precautions) if breathing has stopped, and CPR if heart action has stopped. Transfer promptly to a medical facility. When this chemical has been swallowed, get medical attention. Give large quantities of water and induce vomiting. Do not make an unconscious person vomit. Do not induce vomiting when formulations containing petroleum solvents are ingested

Personal Protective Methods: Applicators and other handlers must wear: Coveralls worn over long-sleeved shirt and long pants; Chemical-resistant gloves such as DuPont™ Tychem® suit fabrics, barrier laminate, or Viton®; Chemical-resistant footwear plus socks; Protective eye wear; Chemical-resistant headgear for overhead exposure; Chemical-resistant apron when cleaning equipment, mixing, or loading[83]. Agricultural Use/Engineering Controls: When handlers use closed systems, enclosed cabs, or aircraft in a manner that meets the requirements listed in the Worker Protection Standard (WPS) for agricultural pesticides, ***40 CFR 170.240(d)(4-6)***, the handler PPE requirements may be reduced or modified as specified in the Worker Protection Standard. Firefighters should wear NIOSH approved self-contained breathing apparatus and full protective clothing.

Respirator Selection: *At any detectable concentration:* SCBAF: Pd,Pp (APF = 10,000) (any NIOSH/MSHA- or European Standard EN 149-approved self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode); or SaF: Pd,Pp: ASCBA (APF = 10,000) (any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary, self-contained breathing apparatus operated in a pressure-demand or other positive-pressure mode). *Escape:* 100F (APF = 50) (any air-purifying, full facepiece respirator with an N100, R100, or P100 filter k-mounted organic vapor canister having a high-efficiency particulate filter); or SCBAE (any appropriate escape-type, self-contained breathing apparatus).

Storage: Color Code-Blue: Health Hazard/Possible Human Carcinogen: Store in a tightly closed container in a dry, well-ventilated and secure poison location. Prior to working with this chemical you should be trained on its proper handling and storage. Where possible, automatically transfer material from other storage containers to process containers. Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: Environmentally hazardous substances, solid or liquid, usually fall in Hazard Class 9.

Spill Handling: Careful, a possible carcinogen. For solids, *small spill*, isolate spill or leak area in all directions for at least 25 meters/75 feet. Increase, in the downwind direction, as necessary. For a *large spill* evacuate downwind at least 100 meters/330 feet. Do not touch damaged containers or spilled material unless wearing appropriate protective clothing. Do not touch damaged containers or spilled material unless wearing appropriate protective clothing. Stop leak if you can do it without risk. Keep combustibles (wood, paper, oil, etc.) away from spilled material. Do not allow water to get inside containers. *Small dry spill*: with clean shovel place material into clean, dry container and cover loosely; move containers from spill area. *Large spill*: dike far ahead of liquid spill for later disposal. Following product recovery, flush area with water. Prevent entry into waterways, sewers, basements or confined areas. Cover with plastic sheet to prevent spreading. Absorb or cover with dry earth, sand or other non-combustible material and transfer to containers. Do not allow water to get inside containers. Prevent entry into waterways, sewers, basements or confined areas. Cover with plastic sheet to prevent spreading. Absorb or cover with dry earth, sand or other non-combustible material and transfer to containers.

Fire Extinguishing: Hazardous decomposition includes toxic gases, including oxides of nitrogen, carbon, hydrogen fluoride and hydrogen chloride gases. As an immediate precautionary measure, isolate spill or leak area in all directions for at least 50 meters/150 feet for liquids and at least 25 meters/75 feet for solids. *Fire involving storage or vehicular tanks:* isolate for 800 meters/0.5 mile in all directions; also, consider initial evacuation for 800 meters/0.5 mile in all directions. *On a small fire:* use dry chemical, CO_2, water spray or regular foam. *On a large fire:* use water spray, fog or regular foam. Do not scatter spilled material with high-pressure streams of water. Move containers from fire area if you can do it without risk. Dike fire-control water for later disposal. *Fire involving tanks:* from a secure, explosion-proof location, use water spray to cool exposed containers. If cooling streams are ineffective (venting sound increases in volume and pitch, tank discolors, or shows any signs of deforming), withdraw immediately to a secure position. Always stay away from tanks engulfed in fire. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode.

Disposal Method Suggested: It is the responsibility of chemical waste generators to determine the toxicity and physical properties of a discarded chemical and to properly identify its classification and certification as a hazardous waste and to determine the disposal method. U.S. EPA guidelines for the classification determination are listed in 40 CFR Parts 261.3. Additionally, waste generators must consult and follow all regional, national, state and local hazardous waste laws to ensure complete and accurate classification and disposal methods. Follow recommendations for the disposal of pesticides and pesticide containers. Containers must be disposed of properly by following package label directions or by contacting your local or federal environmental control agency, or by contacting your regional EPA office.

Disposal Method Suggested: Do not discharge into drains or sewers. Dispose of waste material as hazardous waste using a licensed disposal contractor to an approved landfill. Consult with environmental regulatory agencies for guidance on acceptable disposal practices. If allowed, incineration with effluent gas scrubbing is recommended.

Containers must be disposed of properly by following package label directions or by contacting your local or federal environmental control agency, or by contacting your regional EPA office.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- Pesticide Management Education Program, "Oxadiazon (Ronstar) Herbicide Profile 2/85," Cornell University, Ithaca, NY (February 1985). http://pmep.cce.cornell.edu/profiles/herb-growthreg/naa-rimsulfuron/oxadiazon/herb-prof-oxadiazon.html

Oxamyl O:0170

Use Type: Insecticide, Nematicide, Acaricide

CAS Number: 23135-22-0 (solid); 97502-85-7 (flammable liquid)

Formula: $C_7H_{13}N_3O_3S$

Synonyms: 2-(Dimethylamino)-N[((methylamino)carbonyl)oxy]2-oxoethanimidothioicacidmethylester;2-Dimethylamino-1-(methylamino)glyoxal-*O*-methylcarbamoylmonoxime; *N,N*-Dimethyl-α-methylcarbamoyloxyimino-α-(methylthio)acetamide; *N,N*-dimethyl-*N*-[(methylcarbamoyl)oxy]-1-thiooxamimidic acid methyl ester; Methyl-2-(dimethylamino)-*N*-[((methylamino)carbonyl)oxy]-2-oxoethanimidothioate; Methyl-1-(dimethylcarbamoyl)-*N*-(methylcarbamoyloxy)thioformimidate; *S*-Methyl-1-(dimethylcarbamoyl)-*N*-[(methylcarbamoyl)oxy]thioformimidate; Methyl-*N,N'*-dimethyl-*N*-[(methylcarbamoyl)oxy]-1-thiooxamimidate

Trade Names: BLADE®; D-1410®; DPX 1410®; INSECTICIDE-NEMACIDE 1410®; OXAMYL CARBAMATE INSECTICIDE®; THIOXAMYL®; VYDATE®; VYDATE® 10G; VYDATE L®; VYDATE INSECTICIDE/NEMATICIDE®; VYDATE OXAMYL INSECTICIDE/NEMATOCIDE®[C]

Chemical class: Carbamate (N-methyl)

EPA/OPP PC Code: 103801

California DPR Chemical Code: 1910

HSDB Number: 6453

UN/NA & ERG Number: UN2588 (Pesticide, solid, poisonous, n.o.s.)/151; UN2902 (Pesticide, liquid, poisonous, n.o.s.)/151

RTECS® Number: RP2300000

EC Number: 245-445-3 [006-059-00-9]

Uses: A systemic and contact insecticide/acaricide and nematicide, oxamyl is a restricted use pesticide used on apples, bananas, carrots, celery, citrus, cotton, cucumbers, eggplants, garlic, ginger, muskmelon (including cantaloupe and honeydew melon), onion (dry bulb), peanuts, pears, peppers, peppermint, pineapples, plantains, potatoes, pumpkins, soybeans, spearmint, squash, sweet potatoes, tobacco, tomatoes, watermelons, yams. Oxamyl is also used on non-bearing apple, cherry, citrus, peach, pear, and tobacco. It is applied directly onto plants or the soil surface. It is available in both liquid and granular form, but the granular form is banned in the U.S. It has no residential use. Registered for use in EU countries[115].

U.S. Maximum Allowable Residue Levels for Oxamyl and its oxime metabolite N,N-dimethyl-N-hydroxy-1-thiooxamimidate calculated as oxamyl [40 CFR 180.303(a)(1)]: in or on the following food commodities: apple 2.0 ppm; banana 0.3 ppm; cantaloupe 2.0 ppm; celery 3.0 ppm; cottonseed 0.2 ppm; cucumber 2.0 ppm; eggplant 2.0 ppm; fruit, citrus 3.0 ppm; melon, honeydew 2.0 ppm; peanut 0.2 ppm; peanut 0.2 ppm; peanut, hay 2.0 ppm; pear 2.0 ppm; peppermint, hay 10.0 ppm; pepper, bell 3.0 ppm; pepper, non-bell 5.0 ppm; pineapple 1.0 ppm; potatoe 0.1 ppm; pumpkin 2.0 ppm; root crop vegetables 0.1 ppm; soybean 0.2 ppm; spearmint, hay 10.0 ppm; squash, summer 2.0 ppm; squash, winter 2.0 ppm; tomatoe 2.0 ppm, and watermelon 2.0 ppm. ***[40 CFR 180.303(a)(1)]:*** as a result of application of the insecticide to growing pineapples, pineapple 6 ppm; bran 6 ppm.

Regulatory Authority and Advisory Information:

Carcinogenicity[83]: EPA Group E, evidence of non-carcinogenicity for humans.

Acute Oral Category: 1, DANGER–POISON

Health Advisory: Nerve Toxin (S!)

EPA Hazardous Waste Number (RCRA No.): P194

RCRA 40CFR268.48; 61FR15654, Universal Treatment Standards: Wastewater (mg/L), 0.056; Non-wastewater (mg/kg), 0.28

Superfund/EPCRA 302 Extremely Hazardous Substances: TPQ = 100/10,000 lb (45.4/4,540 kg)

Superfund/EPCRA 40CFR302.4 RQ: EHS, 1 lb (0.454 kg)

European/International Regulations: Hazard Symbol: T+, Xn, N; risk phrases: R21; R26/28; R51/53; safety phrases: S1/2; S36/37; S45; S61 (see Appendix 1)

WGK (German Aquatic Hazard Class): 3-Severe hazard to water.

Description: Oxamyl is a white crystalline solid. Sulfur- or garlic-like odor. Molecular weight = 219.29; Specific gravity (H_2O:1) = 0.98 @ 25 °C; Boiling point = (decomposes) 310 °C; Freezing/Melting point = 100–102 °C; Vapor pressure = 2.98×10^{-4} mmHg @ 25 °C. Hazard Identification (based on NFPA-704 M Rating System): Health 4, Flammability 1, Reactivity 0. Highly soluble in water; solubility = 29 g/L.

Incompatibilities: Aeration, sunlight, alkalinity, and higher temperatures increase the rate of decomposition[88]. Carbamates are incompatible with reducing agents, strong acids, oxidizing acids, peroxides, and bases. Contact with active metals or nitrides causes the release of flammable, and potentially explosive, hydrogen gas. May form explosive materials with phosphorus pentachloride. Corrosive.

Permissible Exposure Limits in Air:

Protective Action Criteria (PAC) Ver. 27[89]

PAC-1: 0.15 mg/m^3
PAC-2: 1.7 mg/m^3
PAC-3: 4.75 mg/m^3

Permissible Concentration in Water: Federal Drinking Water Guidelines: 200 μg/L; State Drinking Water Guidelines:

Arizona 180μg/L; Maine 175μg/L; State Drinking Water Standard: California 50μg/L.

Determination in Water: Log K_{ow} = <–0.5. Unlikely to bioaccumulate in marine organisms.

Routes of Entry: Inhalation, ingestion, skin and/or eye contact.

Harmful Effects and Symptoms

Short Term Exposure: Contact can cause skin and eye irritation. Acute exposure to oxamyl usually leads to a cholinergic crisis. Signs and symptoms may include increased salivation, lacrimation (tearing), perspiration, spontaneous defecation, and spontaneous urination. Pinpoint pupils, blurred vision, tremor, muscle twitching, mental confusion, convulsions, and coma may occur. Gastrointestinal symptoms include abdominal pain, diarrhea, nausea, and vomiting. Bradycardia (slow heart rate) is common. Dyspnea (shortness of breath) and pulmonary edema may also occur. Classified by the World Health Organization as highly hazardous. Has also been rated as extremely to super-toxic. Acute oral exposure (ingestion) to oxamyl has caused death. Carbamate insecticides inhibit the cholinesterase activity of enzymes, causing accumulation of acetylcholine at synapses and altering the way in which nervous impulses are transmitted. However, within several hours carbamates spontaneously detach from the enzymes. LD_{50} (oral, rat) = <6 mg/kg; (dermal, rat) = >1500 mg/kg.

Long Term Exposure: Cholinesterase inhibitor; cumulative effect is possible. This neurotoxin may damage the nervous system, causing numbness and/or weakness in the hands and feet. Repeated exposure may cause personality changes with depression, anxiety, and irritability. May cause liver damage.

Points of Attack: Respiratory system, lungs, central nervous system, cardiovascular system, skin, eyes, liver, plasma and red blood cell cholinesterase.

Medical Surveillance: Routine biological monitoring of pesticide applicators and field workers includes testing of plasma and red blood cell acetylcholinesterase levels (for enzyme poisoned by this chemical). These tests are normally accurate only if done within about two hours of exposure. If exposure stops, plasma levels return to normal in 1–2 weeks while red blood cell levels may be reduced for 1–3 months. When acetylcholinesterase enzyme levels are reduced by 25% or more below preemployment levels, risk of poisoning is increased, even if results are in lower ranges of "normal." Reassignment to work not involving carbamate pesticides is recommended until enzyme levels recover. Do not drink any alcoholic beverages before or during use. Also consider complete blood count and chest x-ray following acute overexposure. Consider liver function test.

First Aid: Speed in removing material from eyes and skin is of extreme importance. *Eyes:* Eye contact can cause dangerous amounts of these chemicals to be quickly absorbed through the mucous membrane into the bloodstream. Immediately and gently flush eyes with plenty of warm or cold water (NO hot water) for at least 15 minutes, occasionally lifting the upper and lower eyelids. Get medical aid immediately. *Skin:* Get medical aid. Dermal contact can cause dangerous amounts of these chemicals to be absorbed into the bloodstream. Wearing the appropriate PPE equipment and respirator for carbamate pesticides, immediately flush skin with plenty of soap and water for at least 15 minutes while removing contaminated clothing and shoes. Shampoo hair promptly if contaminated; protect eyes. *Ingestion:* Call poison control. Loosen all clothing. Never give anything by mouth to an unconscious person. Get medical aid. Do NOT induce vomiting. * If conscious, alert, and able to swallow, rinse mouth and have victim drink 4 to 8 ounces of water. Check to see if poison control instructs you to use ipecac syrup, otherwise administer slurry of activated charcoal (2 oz in 8 oz of water). If victim is *UNCONSCIOUS OR HAVING CONVULSIONS,* do nothing except keep victim warm. **In some cases you may be specifically instructed by poison control to induce vomiting by way of 2 tablespoons of syrup of ipecac (adult) washed down with a cup of water.* Do NOT give activated charcoal before or with ipecac syrup. *Inhalation:* Get medical aid. Do not contaminate yourself. Wearing the appropriate PPE equipment and respirator for carbamate pesticides, immediately remove the victim from the contaminated area to fresh air. If the victim is not breathing, administer artificial respiration. Do not use mouth-to-mouth method if victim ingested or inhaled the substance; give artificial respiration with the aid of a pocket mask equipped with a one-way valve or other proper respiratory medical device. If breathing is difficult, administer oxygen through bag/mask apparatus until medical help arrives. Do not leave victim unattended. *Note to physician or authorized medical personnel.* Administer atropine, 2 mg (1/30 gr) intramuscularly or intravenously as soon as any local or systemic signs or symptoms of an intoxication are noted; repeat the administration of atropine every 3 to 8 minutes until signs of atropinization (mydriasis, dry mouth, rapid pulse, hot and dry skin) occur; initiate treatment in children with 0.05 mg/kg of atropine; repeat at 5 to 10 minute intervals. Watch respiration, and remove bronchial secretions if they appear to be obstructing the airway; intubate if necessary. *Medical note:* 2-PAMCI may be contraindicated in the case of some carbamate poisonings.

Personal Protective Methods: Wear protective gloves and clothing to prevent any reasonable probability of dermal and/or eye contact. Safety equipment suppliers/manufacturers can provide recommendations on the most protective glove/clothing material for your operation. DuPont™ Tychem® suit fabrics[88]. All protective clothing (suits, gloves, footwear, headgear) should be clean, available each day, and put on before work. Contact lenses should not be worn when working with this chemical. Wear dust-proof chemical goggles and face shield unless full facepiece respiratory protection is worn. Employees should wash immediately with soap when skin is wet or contaminated. Provide emergency showers and eyewash.

Respirator Selection: *At concentrations above the NIOSH REL, or where there is no REL, at any detectable concentration:* SCBAF:Pd,Pp (APF = 10,000): (any self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode); or SaF:Pd,Pp:ASCBA (APF = 10,000) (any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary self-contained positive-pressure breathing apparatus). *Escape*: GmFOv100 (APF = 50) [any air-purifying, full facepiece respirator (gas mask) with a chin-style, front- or back-mounted organic vapor canister having an N100, R100, or P100 filter]; or SCBAE (any appropriate escape-type, self-contained breathing apparatus).

Storage: (1) Color Code-White: Corrosive or Contact Hazard; Store separately in a corrosion resistant location. Prior to working with this chemical you should be trained on its proper handling and storage. Store in tightly closed containers in a cool, well-ventilated area. (2) Color Code-Blue (solid): Health Hazard/Poison. Store in a secure poison location. Prior to working with this chemical you should be trained on its proper handling and storage. Store in tightly closed containers in a cool, well-ventilated area away from strong alkalis (such as sodium hydroxide, sodium bicarbonate, etc.). Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: Pesticides, solid, toxic/poisonous, n.o.s require a shipping label of "poisonous materials" and fall in Hazard Class 6.1. Technical name required.

Spill Handling: For solids, isolate spill or leak area in all directions for at least 25 meters/75 feet. Increase, in the downwind direction, as necessary. Do not touch damaged containers or spilled material unless wearing appropriate protective clothing. Stop leak if you can do it without risk. Prevent entry into waterways, sewers, basements or confined areas. Cover with plastic sheet to prevent spreading. Absorb or cover with dry earth, sand or other non-combustible material and transfer to containers. Do not allow water to get inside containers.

Fire Extinguishing: Hazardous decomposition includes oxides of nitrogen, sulfur, and carbon. *Solid: On a small fire:* use dry chemical, CO_2 or water spray. *On a large fire:* use water spray, fog or regular foam. Move containers from fire area if you can do it without risk. Dike fire-control water for later disposal; do not scatter the material. Use water spray or fog; do not use straight streams. *Fire involving storage or vehicular tanks:* isolate for 800 meters/0.5 mile in all directions; also, consider initial evacuation for 800 meters/0.5 mile in all directions. Fight fire from maximum distance or use unmanned hose holders or monitor nozzles. Do not get water inside containers. Cool containers with flooding quantities of water until well after fire is out. Withdraw immediately in the case of rising sound from venting safety devices or discoloration of tank. ALWAYS stay away from tanks engulfed in fire. For massive fire, use unmanned hose holders or monitor nozzles; if this is impossible, withdraw from area and let fire burn. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies.

Disposal Method Suggested: Do not discharge into drains or sewers. Dispose of waste material as hazardous waste using a licensed disposal contractor to an approved landfill. Consult with environmental regulatory agencies for guidance on acceptable disposal practices. Generators of waste containing this contaminant (≥100 kg/mo) must conform with EPA regulations governing storage, transportation, treatment, and waste disposal. Incineration with effluent gas scrubbing is recommended. Containers must be disposed of properly by following package label directions or by contacting your local or federal environmental control agency, or by contacting your regional EPA office.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- Environmental Protection Agency, "Interim Reregistration Eligibility Decision (IRED), Oxamyl," Washington DC (October 2000). http://www.epa.gov/REDs/0253ired.pdf
- USEPA, Office of Pesticide Programs, Pesticide Residue Limits, "Oxamyl," 40 CFR 180.303. http://www.epa.gov/pesticides/food/viewtols.htm
- EXTOXNET, Extension Toxicology Network, "Pesticide Information Profile, Oxamyl," Oregon State University, Corvallis, OR (June 1996). http://extoxnet.orst.edu/pips/oxamyl.htm
- New Jersey Department of Health and Senior Services, "Hazardous Substance Fact Sheet, OXAMYL," Trenton, NJ (July 1999). http://www.state.nj.us/health/eoh/rtkweb/2618.pdf
- USEPA, "Chemical Profile: Oxamyl," Washington DC, Chemical Emergency Preparedness Program (Nov.30, 1987)

Oxycarboxin O:0175

Use Type: Fungicide

CAS Number: 5259-88-1

Formula: $C_{12}H_{13}NO_4S$

Synonyms: Carboxin sulfone; DCMOD; 2,3-Dihydro-5-carboxanilido-6-methyl-1,4-oxathiin-4,4-dioxide; 5,6- 5,6-Dihydro-2-methyl-1,4-oxathiin-3-carboxanilide 4,4-dioxide; 5,6-Dihydro-2-methyl-*N*-phenyl-1,4-oxathiin-3-carboxamide-4,4-dioxide; 1,4-Oxathiin-3-carboxanilide, 5,6-dihydro-2-methyl-, 4,4-dioxide; 1,4-Oxathiin-3-carboxamide, 5,6-dihydro-2-methyl-*N*-phenyl-, 4, 4-dioxide; Oxycarboxine

Trade Names: CARBOJECT®[C]; DYNAM®; F461®;

FUNGISOL®[C]; PLANTVAX®; PLANT WAX®; VITAVEX®

Chemical class: Carboxamide

EPA/OPP PC Code: 090202

California DPR Chemical Code: 1434

HSDB Number: 1747

UN/NA & ERG Number: UN3077 (solid)/171

RTECS® Number: RP4900000

EC Number: 226-006-2 [*Annex I Index No.*: [006-060-00-4]

Uses: Registered as a foliar systemic fungicide for use against rust on carnations and greenhouse geranium. Not approved for use in EU countries[115]. Registered for use in the U.S. and Canada.

Regulatory Authority and Advisory Information:

Acute Oral Category: 3, CAUTION

Health Advisory: Developmental/Reproductive Toxin (TRI)

European/International Regulations: Hazard Symbol: Xn, N; risk phrases: R22; R52/53; safety phrases: S2; S61 (see Appendix 1)

Description: Oxycarboxin is a white corrosive solid. Molecular weight = 290.42; 267.30; Specific gravity (H_2O:1) = 1.40 @ 20 °C; Boiling point = 528 °C; Freezing/Melting point = 121 °C; Vapor pressure = 3.2×10^{-11} mmHg @ 25 °C; Flash point = 220 °C. Hazard Identification (based on NFPA-704 M Rating System): Health 4, Flammability 1, Reactivity 0. Slightly soluble in water; solubility = 0.3 g/L @ 25 °C.

Incompatibilities: May react with strong oxidizers such as chlorates, peroxides, nitrates, etc. Can become unstable in acidic and alkaline media. Combustible; dust may form explosive mixture with air. Corrosive, may attack some metals, rubbers, and plastics.

Determination in Water: Log K_{ow} = <1. Unlikely to bioaccumulate in marine organisms.

Routes of Entry: Inhalation, ingestion dermal and/or eye contact. May penetrate unbroken skin.

Harmful Effects and Symptoms

Short Term Exposure: Corrosive. Harmful if ingested. May cause skin, eye, and respiratory tract irritation.

LD_{50} (oral, rat) = >2 g/kg; (dermal, rat) = >5 g/kg[83].

Long Term Exposure: May affect reproduction, DNA.

Points of Attack: Skin, eyes, reproductive system.

Medical Surveillance: Comprehensive preplacement or initial medical and work histories with emphasis on reproductive experience and menstrual history. Comprehensive physical examination with emphasis on the genito-urinary tract analysis to include sperm count, motility and morphology. Other tests, such as serum testosterone, serum follicle stimulating hormone (FSH), and serum lutenizing hormone (LH), may be carried out if, in the opinion of the responsible physician, they are indicated. Employees shall be counseled by a health officer or physician to ensure that each employee is aware that this chemical has been implicated in the production of effects on the reproductive system.

First Aid: If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least 15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately. If this chemical contacts the skin, remove contaminated clothing and wash immediately with soap and water. Seek medical attention immediately. If this chemical has been inhaled, remove from exposure, begin rescue breathing (using universal precautions) if breathing has stopped, and CPR if heart action has stopped. Transfer promptly to a medical facility. When this chemical has been swallowed, get medical attention. Give large quantities of water and induce vomiting. Do not make an unconscious person vomit. Do not induce vomiting when formulations containing petroleum solvents are ingested.

Personal Protective Methods: Wear protective gloves and clothing to prevent any reasonable probability of dermal and/or eye contact. Safety equipment suppliers/manufacturers can provide recommendations on the most protective glove/clothing material for your operation. Employees should wash immediately with soap when skin is wet or contaminated. Provide emergency showers and eyewash.

Respirator Selection: *At any concentrations above the NIOSH REL, or where there is no REL, at any detectable concentration:* SCBAF: Pd,Pp (APF = 10,000) (any NIOSH/MSHA- or European Standard EN 149-approved self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode); or SaF: Pd,Pp: ASCBA (APF = 10,000) (any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary, self-contained breathing apparatus operated in a pressure-demand or other positive-pressure mode).

Storage: Color Code-White: Corrosive or Contact Hazard; Store separately in a corrosion-resistant location. Prior to working with oxycarboxin you should be trained on its proper handling and storage. Store in tightly closed containers in a cool, well-ventilated area. Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: This material may be classified as Environmentally hazardous substances, liquid or solid, n.o.s. It usually falls in Hazard Class 9.

Spill Handling: First remove all sources of ignition. Evacuate persons not wearing protective equipment from area of spill or leak until clean up is complete. Collect powdered material in the most convenient and safe manner and deposit in sealed containers. Ventilate area after clean up is complete. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable.

Fire Extinguishing: Hazardous decomposition includes oxides of nitrogen, carbon and sulfur. Use dry chemical, carbon dioxide; water spray; or alcohol-resistant foam extinguishers. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies. From a secure, explosion-proof location, use water spray to cool exposed containers. If cooling streams are ineffective (venting sound increases in volume and pitch, tank discolors, or shows any signs of deforming), withdraw immediately to a secure position. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode.

Disposal Method Suggested: Do not discharge into drains or sewers. Dispose of waste material as hazardous waste using a licensed disposal contractor to an approved landfill. Consult with environmental regulatory agencies for guidance on acceptable disposal practices. If allowed, incineration with effluent gas scrubbing is recommended. Containers must be disposed of properly by following package label directions or by contacting your local or federal environmental control agency, or by contacting your regional EPA office.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- Pesticide Management Education Program, "Oxycarboxin (Plantvax) Chemical Profile 2/85," Cornell University, Ithaca, NY (February 1985). http://pmep.cce.cornell.edu/profiles/fung-nemat/febuconazole-sulfur/oxycarboxin/fung-prof-oxycarboxin.html

Oxyfluorfen O:0205

Use Type: Herbicide

CAS Number: 42874-03-3

Formula: $C_{15}H_{11}ClF_3NO_4$

Synonyms: Benzene, 2-chloro-1-(3-ethoxy-4-nitrophenoxy)-4-(trifluoromethyl)-; Caswell No. 188AAA; 2-Chloro-1-(3-ethoxy-4-nitrophenoxy)-4-(trifluoromethyl)benzene; 2-Chloro-4-trifluoromethyl-3'-ethoxy-4'-nitrodiphenyl ether; 2-Chloro-α,α,α-trifluoro-*p*-tolyl-3-ethoxy-4-nitrophenyl ether; Ether, 2-chloro-α,α,α-trifluoro-*p*-tolyl-3-ethoxy-4-nitro phenyl; Oxyfluorfene; Oxyfluorofen

Trade Names: EDGER®; FIRE POWER® (glyphosate + oxyfluorfen); GALIGAN®; GOAL®; HADAF®; KLEENUP®; KOLTAR®; MON-78095®; RH-2915®; RH-915®; ROUT® (with oryzalin); TRIOX®

Chemical class: Diphenyl ether

EPA/OPP PC Code: 111601; (288600 old EPA code number)

California DPR Chemical Code: 1973

HSDB Number: 7507

UN/NA & ERG Number: UN3082 (liquid)/171

RTECS® Number: DV4725000

EC Number: 255-983-0

Uses: Oxyfluorfen is used for broad-spectrum pre-emergence and post-emergent control of annual broadleaf and grassy weeds in a variety of tree fruit, nut, vine, and field crops. The largest agricultural markets are wine grapes and almonds. Also used on ornamental and forestry sites. Oxyfluorfen is also used for weed control in landscapes, patios, driveways, and similar non-crop areas in residential, highway and rights-of-way sites. Not approved for use in EU countries[115]. Registered for use in the U.S. and Canada.

U.S. Maximum Allowable Residue Levels for Oxyfluorfen [40 CFR 180.381 (a)]: almond, hulls 0.1 ppm; artichoke, globe 0.05 ppm; avocado 0.05 ppm; banana (including plantain) 0.05 ppm; broccoli 0.05 ppm; cabbage 0.05 ppm; cattle, fat 0.05 ppm; cattle, meat byproducts 0.05 ppm; cattle, meat 0.05 ppm; cauliflower 0.05 ppm; cocoa bean, dried bean 0.05 ppm; coffee, bean 0.05 ppm; corn, grain 0.05 ppm; cotton, undelinted seed 0.05 ppm; dates 0.05 ppm; egg 0.05 ppm; feijoa 0.05 ppm; fig 0.05 ppm; fruit, pome, group 11, 0.05 ppm; fruit, stone, group 12, 0.05 ppm; goat, fat 0.05 ppm; goat, meat byproducts 0.05 ppm; goat, meat 0.05 ppm; grape 0.05 ppm; hog, fat 0.05 ppm; hog, meat byproducts 0.05 ppm; hog, meat 0.05 ppm; horseradish 0.05 ppm; horse, fat 0.05 ppm; horse, meat byproducts 0.05 ppm; horse, meat 0.05 ppm; kiwifruit 0.05 ppm; nut, tree, group 14, 0.05 ppm; olive 0.05 ppm; onion, dry bulb 0.05 ppm; milk 0.05 ppm; mint hay (peppermint and spearmint) 0.1 ppm; persimmon 0.05 ppm; pistachio 0.05 ppm; pomegranate 0.05 ppm; poultry, fat 0.05 ppm; poultry, meat byproducts 0.05 ppm; poultry, meat 0.05 ppm; sheep, fat 0.05 ppm; sheep, meat byproducts 0.05 ppm; sheep, meat 0.05 ppm; soybean 0.05 ppm. ***Regional registration, as defined in section 180.1(n) [40 CFR 180.381(b)]:*** blackberry 0.05 ppm; chickpea, seed 0.05 ppm; guava 0.05 ppm; papaya 0.05 ppm; raspberry 0.05 ppm; taro, corm and leaves 0.05 ppm.

Regulatory Authority and Advisory Information:

Carcinogenicity[83]: EPA Group C, Possible human carcinogen

Acute Oral Category: 4, Caution, Not acutely toxic

AB 2588-Air Toxics "Hot Spots" Chemicals (CAL) as chlorophenoxy pesticides

EPCRA Section 313 Form R *de minimis* concentration reporting level: 1.0%

Description: Orange to deep red-brown crystalline solid or powder. Smoke-like odor. Molecular weight = 361.70; Specific gravity (H_2O:1) = 1.49; Boiling point = (decomposes) 330 °C; Freezing/Melting point = 85 °C; Vapor pressure = 2.1×10^{-7} mm @ 20 °C. Henry's Law constant = 1.2×10^{-6} atm-m^3/mol @ 25 °C (est)[83]. Slightly soluble in water; solubility = 0.098 ppm.

Incompatibilities: Decomposes >330 °C releasing toxic hydrogen fluoride, hydrogen chloride and nitrogen oxides.

Determination in Water: Log K_{ow} = >4.5. Values above 3.0 are likely to bioaccumulate in aquatic organisms.

Routes of Entry: Inhalation, ingestion, absorbed through the skin.

Harmful Effects and Symptoms

Short Term Exposure: Poisonous; may be fatal if inhaled, swallowed, or absorbed through skin. Severely irritates eyes, skin and respiratory tract, with burning sensation, pain, redness and swelling. Metabolic stimulant. If inhaled, causes coughing, dilated pupils, headache, profuse perspiration, intense thirst, extreme fatigue, rapid pulse, high fever, clammy, flushed skin, rapid breathing, nausea, vomiting, cyanosis (bluish tint to skin and lips), anxiety and confusion, convulsions, risk of lung edema. If swallowed, face and lips turn bluish. Liver injury with associated jaundice, kidney failure, and cardiac arrhythmias are commonly noted. Nerve damage, which may be delayed, may include swelling of legs and feet, muscle twitch and stupor. Severe exposure can cause death from heart failure. Dust or liquid left in contact with the skin for several hours may be absorbed. This may result in severe delayed symptoms as listed above. These symptoms may last for months or years. LD_{50} (oral, rat) = >5 g/kg; LD_{50} (dermal, rat) = >10 g/kg.

Long Term Exposure: Fluorides may cause bone disease (pain and tenderness of the bones); mottled teeth in children. Workers exposed to chlorophenoxy compounds over a 5 to 10 year period at levels above 10 mg/m^3 complained of weakness, rapid fatigue, headache and vertigo. Liver damage, low blood pressure and slowed heartbeat were also found. Based on animal tests, may affects human reproduction.

Points of Attack: Eyes, skin, respiratory system, central nervous system, cardiovascular system, liver, spleen, kidney, reproduction system.

Medical Surveillance: Preliminary medical exam to detect chronic diseases of central nervous system, liver, heart, kidneys, lung and skin, as well as endocrinological or immunological disturbances, should protect susceptible individuals. Periodical medical exams of internal organs, skin and eyes are important to avoid chronic occupational intoxications. They should include lab and patch tests when necessary[83]. This chemical is a suspected or known human carcinogen. Exposed persons should contact a physician for advice regarding the possible long term health effects and advice for medical monitoring. If symptoms develop or overexposure is suspected, the following may be useful: Liver and kidney function tests. Exam of the nervous system.

First Aid: If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least 15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately. If this chemical contacts the skin, remove contaminated clothing and wash immediately with soap and water. Seek medical attention immediately. If this chemical has been inhaled, remove from exposure, begin rescue breathing (using universal precautions) if breathing has stopped, and CPR if heart action has stopped. Transfer promptly to a medical facility. When this chemical has been swallowed, get medical attention. *Do not induce vomiting when formulations containing petroleum solvents are ingested*. Otherwise, give large quantities of water and induce vomiting. Do not make an unconscious person vomit.

Personal Protective Methods: Diphenyl ether derivatives may react with the following absorbent materials: Cellulose-Based; Expanded Polymeric[88]. Applicators and other handlers must wear: Coveralls worn over long-sleeved shirt and long pants; Chemical-resistant gloves such as DuPont™ Tychem® suit fabrics, barrier laminate, or Viton®; Chemical-resistant footwear plus socks; Protective eye wear; Chemical-resistant headgear for overhead exposure; Chemical-resistant apron when cleaning equipment, mixing, or loading[83]. Agricultural Use/ Engineering Controls: When handlers use closed systems, enclosed cabs, or aircraft in a manner that meets the requirements listed in the Worker Protection Standard (WPS) for agricultural pesticides, ***40 CFR 170.240(d)(4-6)***, the handler PPE requirements may be reduced or modified as specified in the Worker Protection Standard. Firefighters should wear NIOSH approved self-contained breathing apparatus and full protective clothing.

Respirator Selection: *At any detectable concentration:* SCBAF: Pd,Pp (APF = 10,000) (any NIOSH/MSHA- or European Standard EN 149-approved self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode); or SaF: Pd,Pp: ASCBA (APF = 10,000) (any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary, self-contained breathing apparatus operated in a pressure-demand or other positive-pressure mode). *Escape:* 100 F (APF = 50) (any air-purifying, full facepiece respirator with an N100, R100, or P100 filter k-mounted organic vapor canister having a high-efficiency particulate filter); or SCBAE (any appropriate escape-type, self-contained breathing apparatus).

Storage: Color Code-Blue: Health Hazard/Poison: Store in a secure poison location. Prior to working with this chemical you should be trained on its proper handling and storage. Store in a refrigerator or a cool, dry place. A regulated, marked area should be established where this chemical is handled, used, or stored in compliance with OSHA Standard 1910.1045. Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: Environmentally hazardous substances, solid or liquid, usually fall in Hazard Class 9 and Packing Group III.

Spill Handling: First remove all sources of ignition. Evacuate persons not wearing protective equipment from area of spill or leak until clean up is complete. Remove all sources of ignition and dampen spilled material with 60–70% acetone to avoid airborne dust. Use HEPA vacuum or wet method to reduce dust during clean up. Do not dry sweep. Collect powdered material in the most convenient and safe manner and deposit in sealed containers. Ventilate area after clean up is complete. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable.

Fire Extinguishing: Hazardous decomposition includes nitrogen oxides, hydrogen fluoride, hydrogen chloride, and fluorine. This chemical is a combustible solid, but does not readily ignite. As an immediate precautionary measure, isolate spill or leak area in all directions for at least 50 meters/150 feet for liquids and at least 25 meters/75 feet for solids. *Fire involving storage or vehicular tanks:* isolate for 800 meters/0.5 mile in all directions; also, consider initial evacuation for 800 meters/0.5 mile in all directions. *On a small fire:* use dry chemical, CO_2, water spray or regular foam. *On a large fire:* use water spray, fog or regular foam. Do not scatter spilled material with high-pressure streams of water. Move containers from fire area if you can do it without risk. Dike fire-control water for later disposal. *Fire involving tanks:* from a secure, explosion-proof location, use water spray to cool exposed containers. If cooling streams are ineffective (venting sound increases in volume and pitch, tank discolors, or shows any signs of deforming), withdraw immediately to a secure position. Always stay away from tanks engulfed in fire. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode.

Disposal Method Suggested: Small quantities may be landfilled but large quantities should be incinerated. Containers must be disposed of properly by following package label directions or by contacting your local or federal environmental control agency, or by contacting your regional EPA office.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- USEPA, “Reregistration Eligibility Decision (RED) Fact Sheet, Oxyfluorfen,” Office of Prevention, Pesticides and Toxic Substances, Washington DC (October 2002). http://www.epa.gov/REDs/factsheets/oxyfluorfen_red_fs.htm
- EXTOXNET, Extension Toxicology Network, “Pesticide Information Profile, Oxyfluorfen,” Oregon State University, Corvallis, OR (June 1996). http://extoxnet.orst.edu/pips/oxyfluor.htm

P

Paclobutrazol P:0025

Use Type: Plant growth regulator
CAS Number: 76738-62-0
Formula: $C_{15}H_{20}ClN_3O$
Synonyms: 1-*tert*-Butyl-2-(*p*-chlorobenzyl)-2-(1,2,4-triazol-1-yl)ethanol; (2RS,3RS)-1-(4-Chlorophenyl)-4,4-dimethyl-2-(1*H*-1,2,4-triazol-1-yl) pentan-3-ol; (±)-R*,R*-β-[(4-Chlorophenyl) methyl]-α-(1,1-dimethylethyl)-1*H*-1,2,4-triazol-1-ethanol
Trade Names: BONZI®; CLIPPER®; CULTAR®; ICI-PP 333®; MON-7325®[C]; PARLAY®; PICCOLO®; PP 333®; PROFILE®; TURF MANAGER®
Chemical class: Azole; Triazole
EPA/OPP PC Code: 125601
California DPR Chemical Code: 2259
UN/NA & ERG Number: UN1325 (flammable solid, organic)/133
RTECS® Number: XZ4803300
EC Number: 266-325-7 [*Annex I Index No.:* 616-379-6]
Uses: Used by arborists to maintain deciduous and broadleaf trees near buildings, reduce the growth of trees near power lines, and extend the longevity of trees on sites with limited natural resource.
Human toxicity (long-term): Very low–175.00 ppb, Health Advisory
Fish toxicity (threshold): Very low–4075.70930 ppb, MATC (Maximum Acceptable Toxicant Concentration)
Regulatory Authority and Advisory Information:
Carcinogenicity[83]: EPA Group D, Not classifiable as a human carcinogen
Acute Oral Category: 3, CAUTION
European/International Regulations: Hazard Symbol: Xn, N; risk phrases: R20/22; R51/53; R63; safety phrases: S2; S60, S61 (see Appendix 1)
Description: White crystalline, flammable solid. Odorless. Molecular weight = 293.78; Specific gravity (H_2O:1) = 1.21; Boiling point = 385 °C; 460 °C; Freezing/Melting point = 164 °C; Vapor pressure = 7.5×10^{-9} mm @ 20 °C; Flash point = 233 °C[U of Akron]. Hazard Identification (based on NFPA-704 M Rating System): Health 1, Flammability 2, Reactivity 3. Low solubility in water; solubility = 37 ppm.
Incompatibilities: Keep away from all sources of ignition. Contact with strong oxidizers may cause fire or explosion. The triazoles are sensitive to heat, friction, and impact. Sensitivity varies with the type substitution to the triazole ring. Metal chelated and halogen substitution of the triazol ring make for a particularly heat-sensitive material. Azido and nitro derivatives have been employed as high explosives. No matter the derivative these materials should be treated as explosives[88].
Permissible Concentration in Water: Runoff from spills or fire control may cause water pollution.
Determination in Water: Log K_{ow} = >3.0. Values above 3.0 are likely to bioaccumulate in aquatic organisms.
Routes of Entry: Inhalation, ingestion, dermal and/or eye contact.
Harmful Effects and Symptoms
Short Term Exposure: Irritates skin, eyes and respiratory tract. May be able to penetrate the unbroken skin. LD_{50} (oral, rat) = >1 g/kg; LD_{50} (dermal, rat) = >1 g/kg.
Long Term Exposure: Developmental/Reproductive Toxin in animals. May cause reproductive and fetal effects.
Medical Surveillance: A suspected reproductive toxin. Comprehensive physical examination with emphasis on the genito-urinary tract analysis to include sperm count, motility and morphology. Other tests, such as serum testosterone, serum follicle stimulating hormone (FSH), and serum lutenizing hormone (LH), may be carried out if, in the opinion of a physician, they are indicated.
First Aid: If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least 15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately. If this chemical contacts the skin, remove contaminated clothing and wash immediately with soap and water. Seek medical attention immediately. If this chemical has been inhaled, remove from exposure, begin rescue breathing (using universal precautions) if breathing has stopped, and CPR if heart action has stopped. Transfer promptly to a medical facility. When this chemical has been swallowed, get medical attention. Give large quantities of water and induce vomiting. Do not make an unconscious person vomit.
Personal Protective Methods: Wear positive-pressure self-contained breathing apparatus (SCBA). Wear chemical protective clothing that is specifically recommended by the manufacturer. DuPont™ Tychem® Suit Fabrics is recommended by one government source[88]. It may provide little or no thermal protection. Structural firefighters' protective clothing provides limited protection in fire situations ONLY; it is not effective in spill situations where direct contact with the substance is possible.
Respirator Selection: Where the neat (undiluted) test chemical is weighed and diluted, wear a NIOSH-approved half-face respirator equipped with a combination filter cartridge, i.e. organic vapor/acid gas/HEPA (specific for organic vapors, HCl, acid gas, SO_2 and a high-efficiency particulate filter)[88]. Wherever and whenever workplace conditions warrant respirator use, a respiratory protection program must be followed that meets one or more of the following government standards: OSHA's 29 CFR 1910.134, ANSI Z88.2, or European Standard EN 149.

Storage: Keep away from sparks and other sources of ignition. Color Code-Red: Flammability Hazard: Store in a flammable liquid storage area or approved cabinet away from ignition sources and corrosive and reactive materials. Store in a refrigerator and under nitrogen gas. Prior to working with this chemical you should be trained on its proper handling and storage. Store in tightly closed containers in a cool, well-ventilated area. If this material contains a flammable carrier, sources of ignition, such as smoking and open flames, are prohibited where this chemical is used, handled, or stored in a manner that could create a potential fire or explosion hazard. Metal containers involving the transfer of 5 gallons or more of this chemical should be grounded and bonded. Drums must be equipped with self-closing valves, pressure vacuum bungs, and flame arresters. Use only non-sparking tools and equipment, especially when opening and closing containers of this chemical. Wherever this chemical is used, handled, manufactured, or stored, use explosion-proof electrical equipment and fittings. Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: Flammable solid, organic, n.o.s. It usually falls in Hazard Class 4.1 and Packing Group II.

Spill Handling: For solids, isolate spill or leak area in all directions for at least 25 meters/75 feet. Increase, in the downwind direction, as necessary. First remove all sources of ignition. Evacuate persons not wearing protective equipment from area of spill or leak until clean up is complete. Do not touch damaged containers or spilled material unless wearing appropriate protective clothing. Stop leak if you can do it without risk. Prevent entry into waterways, sewers, basements or confined areas. Cover with plastic sheet to prevent spreading. Absorb or cover with dry earth, sand or other non-combustible material and transfer to containers. If you spill this chemical, you should dampen the solid spill material with water, then transfer the dampened material to a suitable container. Use absorbent paper dampened with water to pick up any remaining material. Seal your contaminated clothing and the absorbent paper in a vapor-tight plastic bag for eventual disposal. Wash all contaminated surfaces with a soap and water solution. Do not reenter the contaminated area until the Safety Officer (or other responsible person) has verified that the area has been properly cleaned. Do not allow water to get inside containers. Ventilate area after clean up is complete. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable.

Fire Extinguishing: Treat this material as explosive. Hazardous decomposition includes toxic oxides of nitrogen and hydrogen chloride gas. Use dry chemical, water spray, alcohol-resistant foam, carbon dioxide extinguishers. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies. From a secure, explosion-proof location, use water spray to cool exposed containers. If cooling streams are ineffective (venting sound increases in volume and pitch, tank discolors, or shows any signs of deforming), withdraw immediately to a secure position. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode

Disposal Method Suggested: Consult with environmental regulatory agencies for guidance on acceptable disposal practices. Contact a licensed disposal facility about surplus and non-recyclable solutions. Burn in a chemical incinerator equipped with an afterburner and scrubber. Extra care must be exercised as the material in an organic solvent is highly flammable. In accordance with 40CFR165, follow recommendations for the disposal of pesticides and pesticide containers. Containers must be disposed of properly by following package label directions or by contacting your local or federal environmental control agency, or by contacting your regional EPA office. Incineration or permanganate oxidation.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- Pesticide Management Education Program, "Paclobutrazol (Clipper 50 WP) Herbicide Profile 8/85," Cornell University, Ithaca, NY (August 1985). http://pmep.cce.cornell.edu/profiles/herb-growthreg/naa-rimsulfuron/paclobutrazol/herb-prof-paclobutrazol.html

Paraquat P:0150

Use Type: Herbicide, Defoliant, Desiccant

CAS Number: 4685-14-7 (cation); 1910-42-5 (dichloride)

Formula: $C_{12}H_{14}Cl_2N_2$; $C_{12}H_{14}N_2Cl_2$

Synonyms: AI3-61943; Bipyridinium, 1,1'-dimethyl-4,4'-, dichloride; 4,4'-Bipyridinium, 1,1'-dimethyl-, dichloride; Dimethyl violgen chloride; 1,1'-Dimethyl-4, 4'-bipyridinium dichloride; *N,N'*-Dimethyl-4,4'-bipyridinium dichloride; *N,N'*-Dimethyl-4, 4'-bipyridylium dichloride; 1,1'-Dimethyl-4,4'-bipyridynium dichloride; 1,1-Dimethyl-4,4-dipyridilium dichloride; 4,4'-Dimethyldipyridyl dichloride; 1,1'-Dimethyl-4,4'-dipyridylium chloride; *N,N'*-Dimethyl-4, 4'-dipyridylium dichloride; 1,1'-Dimethyl-4,4'-dipyridylium dichloride; Dimethyl viologen chloride; Methyl viologen (reduced); Methyl viologen; Methyl viologen chloride; Methyl viologen dichloride; NCS 263500; NCS 88126; Paraquat dichloride; Paraquat chloride; Viologen, methyl-

Trade Names: AH 501®; CEKUQUAT®; CHECK-THRU®; COLONEL HERBICIDE®[C]; CRISQUAT®; CYCLONE®; DEXTRONE®; DEXTRONE-X®; ESGRAM®; GAMIXEL®; GOLDQUAT 276®; GRAMOXONE®; GRAMOXONE D®; GRAMOXONE DICHLORIDE®; GRAMOXONE S®; GRAMOXONE W®; HERBIKILL®; HERBOXONE®; OK 622®; ORTHO PARAQUAT CL®[C]; PARA-COL®; PARAMINE®; PARAQUAT CL®[C]; PARAQUAT DICHLORIDE BIPYRIDYLNIUM HERBICIDE®; PATHCLEAR®; PILLARQUAT®; PILLARXONE®; PP148®; PRELUDE®[C]; STARFIRE®; SUREFIRE®; SWEEP®; TERRAKLENE®; TOTACOL®; TOXER TOTAL®; UNIQUAT®; WEEDOL®

Chemical class: Bipyridilium; Quarternary nitrogen compound

EPA/OPP PC Code: 061603; 061601 (dichloride salt)

California DPR Chemical Code: 1601

HSDB Number: 1668

UN/NA & ERG Number: UN2781/151

RTECS® Number: DW1960000 (cation); DW2275000 (dichloride); DW2280000 (diiodide); DW2010000 (dimethylsulfate)

EC Number: 225-141-7; 217-615-7 [*Annex I Index No.:* 613-090-00-7]

Uses: Paraquat is a quaternary nitrogen herbicide widely used for broadleaf weed control. It is a quick-acting, non-selective compound, that destroys green plant tissue on contact and by translocation within the plant. It has been employed for killing marijuana in the U.S. and in Mexico. It is also used as a crop desiccant and defoliant, and as an aquatic herbicide. It is used in many formulations with other herbicides, e. g., simazine and diquat. Paraquat dichloride is registered for the control of weeds and grasses in agricultural and non-agricultural areas. It is used as a preplant or pre-emergence herbicide on vegetables, grains, cotton, grasses, sugarcane, peanuts, potatoes, and on areas for tree plantation establishment. Paraquat is applied as a directed spray post-emergence herbicide around fruit crops, vegetables, trees, vines, grains, soybeans, and sugarcane. It is used for dormant season applications on clover and other legumes, and for chemical fallow. It is also used as a desiccant or harvest aid on cotton, dry beans, soybeans, potatoes, sunflowers, sugarcane and as a post-harvest desiccant on tomatoes. It is applied to pine trees to induce resin soaking. Paraquat dichloride is also used on non-crop areas such as public airports, electric transformer stations and around commercial buildings to control weeds. Not approved for use in EU countries[115]. A U.S. EPA restricted Use Pesticide (RUP).

U.S. Maximum Allowable Residue Levels for Paraquat derived from application of either the bis(methyl sulfate) or the dichloride salt (both calculated as the cation) in or on the following food commodities: [40 CFR 180.205(a)]: Acerola 0.05 ppm; almond, hulls 0.5 ppm; animal feed, nongrass, group 18, forage 75. 0 ppm; animal feed, nongrass, group 18, hay 210.0 ppm; artichoke, globe 0.05 ppm; asparagus 0.5 ppm; avocado 0.05 ppm; banana 0.05 ppm; barley, grain 0.05 ppm; barley, hay 3.5 ppm; barley, straw 1.0 ppm; beet, sugar, roots 0.5 ppm; beets, sugar, tops 0.05 ppm; berry group 13, 0.05 ppm; cacao bean, bean 0.05 ppm; carrot, roots 0.05 ppm; cattle, fat 0.05 ppm; cattle, kidney 0.5 ppm; cattle, meat 0.05 ppm; cattle, meat byproducts, except kidney 0.05 ppm; coffee, bean, green 0.05 ppm; corn, field, forage 3.0 ppm; corn, field, grain 0.1 ppm; corn, field, stover 10.0 ppm; corn, pop, grain 0.1 ppm; corn, pop, stover 10.0 ppm; corn, sweet, kernel plus cob with husks removed 0.05 ppm; cotton, gin byproducts 110.0 ppm; cotton, undelinted seed 3.5 ppm; cowpea, forage 0.1 ppm; cowpea, hay 0.4 ppm; cranberry 0.05 ppm; egg 0.01 ppm; endive 0.05 ppm; fig 0.05 ppm; fruit, citrus, group 10, 0.05 ppm; fruit, pome, group 11, 0.05 ppm; fruit, stone, group 12, 0.05 ppm; ginger 0.1 ppm; goat, fat 0.05 ppm; goat, kidney 0.5 ppm; goat, meat 0.05 ppm; goat, meat byproducts, except kidney 0.05 ppm; grain, aspirated fractions 65.0 ppm; grape 0.05 ppm; grass, forage 90.0 ppm; grass, hay 40.0 ppm; guar, seed 0.5 ppm; guava 0.05 ppm; hog, fat 0.05 ppm; hog, kidney 0.5 ppm; hog, meat 0.05 ppm; hog, meat byproducts, except kidney 0.05 ppm; hop, dried cones 0.5 ppm; horse, fat 0.05 ppm; horse, kidney 0.5 ppm; horse, meat 0.05 ppm; horse, meat byproducts, except kidney 0.05 ppm; kiwifruit 0.05 ppm; lentil, seed 0.3 ppm; lettuce 0.05 ppm; milk 0.01 ppm; nut, tree, group 14, 0.05 ppm; okra 0.05 ppm; olive 0.05 ppm; onion, bulb 0.1 ppm; onion, green 0.05 ppm; papaya 0.05 ppm; passionfruit 0.2 ppm; pea and bean, dried shelled, except soybean, subgroup 6C, except guar bean 0.3 ppm; pea and bean, succulent shelled, subgroup 6B, 0.05 ppm; pea, field, hay 0.8 ppm; pea, field, vines 0.2 ppm; peanut 0.05 ppm; peanut, hay 0.5 ppm; peppermint, tops 0.5 ppm; persimmon 0.05 ppm; pineapple 0.05 ppm; pineapple, process residue 0.25 ppm; pistachio 0.05 ppm; potato 0.5 ppm; rhubarb 0.05 ppm; rice, grain 0.05 ppm; rice, straw 0.06 ppm; safflower, seed 0.05 ppm; sheep, fat 0.05 ppm; sheep, kidney 0.5 ppm; sheep, meat 0.05 ppm; sheep, meat byproducts, except kidney 0.05 ppm; sorghum, forage, forage 0.1 ppm; sorghum, grain, forage 0.1 ppm; sorghum, grain, grain 0.05 ppm; soybean, forage 0.4 ppm; soybean, hay 10.0 ppm; soybean, hulls 4.5 ppm; soybean, seed 0.7 ppm; spearmint, tops 0.5 ppm; strawberry 0.25 ppm; sugarcane, cane 0.5 ppm; sugarcane, molasses 3.0 ppm; sunflower, seed 2.0 ppm; turnip, greens 0.05 ppm; turnip, roots 0.05 ppm; vegetable, brassica, leafy, group 5, 0.05 ppm; vegetable, cucurbit, group 9, 0.05 ppm; vegetable, fruiting, group 8, 0.05 ppm; vegetable, legume, edible podded, subgroup 6A, 0.05 ppm; wheat, forage 0.5 ppm; wheat, grain 1.1 ppm; wheat, hay 3.5 ppm; wheat, straw 50.0 ppm; ppm. ***Regional registration, as defined in section 180.1(n) [40 CFR 180.205(c)]:*** cassava 0.05 ppm; pea, pigeon, seed 0.05 ppm; tanier 0.05 ppm; taro, corm 0.1 ppm; tyfon 0.05 ppm; yam, true, tuber 0.05 ppm.

Human toxicity (long-term): High

Regulatory Authority and Advisory Information:

Carcinogenicity[83]: EPA Group C, Possible human carcinogen

Health Advisory: Mutagen, Very toxic by Inhalation (EU)

Acute Oral Category: 2, WARNING

Superfund/EPCRA 302 Extremely Hazardous Substances: TPQ = 100/10,000 lb (45.4/4,540 kg) as paraquat dichloride
Superfund/EPCRA 40CFR302.4 RQ: EHS, 1 lb (0.454 kg) as paraquat dichloride
EPCRA Section 313 Form R *de minimis* concentration reporting level: 1.0% as paraquat dichloride
European/International Regulations (*dichloride*): Hazard Symbol: T+, N; risk phrases: R24/25; R26; R36/37/38; R48/25; R50/53; safety phrases: S1/2; S22; S28; S36/37/39; S45; S60; 61 (see Appendix 1)

Description: Paraquat is a yellow solid. Aqueous solution is red. Faint, ammonia-like odor. Molecular weight = 186.25; 186.12; Specific gravity (H_2O:1) = 1.24 @ 20 °C; Boiling point = (decomposes); Freezing/Melting point = 298 °C (decomposes). Hazard Identification (based on NFPA-704 M Rating System): (paraquat) Health 4, Flammability 0, Reactivity 0. Soluble in water. Physical and toxicological properties may be affected by carrier solvents in commercial formulations.

Paraquat dichloride is a quaternary ion which usually is used as the dichloride salt. Molecular weight = 257.18. Highly soluble in water.

Incompatibilities: Keep away from strong oxidizers, alkylaryl-sulfonate wetting agents, strong bases (hydrolysis). Decomposes in heat (>175–180 °C) and in the presence of ultraviolet light[9], producing nitrogen oxides, hydrogen chloride; deadly phosgene gas may be formed. May cause pitting of some metals.

Permissible Exposure Limits in Air: NIOSH IDLH = 1.0 mg/m^3
OSHA PEL: 0.5 mg/m3 TWA, respirable dust [Skin]; vacated 1989 OSHA PEL 0.1 mg/m3 TWA, [Skin] is still enforced in some states (dichloride)
NIOSH REL: 0.1 mg/m3 TWA, respirable fraction [Skin] (dichloride)
ACGIH TLV: 0.5 mg/m3 TWA, respirable fraction [Skin]. Excursion Limit Recommendation: Excursions in worker exposure levels may exceed 3 times the TLV-TWA for no more than a total of 30 minutes during a work day, and under no circumstances should they exceed 5 times the TLV-TWA, provided that the TLV-TWA is not exceeded.
Protective Action Criteria (PAC) Ver. 27[89]
PAC-1: 0.1 mg/m^3
PAC-2: 0.1 mg/m^3
PAC-3: 1.5 mg/m^3

Determination in Air: Sample collection by mixed cellulose ester membrane filter; Water; High-pressure liquid chromatography/Ultraviolet detection; NIOSH IV, Method #5003[18].

Permissible Concentration in Water: Federal Drinking Water Guidelines: 3 ppb[93]; EPA Health Advisory: 30 μg/L; State Drinking Water Guidelines: Arizona 3 μg/L; Maine 3 μg/L; Florida 315 μg/L. Canadian Drinking Water Standards: IMAC 0.01 mg/L

Determination in Water: Log K_{ow} = Negative (>–4.0). Unlikely to bioaccumulate in marine organisms. *Paraquat dichloride*: Freezing/Melting point = 300 °C (decomposition)

Routes of Entry: Inhalation, ingestion, skin and/or eye contact. Absorbed through the skin.

Harmful Effects and Symptoms

Short Term Exposure: Irritates the eyes, skin, and respiratory tract. Inhalation can cause pulmonary edema, a medical emergency that can be delayed for several hours. This can cause death. Effects occur in two stages, immediate and delayed. Caution is advised. Exposure to paraquat may be fatal; there is no effective antidote. Signs and symptoms of acute exposure to paraquat may be severe and include nausea, vomiting, diarrhea, and abdominal pain. A burning sensation of the mouth and esophagus with possible ulceration may occur following ingestion. Eye exposure may result in corneal opacification (cloudiness). Dermatitis and nail atrophy may occur following dermal and/or eye contact. Delayed effects include transient reversible liver injury, acute renal failure and progressive pulmonary fibrosis with associated dyspnea (shortness of breath) and pulmonary edema. Progressive pulmonary fibrosis associated with dyspnea and pulmonary edema may be delayed and occur in a few days or up to 2 weeks following exposure to paraquat. Absorbed through the skin and can lead to symptoms as listed in the following paragraph. In addition, can cause fingernail discoloration and damage (which returns to normal when exposure stops), irritation, redness, swelling and burning. Exposure through ingestion may cause burning of the mouth and throat, nausea, vomiting, abdominal pain, diarrhea and damage to the kidneys, heart and liver. Lung damage, leading to death, may occur. One half ounce of a 20% solution has caused death. Ingestion can also cause lung hemorrhage and fibrosis. The substance may cause effects on the lungs, kidneys, liver, cardiovascular system and gastrointestinal tract, resulting in impaired functions, tissue lesions. LD_{50} (oral, rat) = <400 mg/kg[83]; LD_{50} (dermal, rat) = >2 g/kg[83].

Long Term Exposure: Repeated or prolonged contact with skin may cause damage and possible loss of the fingernails, and can lead to dry and cracking skin with blistering. Repeated or prolonged exposure to the aerosol can cause lung irritation, lung damage; bronchitis may develop. Can cause scarring of the lungs, leading to breathlessness. Can damage the liver, kidneys and affect the heart. In 2011 this chemical and rotenone were linked to the potential for Parkinson's disease.

Points of Attack: Eyes, skin, respiratory system, heart, liver, kidneys and gastrointestinal tract.

Medical Surveillance: Preliminary medical exam to detect chronic diseases of central nervous system, liver, heart, kidneys, lung and skin, as well as endocrinological or immunological disturbances, should protect susceptible individuals. Periodical medical exams of internal organs, skin and eyes are important to avoid chronic occupational intoxications. They should include lab and patch tests when necessary[83]. This chemical is a suspected or known human carcinogen. Exposed persons should contact a physician for advice regarding the possible long term health effects and advice for medical monitoring. Consider the points of attack in preplacement and periodic physical examinations. Liver and kidney function tests. EKG. Consider chest x-ray following acute overexposure. Chemical users should be cautioned about the use of alcohol, which can increase liver damage. Evaluation by a qualified allergist, including exposure history and testing, may help diagnose allergy.

First Aid: If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least 15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately. If this chemical contacts the skin, remove contaminated clothing and wash immediately with soap and water. Seek medical attention immediately. If this chemical has been inhaled, remove from exposure, begin rescue breathing (using universal precautions) if breathing has stopped, and CPR if heart action has stopped. Transfer promptly to a medical facility. When this chemical has been swallowed, get medical attention. Give large quantities of water, or bentonite clay in water, or activated charcoal in water, and induce vomiting. Do not make an unconscious person vomit. Medical observation is recommended for 24 to 48 hours following breathing overexposure, as pulmonary edema may be delayed. As first aid for pulmonary edema, a doctor or authorized paramedic may consider administering a corticosteroid spray. Obtain authorization and/or further instructions from the local hospital for performance of other invasive procedures. Rush to a health care facility.

Personal Protective Methods: Wear protective gloves and clothing to prevent any reasonable probability of dermal and/or eye contact. Safety equipment suppliers/manufacturers can provide recommendations on the most protective glove/clothing material for your operation. All protective clothing (suits, gloves, footwear, headgear) should be clean, available each day, and put on before work. Contact lenses should not be worn when working with this chemical. Wear dust-proof chemical goggles and face shield unless full facepiece respiratory protection is worn. Employees should wash immediately with soap when skin is wet or contaminated. Provide emergency showers and eyewash.

Respirator Selection: SCBA > 0.1 mg/m^3. NIOSH: *Up to 1 mg/*m^3*:* CcrOv95 (APF = 10) [any air-purifying half-mask respirator with organic vapor cartridge(s) in combination with an N95, R95, or P95 filter. The following filters may also be used: N99, R99, P99, N100, R100, P100]; * or PaprOvHie (APF = 25) (any powered air-purifying respirator with an organic vapor cartridge in combination with a high-efficiency particulate filter); * or Sa (APF = 10) (any supplied-air respirator); * or SCBAF (APF = 50) (any self-contained breathing apparatus with a full facepiece). *Emergency or planned entry into unknown concentrations or IDLH conditions:* SCBAF: Pd,Pp (APF = 10,000) (any NIOSH/MSHA- or European Standard EN 149-approved self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode); or SaF: Pd,Pp: ASCBA (APF = 10,000) (any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary, self-contained breathing apparatus operated in a pressure-demand or other positive-pressure mode). *Escape:* GmFOv100 (APF = 50) [any air-purifying, full facepiece respirator (gas mask) with a chin-style, front- or back-mounted organic vapor canister having an N100, R100, or P100 filter]; or SCBAE (any appropriate escape-type, self-contained breathing apparatus).

Storage: Color Code-Blue (solid): Health Hazard/Poison. Store in a secure poison location. Prior to working with this chemical you should be trained on its proper handling and storage. This chemical is inactivated by inert clays and anionic surfactants. Store in tightly closed containers in a cool, well-ventilated area away from oxidizers; alkylaryl-sulfonate wetting agents; light. Where possible, automatically pump material from drums or other storage containers to process containers. If this material contains a flammable carrier, sources of ignition, such as smoking and open flames, are prohibited where this chemical is handled, used, or stored. Metal containers involving the transfer of this chemical should be grounded and bonded. Use only non-sparking tools and equipment, especially when opening and closing containers of this chemical. Wherever this chemical is used, handled, manufactured, or stored, use explosion-proof electrical equipment and fittings. Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: Bipyridilium pesticides, solid, toxic, require a shipping label of "poisonous materials." They fall in DOT Hazard Class 6.1 and Packing Group II.

Spill Handling: First remove all sources of ignition. Evacuate persons not wearing protective equipment from area of spill or leak until clean up is complete. Hazardous decomposition includes nitrogen oxides. Stay upwind; keep out of low areas. Ventilate closed spaces before entering them. Remove and isolate contaminated clothing at the site. If water pollution occurs, notify appropriate authorities. Do not touch spilled material; stop leak if you can do so without risk. Use water spray to reduce vapors. *Small spills:* absorb with sand or other noncombustible absorbent material and place into containers for later disposal. *Small dry spills:* with clean shovel place material into clean, dry container and cover; move containers from spill area. *Large spills:* dike far ahead of spill for later disposal. Ventilate area after clean up is complete. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable.

Fire Extinguishing: Hazardous decomposition includes oxides of nitrogen. Procedures for bipyridilium pesticides are as follows. *On a small fire:* use dry chemical, CO_2 or water spray. *On a large fire:* use water spray, fog or regular foam. Move containers from fire area if you can do it without risk. Dike fire-control water for later disposal; do not scatter the material. Use water spray or fog; do not use straight streams. *Fire involving tanks or car/trailer loads*: isolate for 800 meters/0.5 mile in all directions; also, consider initial evacuation for 800 meters/0.5 mile in all directions. Fight fire from maximum distance or use unmanned hose holders or monitor nozzles. Do not get water inside containers. Cool containers with flooding quantities of water until well after fire is out. Withdraw immediately in the case of rising sound from venting safety devices or discoloration of tank. ALWAYS stay away from tanks engulfed in fire. For massive fire, use unmanned hose holders or monitor nozzles; if this is impossible, withdraw from area and let fire burn. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies.

Disposal Method Suggested: Paraquat is rapidly inactivated in soil. It is also inactivated by anionic surfactants. Therefore an effective and environmentally safe disposal method would be to mix the product with ordinary household detergent and bury the mixture in clay soil. In accordance with 40CFR165, follow recommendations for the disposal of pesticides and pesticide containers. Containers must be disposed of properly by following package label directions or by contacting your local or federal environmental control agency, or by contacting your regional EPA office. Consult with environmental regulatory agencies for guidance on acceptable disposal practices.

References:

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- New Jersey Department of Health and Senior Services, "Hazardous Substance Fact Sheet, Paraquat," Trenton, NJ (September 1999). http://www.state.nj.us/health/eoh/rtkweb/1458.pdf
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- Sax, N. I., Ed., "Dangerous Properties of Industrial Materials Report," 8, No. 2, 67-72 (1988)
- USEPA, "Health Advisory: Paraquat," Washington DC, Office of Drinking Water (August 1987)
- New York State Department of Health, "Chemical Fact Sheet: Paraquat," Albany, NY, Bureau of Toxic Substance Assessment (Version 2, Feb.1986 and Version 3)

Parathion-ethyl P:0170

Use Type: Insecticide, Acaricide

CAS Number: 56-38-2

Formula: $C_{10}H_{14}NO_5PS$

Synonyms: AAT; AATP; *O,O*-Diethyl *O*-(*p*-nitrophenyl) phosphorothioate; Diethyl *p*-nitrophenyl phosphorothionate; Diethyl 4-nitrophenyl phosphorothionate; *O,O*-Diethyl *O*-(4-nitrophenyl) phosphorothioate; *O,O*-Diethyl-*O,p*-nitrophenyl phosphorothioate; Diethyl *p*-nitrophenyl thionophosphate; *O,O*-Diethyl *O*-*p*-nitrophenyl thiophosphate; Diethyl parathion; DNTP; DPP; ENT 15,108; NCI-C00226; Ethyl parathion; OMS 19; Parathene; Parathion thiophos; Parationa (Spanish); Phosphorothioic acid, *O,O*-diethyl-*O*-(4-nitrophenyl) ester; Phosphorothioic acid, *O,O*-diethyl *O*-(*p*-nitrophenyl) ester; Phosphostigmine; RB; SNP

Trade Names: (There are 921 active and canceled/transferred labels registered with the U.S. EPA) ACC 3422®; ALKRON®[C]; ALLERON®; AMERICAN CYANAMID 3422®; APHAMITE®; ARALO®; B 404®; BAY E-605®; BAYER E-605®; BLADAN®; BLADAN F®; COMPOUND 3422®; COROTHION®; CORTHION®; COR-THION®; DANTHION®; DREXEL PARATHION 8E®; E 605®; E 605 F®; ECATOX®; EKATIN WF & WF ULV®; EKATOX®; ETHLON®; ETILON®; FIGHTER®; FOLIDOL®; FOLIDOL E®; FOLIDOL E-605®; FOLIDOL E&E 605®; FOLIDOL OIL®; FOSFERMO®; FOSFERNO®; FOSFEX®; FOSFIVE®; FOSOVA®; FOSTERN®; FOSTOX®; GEARPHOS®; GENITHION®; IDA SEIS-TRES 6-3®; KALPHOS®; KOLODUST®[C]; KYPTHION®; LETHALAIRE G-54®; LIROTHION®; MURFOS®; MURPHOS®; NIRAN®[C]; NIUIF 100®; NITROSTIGMINE®; NOURITHION®; NOVAFOS-M®; OLEOFOS 20®; OLEOPARATHENE®; OLEOPARATHION®; ORTHOPHOS®; PAC®; PACOL®; PARA-KILL®[C]; PARAMAR®; PARA-TOX®[C]; PANTHION®; PARADUST®; PARAPHOS®; PARAWET®; PENNCAP E®; PESTOX PLUS®; PETHION®; PHOSKIL®; PLEOPARAPHENE®; RHODIASOL®; RHODIATOX®; RHODIATROX®; SEIS-TRES 6-3®; SELEPHOS®; SOPRATHION®; STATHION®; SULPHOS®; SUPER RODIATOX®; T-47®; THIOMEX®; THIOPHOS®; THIOPHOS® 3422; TIOFOS®; TOX 47®; TOXOL®; VAPOPHOS®; VITREX®; WOPROPHOS®

Chemical class: Organophosphate

EPA/OPP PC Code: 057401, 057501, 057503

California DPR Chemical Code: 459

HSDB Number: 197

UN/NA & ERG Number: UN2783 (solid)/152; UN3018 (liquid)/152; UN1967 (Parathion and compressed gas mixture)/123

RTECS® Number: TF4550000

EC Number: 200-271-7 [*Annex I Index No.:* 015-034-00-1]

Uses: The U.S. EPA announced in November, 2000, the cancellation of ethyl parathion immediately on seed corn and the eventual phase out for its use in other pesticide products by the end of 2000. By the end of October, 2003, the U.S. EPA phased out its use to control insects and mites on alfalfa, barley, corn, canola, sorghum, soybeans, sunflowers and wheat. Also used to control nuisance birds. Not listed for use in EU countries[115]. Not registered for use in the U.S. There are 25 global suppliers[97].

U.S. Maximum Allowable Residue Levels for Parathion (40 CFR 180.121): Alfalfa, forage 1.25 ppm; alfalfa, hay 5 ppm; almond 0.1 ppm; almond, hulls 3 ppm; barley 1 ppm; bean, dry 1 ppm; beet, sugar 0.1 ppm; beet, sugar, tops 0.1 ppm; cabbage 1 ppm; clover 1 ppm; corn 1 ppm; corn, forage 1 ppm; cotton, undelinted seed 0.75 ppm; cranberry 1 ppm; cucumber 1 ppm; currant 1 ppm; date, dried fruit 1 ppm; dewberry 1 ppm; eggplant 1 ppm; endive 1 ppm; fig 1 ppm; grass, forage 1 ppm; hop 1 ppm; hop, dried cones 1 ppm; oat 1 ppm; onion 1 ppm; pea, dry 1 ppm; pea, field, vines 1 ppm; peanut 1 ppm; pecan 0.1 ppm; potato 0.1 ppm; rapeseed, seed 0.2 ppm; rice 1 ppm; rye 0.5 ppm; soybean 0.1 ppm; soybean, hay 1 ppm; sunflower, seed 0.2 ppm; sweet potato 0.1 ppm; walnut 0.1 ppm; wheat 1 ppm.

Regulatory Authority and Advisory Information:

Carcinogenicity[83]: EPA Group C, Possible human carcinogen; IARC, Group 3 not classifiable as to its carcinogenicity in humans; ACGIH A4, not classified as a human carcinogen

Acute Oral Category: 1, DANGER–POISON.

Health Advisory: Nerve Toxin, Mutagen, Developmental/Reproductive Toxin, Endocrine disruptor (S!)

Potential Ground Water Pollutant [California FAC Section 13145(d)/12811, inactive]

Clean Water Act: Section 311 Hazardous Substances/RQ 40CFR117.3 (same as CERCLA, see below); Section 313 Water Priority Chemicals (57FR41331, 9/9/92)

EPA Hazardous Waste Number (RCRA No.): P089

RCRA 40CFR268.48; 61FR15654, Universal Treatment Standards: Wastewater (mg/L), 0.014; Non-wastewater (mg/kg), 4.6

RCRA 40CFR264, Appendix 9; TSD Facilities Ground Water Monitoring List. Suggested test method(s) (PQL μg/L): 8270(10)

Safe Drinking Water Act: Priority List (55 FR 1470) as parathion degradation

Superfund/EPCRA 302 Extremely Hazardous Substances: TPQ = 100 lb (45.4 kg)

Superfund/EPCRA 40CFR302.4 RQ: CERCLA, 10 lb (4.54 kg)

EPCRA Section 313 Form R *de minimis* concentration reporting level: 1.0%

U.S. DOT 49CFR172.101, Inhalation Hazard Chemical as organophosphates

U.S. DOT Regulated Marine Pollutant (49CFR172.101, Appendix B), severe pollutant

Toxic Chemical (U.S. EPA)[8]

US DOT Regulated Marine Pollutant (49CFR172.101, appendix B), severe pollutant

US DOT 49CFR172.101, Inhalation Hazard Chemical as organophosphates

Rotterdam Convention Annex III [Chemicals Subject to the Prior Informed Consent Procedure (PIC)] [parathion (all formulations: aerosols, dustable powder (DP), emulsifiable concentrate (EC), granules (GR) and wettable powders (WP) of this substance are included, *except* capsule suspensions (CS)]

European/International Regulations: Hazard Symbol: T+, N; risk phrases: R24; R26/28; R48/25; R50/53; safety phrases: S1/2; S28; S36/37; S45; S60; S61 (see Appendix 1)

WGK (German Aquatic Hazard Class): 3-Severe hazard to waters

Description: Parathion is a clear liquid when fresh; pale yellow to dark brown liquid with a garlic-like odor. Commercial parathion products often contain hydrocarbon solvents, such as xylene or toluene, which themselves can cause toxicity. Commercial formulations use carrier solvents that may change the physical properties shown. Molecular weight = 291.27; Specific gravity (H_2O:1) = 1.27 @ 20 °C; Boiling point = 375 °C; 157–162 °C @ 6 mmHg (for CW agent); Freezing/Melting point = 6.1 °C; also listed @ 2.9 °C for chemical warfare (CW) agent; Flash point = 195 °C (oc);120–160 °C (in flammable media). Hazard Identification (based on NFPA-704 M Rating System): Health 4, Flammability 0, Reactivity 0. Slightly soluble in water; solubility = 24 mg/L.

Incompatibilities: May react violently with antimony(V) pentafluoride. Incompatible with lead diacetate, magnesium, silver nitrate. In the presence of strong reducing agents such as hydrides, organophosphates form highly toxic and flammable phosphine gas. Contact with oxidizers can cause the release of toxic oxides of phosphorus. Attacks some plastics, rubbers, and coatings. Rapidly hydrolyzed by alkalis.

Permissible Exposure Limits in Air: IDLH value is 10 mg/m^3 *Warning:* The odor threshold of parathion is five times the OSHA PEL (0.1 mg/m^3) and *does not provide adequate warning of hazardous concentrations*.

OSHA PEL: 0.1 mg/m^3 TWA [skin]

NIOSH REL: 0.05 mg/m^3 TWA [skin]

ACGIH TLV®[1]: 0.05 mg/m^3 TWA, inhalable fraction and vapor [skin]; not classifiable as a human carcinogen; BEI; 0.05 mg[creatinine]/g in urine, end-of-shift.

NIOSH IDLH: 10 mg/m^3

Protective Action Criteria (PAC) Ver. 27[89]

PAC-1: 0.14 mg/m^3

PAC-2: **1.5** mg/m^3

PAC-3: **2** mg/m^3 The NIOSH[2]

*AEGLs (Acute Emergency Guideline Levels) and ERPGs (Emergency Response Planning Guideline) are in **bold face**.

DFG MAK: 0.1 mg/m^3 measured as the, inhalable fraction TWA; Peak Limitation Category II(8) [skin]; Pregnancy

Risk Group D; BAT: 100 μg[*p*-nitrophenol]/L in urine after several shifts (sampling time)

Determination in Air: OSHA versatile sampler-2; Toluene/Acetone; Gas chromatography/Flame photometric detection for sulfur, nitrogen, or phosphorus; NIOSH IV, Method #5600, Organophosphorus pesticides.[18].

Permissible Concentration in Water: Federal Drinking Water Guidelines: 4 ppb[107]. Clean Water Act Requirement: Freshwater aquatic organisms and their uses should not be affected unacceptably if the four day average concn of parathion does not exceed 0.013 μg/L more than once every three years on the average and if the one hour average concentration does not exceed 0.065 μg/L more than once every three years on the average. State Drinking Water Guidelines: Arizona 30 μg/L; Maine 0.2 μg/L; Florida 42 μg/L; California 40 μg/L. Canadian Drinking Water Standards: MAC 0.05 mg/L

Determination in Water: Log K_{ow} = >3.5. Values at or above 3.0 are likely to bioaccumulate in marine organisms.

Routes of Entry: Inhalation, ingestion, skin and/or eye contact. Absorbed through the skin.

Harmful Effects and Symptoms: Persons whose skin or clothing is contaminated with liquid or powdered parathion can cause secondary contamination by direct contact. Severely Restricted for use in EU as parathion-ethyl. See also parathion methyl.

Short Term Exposure: An acetylcholinesterase inhibitor. Systemic toxicity due to parathion can result from all routes of exposure. Symptoms include abdominal cramps, vomiting, diarrhea, pinpoint pupils and blurred vision, excessive sweating, salivation and lacrimation, wheezing, excessive tracheobronchial secretions, agitation, seizures, bradycardia or tachycardia, muscle twitching and weakness, and urinary bladder and fecal incontinence. Seizures are much more common in children than in adults. The heart rate may decrease following oral exposure or increase following dermal exposure. Hypotension (low blood pressure) is not uncommon. Respiratory symptoms include dyspnea (shortness of breath), respiratory depression, and respiratory paralysis. Psychosis may occur. This material is extremely toxic; the probable oral lethal dose is 5–50 mg/kg, or between 7 drops and 1 teaspoonful for a 150 lb person. As little as 1 drop can endanger life if splashed in the eye. Toxicity is highest by inhalation. People at special risk are those with a history of glaucoma, cardiovascular disease, hepatic disease, renal, disease, or central nervous system abnormalities. Some additional details on short-term exposure to parathion are as follows: *Inhalation:* Occasional human exposures at concentrations of 0.1–0.8 mg/m^3 did not give rise to any symptoms. Occasional human exposure@ 1.5–2.0 mg/m^3 resulted in nausea and vomiting. Higher exposures can give rise to dizziness, blurred vision, wheezing, excessive salivation, and muscle and abdominal cramps. An estimated 10 to 20 mg (1/1500 ounce) may cause death. *Skin:* However, many human poisonings have occurred through extensive dermal contact at unspecified levels. This is the greatest hazard for some workers. Symptoms of poisoning include nausea, vomiting, weakness, blurring of vision and muscle cramps. NIOSH lists the following symptoms of exposure: irritation eyes, skin, respiratory system; miosis; rhinorrhea (discharge of thin nasal mucous); headache; chest tightness, wheezing, laryngeal spasm, salivation, cyanosis; anorexia, nausea, vomiting, abdominal cramps, diarrhea; sweating; muscle fasiculation, weakness, paralysis; giddiness, confusion, ataxia; convulsions, coma; low blood pressure; cardiac irregular/irregularities. Death can result from loss of consciousness, coma, excessive bronchial secretions, respiratory depression and cardiac irregularity. Delayed pulmonary edema may occur after inhalation. Parathion toxicity depends on metabolic activation; thus, symptoms may be delayed for 6 to 24 hours following exposure. LD_{50} (oral, rat) = 2 mg/kg; LD_{50} (dermal, rat) = 71 mg/kg.

Long Term Exposure: Persistent weakness and impaired memory have been reported to occur from low-level exposures to organophosphates in the absence of acute cholinergic effects. This chemical may damage the nervous system with repeated exposure, resulting in convulsions, respiratory failure. May cause liver damage. *Carcinogenicity[83]:* The International Agency for Research on Cancer has determined that parathion is not classifiable as to its carcinogenicity to humans. However, EPA lists parathion as a Possible human carcinogen. *Reproductive and developmental effects:* Studies have been reported in which parathion was embryo-toxic and feto-toxic in rodents. There are no studies addressing reproductive or developmental effects in humans exposed to parathion. Cholinesterase inhibitor; cumulative effect is possible.

Points of Attack: Respiratory system, central nervous system, cardiovascular system, eyes, skin and blood cholinesterase.

Medical Surveillance: This chemical is a suspected or known human carcinogen. Exposed persons should contact a physician for advice regarding the possible long term health effects and advice for medical monitoring. Toxicity of parathion depends on metabolic activation; thus, symptoms may be delayed for 6 to 24 hours after exposure. Medical observation is recommended for 24 to 48 hours following breathing overexposure, as pulmonary edema may be delayed. Routine biological monitoring of pesticide applicators and field workers includes testing of plasma and red blood cell acetylcholinesterase levels (for enzyme poisoned by this chemical). These tests are normally accurate only if done within about two hours of exposure. If exposure stops, plasma levels return to normal in 1–2 weeks while red blood cell levels may be reduced for 1–3 months. When acetylcholinesterase enzyme levels are reduced by 25% or more below preemployment levels, risk of poisoning is increased, even if results are in lower ranges of "normal." Reassignment to work not involving organophosphate pesticides is recommended until enzyme levels recover. Do not drink any alcoholic beverages before or during use as it promotes absorption of organophosphates. Also consider complete blood count and chest x-ray following acute overexposure. Do not drink any alcoholic beverages before or during use. Alcohol promotes absorption of organophosphates.

First Aid: **Treatment for organophosphate poisoning consists of thorough decontamination, cardiorespiratory support, and administration of the antidotes atropine and pralidoxime. In cases of severe poisoning, diazepam, an anticonvulsant, should also be administered. Antidotes should be administered as prevention even if the diagnosis is in doubt**. Speed in removing material from eyes and skin is of extreme importance. *Eyes:* Eye contact can cause dangerous amounts of these chemicals to be quickly absorbed through the mucous membrane into the bloodstream. Immediately and gently flush eyes with plenty of warm or cold water (NO hot water) for at least 15 minutes, occasionally lifting the upper and lower eyelids. Get medical aid immediately. *Skin:* Get medical aid. Dermal contact can cause dangerous amounts of these chemicals to be absorbed into the bloodstream. Wearing the appropriate PPE equipment and respirator for organophosphate pesticides, immediately flush skin with plenty of soap and water for at least 15 minutes while removing contaminated clothing and shoes. Shampoo hair promptly if contaminated. The removed, contaminated clothing and shoes should be double-bagged and left in Hot Zone for later disposal by hazardous materials experts. Skin may also be decontaminated with diluted hypochlorite solution. *Inhalation:* Get medical aid. Do not contaminate yourself. Wearing the appropriate PPE equipment and respirator for organophosphate pesticides, immediately remove the victim from the contaminated area to fresh air. If the victim is not breathing, administer artificial respiration. Do not use mouth-to-mouth method if victim ingested or inhaled the substance; give artificial respiration with the aid of a pocket mask equipped with a one-way valve or other proper respiratory medical device. If breathing is difficult, administer oxygen through bag/mask apparatus until medical help arrives. Do not leave victim unattended. *Ingestion:* Call poison control. Loosen all clothing. Never give anything by mouth to an unconscious person. If victim is *unconscious or having convulsions,* do nothing except keep victim warm. Get medical aid. Transfer promptly to a medical facility. In cases of ingestion, **do not induce vomiting**. If the victim is alert and asymptomatic, administer a slurry of activated charcoal at a dose of 1 g/kg (infant, child, and adult dose). A soda can and straw may be of assistance when offering charcoal to a child. *In some cases you may be specifically instructed by poison control to induce vomiting by way of 2 tablespoons of syrup of ipecac (adult) washed down with a cup of water*. Do NOT give activated charcoal before or with ipecac syrup

Note to physician or authorized medical personnel: Treat cases of respiratory compromise, coma, or excessive pulmonary secretions with respiratory support using protocols and techniques available and within the scope of training. Some cases may necessitate procedures such as endotracheal intubation or cricothyrotomy by properly trained and equipped personnel. When possible, atropine (see *Antidotes*, below) should be given under medical supervision. Patients who are comatose, hypotensive, or having seizures or cardiac arrhythmias should be treated according to advanced life support protocols. *Antidotes:* Two antidotes are administered to treat organophosphate poisoning. Atropine is a competitive antagonist of acetylcholine at muscarinic receptors and is used to control the excessive bronchial secretions which are often responsible for death. Pralidoxime relieves both the nicotinic and muscarine effects of organophosphate poisoning by regenerating acetylcholinesterase and can reduce both the bronchial secretions and the muscle weakness associated with poisoning. The initial intravenous dose of atropine in adults should be determined by the severity of symptoms: An initial adult dose of 1.0 to 2.0 mg or pediatric dose of 0.01 mg/kg (minimum 0.01 mg) should be administered intravenously. If intravenous access cannot be established, atropine may also be given intramuscularly, subcutaneously or via endotracheal tube. Doses should be repeated every 15 minutes until excessive secretions and sweating have been controlled. Once bronchial secretion has been controlled, atropine administration should be repeated whenever the secretions begin to recur. In seriously poisoned patients, very large doses may be required. Alterations of pulse rate and pupillary size should not be used as indicators of treatment adequacy. Pralidoxime should be administered as early in poisoning as possible as its efficacy may diminish when given more than 24 to 36 hours after exposure. Doses are as follows: adult 1.0 g; pediatric 25 to 50 mg/kg. The drug should be administered intravenously over 30 to 60 minutes, but in a life-threatening situation one-half of the total dose can be given per minute for a total administration time of 2 minutes. Treatment should begin to take effect within 40 minutes with a reduction in symptoms and the amount of atropine necessary to control bronchial secretion. The initial dose can be repeated in 1 hour and then every 8 to 12 hours until the patient is clinically well and no longer requires atropine. If intravenous access cannot be established, pralidoxime may also be given intramuscularly. Early administration of diazepam in addition to the combined atropine and pralidoxime treatment may help prevent the onset of seizures and potential brain and cardiac morphologic damage following high-level organophosphate poisoning.

Personal Protective Methods: Wear protective gloves and clothing to prevent any reasonable probability of dermal and/or eye contact. Safety equipment suppliers/manufacturers can provide recommendations on the most protective glove/clothing material for your operation. One recommendation is the use of DuPont™ Tychem® suit fabrics[88]. All protective clothing (suits, gloves, footwear, headgear) should be clean, available each day, and put on before work. Contact lenses should not be worn when working with this chemical. Wear splash-proof chemical goggles and face shield unless full facepiece respiratory protection is worn. Employees should wash immediately with soap when skin is wet or contaminated. Provide emergency showers and eyewash.

Respirator Selection: Engineering controls should be used wherever feasible to maintain airborne concentrations of this chemical below the prescribed exposure limit. Respirators and protective equipment are less effective than engineering controls, and should be used only in non-routine or emergency situations which may result in exposure concentrations in excess of the TWA environmental limit. *At any concentrations above the NIOSH REL, or where there is no REL, at any detectable concentration:* SCBAF: Pd,Pp (APF = 10,000) (any NIOSH/MSHA- or European Standard EN 149-approved self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode); or SaF: Pd,Pp: ASCBA (APF = 10,000) (any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary, self-contained breathing apparatus operated in a pressure-demand or other positive-pressure mode).

Storage: (1) Color Code-Red Stripe: Flammability Hazard: Store separately from all other flammable materials. Prior to working with this chemical you should be trained on its proper handling and storage. Before entering confined space where this chemical may be present, check to make sure that an explosive concentration does not exist. Store in tightly closed containers in a cool, well-ventilated area away from chlorine compounds, oxidizing agents; and combustible materials. Sources of ignition, such as smoking and open flames, are prohibited where thei chemical is handled, used, or stored, Use only non-sparking tools and equipment, especially when opening and closing containers. Wherever this chemical is used, handled, manufactured, or stored, use explosion-proof electrical equipment and fittings. Piping should be electrically bonded and grounded. Procedures for the handling, use and storage of cylinders should be in compliance with OSHA 1910.101 and 1910.169, as with the recommendations of the Compressed Gas Association. (2) Color Code-Blue: Health Hazard/Poison. Store in a secure poison location. Prior to working with this chemical you should be trained on its proper handling and storage. Where possible, automatically transfer material from other storage containers to process containers. Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: Organophosphorus pesticides, solid or liquid (nonflammable), require a "poisonous materials" label. This chemical falls in Hazard Class 6.1.

Spill Handling: First remove all sources of ignition. Evacuate persons not wearing protective equipment from area of spill or leak until clean up is complete. Stay upwind; keep out of low areas. Ventilate area of spill or leak. Remove and isolate contaminated clothing at the site. Do not touch spilled material; stop leak if you can do so without risk. Use water spray to reduce vapors. *Small spills:* absorb with sand or other noncombustible absorbent material and place into containers for later disposal. *Large spills:* dike far ahead of spill for later disposal. Collect powdered material in the most convenient and safe manner and deposit in sealed containers. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable. Seek professional environmental engineering assistance from the U.S. EPA Environmental Response Team at (908) 548-8730 (24-hour response line).

Fire Extinguishing: Hazardous decomposition includes oxides of phosphorus, sulfur, and nitrogen. May be fatal if inhaled, ingested or absorbed through skin. Inhalation or contact with some of these materials will irritate or burn skin and eyes. Vapors may cause dizziness or suffocation. *Small fires:* dry chemical, carbon dioxide; water spray; or foam. *Large fires:* water spray, fog, or foam. Stay upwind; keep out of low areas. Ventilate closed spaces before entering them. Firefighting gear (including SCBA) may not provide adequate protection. If exposure occurs, remove and isolate gear immediately and thoroughly decontaminate personnel. Wear positive-pressure breathing apparatus and special protective clothing. Remove and isolate contaminated clothing at the site. Move container from fire area if you can do so without risk. Fight fire from maximum distance. Dike fire-control water for later disposal; do not scatter the material. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies. From a secure, explosion-proof location, use water spray to cool exposed containers. If cooling streams are ineffective (venting sound increases in volume and pitch, tank discolors, or shows any signs of deforming), withdraw immediately to a secure position. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode.

Disposal Method Suggested: Generators of waste containing this contaminant (≥100 kg/mo) must conform with EPA regulations governing storage, transportation, treatment, and waste disposal. Destruction by alkali hydrolysis or incineration. Containers must be disposed of properly by following package label directions or by contacting your local or federal environmental control agency, or by contacting your regional EPA office.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- USEPA, Office of Pesticide Programs, Pesticide Residue Limits, "Parathion," 40 CFR 180.121. http://www.epa.gov/pesticides/food/viewtols.htm

- EXTOXNET, Extension Toxicology Network, “Pesticide Information Profile, Parathion,” Oregon State University, Corvallis, OR (September 1993). http://extoxnet.orst.edu/pips/parathio.htm
- New Jersey Department of Health and Senior Services, “Hazardous Substance Fact Sheet, Parathion,” Trenton, NJ (May 1989, rev. October 2000). http://www.state.nj.us/health/eoh/rtkweb/1459.pdf
- National Institute for Occupational Safety and Health, “Criteria for a Recommended Standard: Occupational Exposure to Parathion,” NIOSH Doc. No. 76-190 (1976)
- Sax, N. I., Ed., “Dangerous Properties of Industrial Materials Report,” 3, No. 3, 92-97 (1983)
- USEPA, “Chemical Profile: Parathion,” Washington DC, Chemical Emergency Preparedness Program (Nov.30, 1987)
- Agency for Toxic Substances and Disease Registry, U.S. Department of Health and Human Services, Public Health Service, “Managing Hazardous Materials Incidents,” Atlanta, GA (June 2003)
- New York State Department of Health, “Chemical Fact Sheet: Parathion,” Albany, NY, Bureau of Toxic Substance Assessment (Version 2, March 1986 and Version 3)

Pelargonic acid P:0184

Use Type: Herbicide, Fungicide
CAS Number: 112-05-0
Formula: $C_9H_{18}O_2$
Synonyms: **Nonanoic acid**; *n*-Nonoic acid; *n*-Nonylic acid; 1-Octanecarboxylic acid; Pelargic acid
Trade Names: CIRRASOL®-185A; ECONOSAN®; EMERY® 202 (mixture with *n*-octoic acid); EMFAC®-1202; HEXACID® C-9; PELARGON®; SCYTHE®; WEST AGRO ACID SANITIZER®
Chemical class: Fatty acid
EPA/OPP PC Code: 217500
California DPR Chemical Code: 2739
HSDB Number: 5554 as nonanoic acid
UN/NA & ERG Number: UN3265/153
RTECS® Number: RA6650000
EC Number: 203-931-2 [*Annex I Index No.:* 607-197-00-2]

Uses: Pelargonic acid occurs naturally in many plants and animals. It is used to control the growth of weeds and as a blossom thinner for apple and pear trees. It is also used as a food additive; as an ingredient in solutions used to commercially peel fruits and vegetables.

U.S. Maximum Allowable Residue Levels for Nonanoic acid [40 CFR 180.940(b)]: Residues are exempted from the requirement of a tolerance when used in accordance with good manufacturing practice as ingredients in an antimicrobial pesticide formulation, provided that the substance is applied on a semi-permanent or permanent food-contact surface (other than being applied on food packaging) with adequate draining before contact with food. (b) When used as ingredients in an antimicrobial pesticide formulation may be applied to: Dairy processing equipment, and food-processing equipment and utensils. Limit: when ready for use, the end-use concentration is not to exceed 90 ppm. ***[40 CFR 180.940 (c)]:*** (c) The following chemical substances when used as ingredients in an antimicrobial pesticide formulation may be applied to: Food-processing equipment and utensils. Limit: when ready for use, the end-use concentration is not to exceed 90 ppm.

Regulatory Authority and Advisory Information: Acute Oral Category: 4, Caution.
Health Advisory: Skin irritant/sensitizer
European/International Regulations: Hazard Symbol: C; risk phrases: R34; safety phrases: S1/2; S26: S28; S36/37/39; S45 (see Appendix 1)
WGK (German Aquatic Hazard Class): 1-Slightly water polluting

Description: Colorless or yellowish, combustible, oily liquid. Faint odor. Molecular weight 158.27; Specific gravity (H_2O:1) = 0.9055 @ 20 °C; Boiling point = 255 °C; Freezing/Melting point = 12.4 °C; Boiling point = 255.5 °C; Vapor pressure = 1.65×10^{-3} mmHg @ 25 °C; Flash point = >125 °C; Autoignition temperature = 400 °C; Explosive limits: LEL = 0.9%; UEL = 5.9%. Hazard Identification (based on NFPA-704 M Rating System): Health 3, Flammability 1, Reactivity 0. Slightly soluble in water; solubility 250 mg/L @ 25 °C.

Incompatibilities: Heated vapors may form explosive mixture with air. May react violently with strong oxidizers, bromine, 90% hydrogen peroxide, phosphorus trichloride, silver powders or dust. Incompatible with strong bases and silver compounds; mixture with some silver compounds may form explosive salts of silver oxalate.

Permissible Exposure Limits in Air: Protective Action Criteria (PAC) Ver. 27[89]
PAC-1: 20 mg/m^3
PAC-2: 220 mg/m^3
PAC-3: 1300 mg/m^3

Determination in Water: Log K_{ow} = >3.0. Values above 3.0 are likely to bioaccumulate in aquatic organisms.

Routes of Entry: Inhalation; ingestion; dermal contact.

Harmful Effects and Symptoms

Short Term Exposure: Corrosive. This material can cause irritation and chemical burns to the skin, eyes, and respiratory and digestive tracts. May cause permanent eye damage. Very harmful if swallowed. Repeated or prolonged dermal contact may cause dermatitis. Inhalation may cause lung edema, a medical emergency that can be delayed up to 72 hours. LD_{50} (oral, rat) = 15 g/kg; LD_{50} (dermal, rat) = >5 g/kg.

Long Term Exposure: Dermatitis; serious problems with the digestive tract and respiratory tracts.

Points of Attack: Skin, eyes, respiratory tract.

Medical Surveillance: Preliminary medical exam to detect chronic diseases of central nervous system, liver, heart, kidneys, lung and skin, as well as endocrinological or immunological disturbances, should protect susceptible individuals.

Periodical medical exams of internal organs, skin and eyes are important to avoid chronic occupational intoxications. They should include lab and patch tests when necessary[83]. Evaluation by a qualified allergist, including exposure history and testing, may help diagnose allergy.

First Aid: If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least 15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately. If this chemical contacts the skin, remove contaminated clothing and wash immediately with soap and water. Seek medical attention immediately. If this chemical has been inhaled, remove from exposure, begin rescue breathing (using universal precautions) if breathing has stopped, and CPR if heart action has stopped. Transfer promptly to a medical facility. When this chemical has been swallowed, get medical attention. Give large quantities of water and induce vomiting. Do not make an unconscious person vomit. Do not induce vomiting when formulations containing petroleum solvents are ingested.

Personal Protective Methods: Wear protective gloves and clothing to prevent any reasonable probability of dermal and/or eye contact. Safety equipment suppliers/manufacturers can provide recommendations on the most protective glove/clothing material for your operation. All protective clothing (suits, gloves, footwear, headgear) should be clean, available each day, and put on before work. Contact lenses should not be worn when working with this chemical. Wear splash-proof chemical goggles and face shield unless full facepiece respiratory protection is worn. Employees should wash immediately with soap when skin is wet or contaminated. Provide emergency showers and eyewash.

Respirator Selection: SCBA > 20 mg/m^3. Wherever and whenever workplace conditions warrant respirator use, a respiratory protection program must be followed that meets one or more of the following government standards: OSHA's 29 CFR 1910.134, ANSI Z88.2, or European Standard EN 149.

Storage: Color Code-White: Corrosive or Contact Hazard; Store separately in a corrosion-resistant location. Prior to working with this chemical you should be trained on its proper handling and storage. Store in tightly closed containers in a cool, well-ventilated area away from incompatible materials listed above. Metal containers involving the transfer of this chemical should be grounded and bonded. Drums must be equipped with self-closing valves, pressure vacuum bungs, and flame arresters. Use only non-sparking tools and equipment, especially when opening and closing containers of this chemical. If this material contains a flammable carrier, sources of ignition, such as smoking and open flames, are prohibited where this chemical is used, handled, or stored in a manner that could create a potential fire or explosion hazard. Wherever this chemical is used, handled, manufactured, or stored, use explosion-proof electrical equipment and fitting.

Spill Handling: First remove all sources of ignition. Evacuate persons not wearing protective equipment from area of spill or leak until clean up is complete. Collect powdered material in the most convenient and safe manner and deposit in sealed containers. Ventilate area after clean up is complete. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable.

Fire Extinguishing: Poisonous and irritating gasses are released in fire, including oxides of carbon. *On a small fire:* use dry chemical powder, carbon dioxide or water spray. *On a large fire:* use water spray, fog or alcohol-resistant foam. Move containers from fire area if you can do it without risk. Dike fire-control water for later disposal. Use water spray or fog; do not scatter material using straight water jet streams. *Fire involving storage or vehicular tanks:* isolate for 800 meters/0.5 mile in all directions; also, consider initial evacuation for 800 meters/0.5 mile in all directions. Fight fire from maximum distance or use unmanned hose holders or monitor nozzles. Do not allow water to get inside containers. Cool containers with flooding quantities of water until well after fire is out. Withdraw immediately in the case of rising sound from venting safety devices or discoloration of tank. *Always* stay away from tanks engulfed in fire. For massive fire, use unmanned hose holders or monitor nozzles; if this is impossible, withdraw from area and let fire burn.

Disposal Method Suggested: Do not discharge into drains or sewers. Dispose of waste material as hazardous waste using a licensed disposal contractor to an approved landfill. Contact a licensed disposal facility about surplus and non-recyclable solutions. Burn in a chemical incinerator equipped with an afterburner and scrubber. Extra care must be exercised as the material in an organic solvent is highly flammable. Consult with environmental regulatory agencies for guidance on acceptable disposal practices. Incineration with effluent gas scrubbing is recommended. Containers must be disposed of properly by following package label directions or by contacting your local or federal environmental control agency, or by contacting your regional EPA office.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- USEPA, Office of Pesticide Programs, "Pelargonic Acid Fact Sheet" (April 2000). http://www.epa.gov/oppbppd1/biopesticides/ingredients/factsheets/factsheet_217500.htm

Penconazole P:0186

Use Type: Fungicide

CAS Number: 66246-88-6

Formula: $C_{13}H_{15}C_{12}N_3$
Synonyms: 1*H*-1,2,4-Triazole,1-[2-(2,4-dichlorophenyl)pentyl]-; 1-[2-(2,4-Dichlorophenyl)pentyl]-1*H*-1,2,4-triazole; (RS)-1-[2-(2,4-Dichlorophenyl)-*N*-pentyl]-1*H*-1,2,4-triazole
Trade Names: AWARD®; CGA-71818®; ONMEX®; TOPAS®; TOPAS-C®; TOPAS-MZ®; TOPAZ®; TOPAZE®; TOPAZE-C®; TOPENCO 100EC®
Chemical class: Azole; Triazole
EPA/OPP PC Code: 128999
UN/NA & ERG Number: UN1915/127
RTECS® Number: XZ4615000
EC Number: 266-275-6
Uses: Penconazole is a systemic fungicide used to control powdery mildew. It is used on apples and grapes and other fruits, hops, tobacco, ornamentals and on vegetables. Not currently registered in the U.S. Reported to be used in most European countries. Currently, there are more than 30 global suppliers[97].
Regulatory Authority and Advisory Information: Acute Oral Category: 3, CAUTION.
Health Advisory: Developmental/Reproductive Toxin
Endocrine disruptor: Listed as a potential ED by the German Federal Environmental Agency
Description: Penconazole is a white powder. Molecular weight = 284.21; Specific gravity (H_2O:1) = 1.27 @ 20 °C; Boiling point = 415 °C; Freezing/Melting point = 57 °C; Vapor pressure = 3.7×10^{-7} mmHg @ 25 °C; Flash point = 205 °C. Hazard Identification (based on NFPA-704 M Rating System): Health 1, Flammability 1, Reactivity 0. Soluble in water.
Permissible Concentration in Water: Runoff from spills or fire control may cause water pollution.
Determination in Water: Log K_{ow} = >3.5. Values above 3.0 are likely to bioaccumulate in aquatic organisms.
Routes of Entry: Ingestion, dermal and/or eye contact. May be absorbed through the unbroken skin.
Harmful Effects and Symptoms
Short Term Exposure: Poisonous if swallowed. Contact may irritate skin and cause eye irritation and possible severe injury. Avoid inhalation. LD_{50} (oral, rat) = <2 g/kg; LD_{50} (dermal, rat) = >3 g/kg.
Long Term Exposure: A potential Endocrine disruptor that can affect thyroid, prostate and testes, weight.
Medical Surveillance: If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least 15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately. If this chemical contacts the skin, remove contaminated clothing and wash immediately with soap and water. If this chemical has been inhaled, remove from exposure, begin rescue breathing (using universal precautions) if breathing has stopped, and CPR if heart action has stopped. Transfer promptly to a medical facility. When this chemical has been swallowed, get medical attention. Give large quantities of water and induce vomiting. Do not make an unconscious person vomit.
Personal Protective Methods: Wear positive-pressure self-contained breathing apparatus (SCBA). Wear chemical protective clothing that is specifically recommended by the manufacturer. DuPont™ Tychem® Suit Fabrics is recommended by one government source[88]. It may provide little or no thermal protection. Structural firefighters' protective clothing provides limited protection in fire situations ONLY; it is not effective in spill situations where direct contact with the substance is possible.
Respirator Selection: Where the neat (undiluted) test chemical is weighed and diluted, wear a NIOSH-approved half-face respirator equipped with a combination filter cartridge, i.e. organic vapor/acid gas/HEPA (specific for organic vapors, HCl, acid gas, SO_2 and a high-efficiency particulate filter)[88]. Wherever and whenever workplace conditions warrant respirator use, a respiratory protection program must be followed that meets one or more of the following government standards: OSHA's 29 CFR 1910.134, ANSI Z88.2, or European Standard EN 149.
Storage: Color Code-Blue: Health Hazard/Poison. Store in a secure poison location. Refrigerate. Prior to working with this chemical you should be trained on its proper handling and storage. Store in tightly closed containers in a cool, well-ventilated area. If this material contains a flammable carrier, sources of ignition, such as smoking and open flames, are prohibited where this chemical is used, handled, or stored in a manner that could create a potential fire or explosion hazard. Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.
Shipping: This material may be classified as an Environmentally hazardous substances, solid, n.o.s. It usually falls in Hazard Class 9.
Spill Handling: For solids, isolate spill or leak area in all directions for at least 25 meters/75 feet. Increase, in the downwind direction, as necessary. First remove all sources of ignition. Evacuate persons not wearing protective equipment from area of spill or leak until clean up is complete. Do not touch damaged containers or spilled material unless wearing appropriate protective clothing. Stop leak if you can do it without risk. Prevent entry into waterways, sewers, basements or confined areas. Cover with plastic sheet to prevent spreading. Absorb or cover with dry earth, sand or other non-combustible material and transfer to containers. If you spill this chemical, you should dampen the solid spill material with water, then transfer the dampened material to a suitable container. Use absorbent paper dampened with water to pick up any remaining material. Seal your contaminated clothing and the absorbent paper in a vapor-tight plastic bag for eventual disposal. Wash all contaminated surfaces with a soap and water solution. Do not reenter the contaminated area until the Safety Officer (or other responsible person) has verified that the area has been properly cleaned. Do not allow water to get inside containers. Ventilate area after clean up is complete. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways,

notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable.

Fire Extinguishing: Hazardous decomposition includes toxic oxides of nitrogen and carbon and hydrogen chloride gas. Use water spray, dry chemical, carbon dioxide; or Halon extinguishers. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies. From a secure, explosion-proof location, use water spray to cool exposed containers. If cooling streams are ineffective (venting sound increases in volume and pitch, tank discolors, or shows any signs of deforming), withdraw immediately to a secure position. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode

Disposal Method Suggested: Consult with environmental regulatory agencies for guidance on acceptable disposal practices. Contact a licensed disposal facility about surplus and non-recyclable solutions. Burn in a chemical incinerator equipped with an afterburner and scrubber. Extra care must be exercised as the material in an organic solvent is highly flammable. In accordance with 40CFR165, follow recommendations for the disposal of pesticides and pesticide containers. Containers must be disposed of properly by following package label directions or by contacting your local or federal environmental control agency, or by contacting your regional EPA office. Incineration or permanganate oxidation.

Pencycuron P:0187

Use Type: Fungicide

CAS Number: 66063-05-6

Formula: $C_{19}H_{21}ClN_2O$

Synonyms: 1-(*p*-Chlorobenzyl)-1-cyclopentyl-3-phenylurea; *N*-[(4-Chlorophenyl)-methyl]-*N*-cyclopentyl-*N*′-phenylurea; Urea, *N*-[(4-chlorophenyl)methyl]-*N*-cyclopentyl-*N*′-phenyl-

Trade Names: BAY® NTN-19701; BAYER® NTN-19701; MONCEREN®; NTN-19701®; PENCYCURONE®

Chemical class: Phenylurea; Substituted urea

EPA/OPP PC Code: 128823

UN/NA & ERG Number: UN3002 (liquid phenylurea)/151

RTECS® Number: YS644000

EC Number: 266-275-6

Uses: Pencycuron is a non-systemic fungicide with specific control against fungicidal diseases (*Rhizoctonia solani* and *Pellicularia)* in potatoes, sugar beets, rice, cotton and ornamentals. Not currently registered in the U.S. Used in most European countries. There are more than 30 global suppliers[97].

Regulatory Authority and Advisory Information: Acute Oral Category: 4, Caution, Not acutely toxic

Description: Red liquid. Molecular weight = 328.87; Specific gravity (H_2O:1) = 1.01 @ 20 °C; Boiling point = 286 °C; Freezing/Melting point = 129.5–135 °C; Vapor pressure = 2.7×10^{-11} mmHg @ 25 °C; Flash point = 273 °C. Practically insoluble in water. Physical and toxicological properties may be affected by carrier solvents in commercial formulations.

Incompatibilities: May react with strong oxidizers such as chlorates, peroxides, nitrates, etc. Noncorrosive to metals.

Determination in Water: Log K_{ow} = >4.0. Values above 3.0 are likely to bioaccumulate in aquatic organisms.

Harmful Effects and Symptoms

Short Term Exposure: Contact with eyes or skin may cause irritation or burns. Inhalation should be avoided; use NIOSH- or CEN (UK)-approved air-purifying respirators for pesticides. May be harmful if swallowed. Dermal contact may cause allergic reaction. LD_{50} (oral, rat) = >5 g/kg; LD_{50} (dermal, rat) = >5 g/kg.

Long Term Exposure: Repeated or prolonged contact may cause skin and lung sensitization, resulting in allergies.

Points of Attack: Skin, lungs.

Medical Surveillance: Evaluation by a qualified allergist, including exposure history and testing, may help diagnose allergy.

First Aid: If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least 15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately. If this chemical contacts the skin, remove contaminated clothing and wash immediately with soap and water. Seek medical attention immediately. If this chemical has been inhaled, remove from exposure, begin rescue breathing (using universal precautions) if breathing has stopped, and CPR if heart action has stopped. Transfer promptly to a medical facility. When this chemical has been swallowed, get medical attention. Give large quantities of water and induce vomiting. Do not make an unconscious person vomit.

Personal Protective Methods: Wear protective gloves and clothing to prevent any reasonable probability of dermal and/or eye contact. Safety equipment suppliers/manufacturers can provide recommendations on the most protective glove/clothing material for your operation. All protective clothing (suits, gloves, footwear, headgear) should be clean, available each day, and put on before work. Contact lenses should not be worn when working with this chemical. Wear dust-proof chemical goggles and face shield unless full facepiece respiratory protection is worn. Employees should wash immediately with soap when skin is wet or contaminated. Provide emergency showers and eyewash.

Respirator Selection: Wherever and whenever workplace conditions warrant respirator use, a respiratory protection program must be followed that meets one or more of the following government standards: OSHA's 29 CFR 1910.134, ANSI Z88.2, or European Standard EN 149.

Storage: Color Code-Blue: Health Hazard/Poison. Store in a secure poison location. Prior to working with pencycuron you should be trained on its proper handling and storage.

Store in tightly closed containers in a cool, well-ventilated area. Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: Phenyl urea pesticides, solid, toxic, require a label of "poisonous materials." This compound falls in Hazard Class 6.1.

Spill Handling: First remove all sources of ignition. Evacuate persons not wearing protective equipment from area of spill or leak until clean up is complete. Do not touch spilled material; stop leak if you can do it without risk. Use water spray to reduce vapors. Collect powdered material in the most convenient and safe manner and deposit in sealed containers. *Large spills:* dike far ahead of spill for later disposal. Ventilate area after clean up is complete. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable.

Fire Extinguishing: Hazardous decomposition includes oxides of nitrogen and carbon; corrosive and toxic fumes of hydrogen chloride and hydrogen cyanide gases and flammable hydrogen gas. This chemical is combustible. Use dry chemical, carbon dioxide; water spray; or standard foam extinguishers. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies. From a secure, explosion-proof location, use water spray to cool exposed containers. If cooling streams are ineffective (venting sound increases in volume and pitch, tank discolors, or shows any signs of deforming), withdraw immediately to a secure position. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode.

Disposal Method Suggested: Incinerate in a unit with effluent gas scrubbing. Containers must be disposed of properly by following package label directions or by contacting your local or federal environmental control agency, or by contacting your regional EPA office.

Pendimethalin P:0188

Use Type: Herbicide

CAS Number: 40487-42-1

Formula: $C_{13}H_{19}N_3O_4$

Synonyms: Aniline, 3,4-dimethyl-2,6-dinitro-*N*-(1-ethylpropyl)-; Benzenamine, 3,4-dimethyl-2,6-dinitro-*N*-(1-ethylpropyl)-; Benzenamine, *N*-(1-ethylpropyl)-3,4-dimethyl-2,6-dinitro-; Caswell No. 454BB; 2,5-Dinitro-*N*-(1-ethylpropyl)-3,4-xylidine; 3,4-Dimethyl-2,6-dinitro-*N*-(1-ethylpropyl) aniline; *N*-(1-Ethylpropyl)-2,6-dinitro-3,4-xylidine; *N*-(1-Ethylpropyl)-3,4-dimethyl-2,6-dinitrobenzenamine; *N*-(1-Ethylpropyl)-3,4-dimethyl-2,6-dinitroanaline; Pendimethaline; *N*-(3-Pentyl)-3,4-dimethyl-2,6-dinitroaniline; Tendimethalin; 3,4-Xylidine, 2,6-dinitro-*N*-(1-ethylpropyl)-

Trade Names: AC 92553®; ACCOTAB®; BULLET® (pendimethalin + cyanazine); GO-GO-SAN®; HERBADOX®; PAY-OFF®; PENOXALIN®; PENOXALINE®; PROWL®; SIPAXOL®; SQUADRON® (with imazaquin); STOMP®; TATA PANIDA®; VALOR®; WAY-UP®

Chemical class: 2,6-Dinitroaniline

EPA/OPP PC Code: 108501; (454300 old EPA code number)

California DPR Chemical Code: 1929

HSDB Number: 6721

UN/NA & ERG Number: UN1596 (Dinitroanilines)/153

RTECS® Number: BX5470000

EC Number: 254-938-2 [*Annex I Index No.:* 609-402-00-X]

Uses: Pendimethalin is a selective pre-emergence and post-emergence herbicide used on various agricultural and non-agricultural sites to control broadleaf weeds and grassy weeds in crops such as apricot, carrot, cherry, corn, cotton, fig, garbanzos, garlic, olive, onion, nectarine, peach, pear, pecan, plum, rice and prune, and noncrop areas. It is applied to soil preplant, pre-emergence, and post-emergence with ground and aerial equipment.

U.S. Maximum Allowable Residue Levels for Pendimethalin including its metabolites and degradates, in or on the commodities. Compliance with the tolerance levels specified in the following table below is to be determined by measuring only pendimethalin, and its metabolite, 4-[(1-ethylpropyl) amino]-2-methyl-3,5-dinitrobenzyl alcohol, calculated as the stoichiometric equivalent of pendimethalin, in or on the following commodities: [40 CFR 180.361(a)]: Alfalfa, forage 3.5 ppm; alfalfa, hay 4.0 ppm; alfalfa, seed 0.10 ppm; almond, hulls 0.4 ppm; apple, wet pomace 0.20 ppm; artichoke, globe 0.1 ppm; asparagus 0.15 ppm; beans 0.10 ppm; bean, forage 0.10 ppm; bean, hay 0.10 ppm; brassica head and stem, subgroup 5-A, 0.1 ppm; carrot 0.5 ppm; citrus, oil 0.5 ppm; corn, field, forage 0.1 ppm; corn, field, grain 0.1 ppm; corn, field, stover 0.1 ppm; corn, pop, grain 0.1 ppm; corn, sweet, forage 0.1 ppm; corn, sweet, kernel plus cob with husks removed 0.1 ppm; corn, sweet, stover 0.1 ppm; cotton, gin byprducts 3.0 ppm; cotton, undelinted seed 0.1 ppm; crayfish 0.05 ppm; fruit, citrus, group 10, 0.1 ppm; fruit, pome, group 11, 0.10 ppm; fruit, stone, group 12, 0.10 ppm; garlic 0.1 ppm; grape 0.1 ppm; grass forage, fodder, and hay crop group 17, forage 20 ppm; grass forage, fodder, and hay crop group 17, hay 13 ppm; grass forage, fodder, and hay crop group 17, straw 4.0 ppm; juneberry 0.10 ppm; leek 0.20 ppm; nut, tree, group 14, 0.1 ppm; olive 0.1 ppm; onion, bulb 0.1 ppm; onion, green 0.20 ppm; onion, welsh 0.20 ppm; peanut 0.1 ppm; peanut, hay 0.1 ppm; peas (except field peas) 0.10 ppm; peppermint, oil 1.0 ppm; peppermint, tops 0.2 ppm; Pistachio 0.1 ppm; pomegranate

0.10 ppm; potato 0.1 ppm; rice, grain 0.1 ppm; rice, straw 0.1 ppm; shallot 0.2 ppm; sorghum, forage 0.1 ppm; sorghum, grain, grain 0.1 ppm; sorghum, grain, stover 0.1 ppm; soybean, forage 0.1 ppm; soybean, hay 0.1 ppm; soybean, seed 0.1 ppm; spearmint, oil 1.0 ppm; spearmint, tops 0.2 strawberry 0.10 ppm; sugarcane, cane 0.1 ppm; sunflower, seed 0.1 ppm; vegetable, fruiting, group B, 0.10 ppm; wheat, grain 0.10 ppm; wheat, forage 3.0 ppm; wheat, hay 0.60 ppm; wheat, straw 0.30 ppm.

Regulatory Authority and Advisory Information:

Carcinogenicity[83]: EPA Group C, Possible human carcinogen

Acute Oral Category: 3, CAUTION

Health Advisory: Tumorigen, Endocrine disruptor (S!)

EPA Acceptable Daily Intake (ADI) Oral Reference Dose (RfD) = 0.04 mg/kg/day

EPCRA Section 313 Form R *de minimis* concentration reporting level: 1.0%

European/International Regulations: Hazard Symbol: Xi, N; risk phrases: R43; R50/53; safety phrases: S2; S24; S29; S37; S60; S61 (see Appendix 1)

Description: Yellow-orange crystalline solid. Mild nut-like odor. Commercial product is available as an emulsifiable concentrate. Molecular weight = 281.33; Specific gravity (H_2O:1) = 1.19 @ 25 °C; Boiling point = (decomposes) 330 °C; Freezing/Melting point = 55–58 °C; Vapor pressure = 9.4×10^{-6} mmHg @ 25 °C. Slightly soluble in water; solubility = 0.32 mg/L @ 20 °C. Physical and toxicological properties may be affected by carrier solvents in commercial formulations.

Incompatibilities: Reacts with oxidizers, acids and alkaline materials. Contact with strong oxidizers may cause fire and explosions.

Permissible Concentration in Water: State Drinking Water Guidelines: Arizona 280 μg/L; Florida 280 μg/L. Runoff from spills or fire control may cause water pollution.

Determination in Water: Method: USGS-NWQL O-1126-95; Procedure: gas chromatography-mass spectrometry with select-ion monitoring; Matrix: natural water; Detection limit: 0.018 μg/L. Log K_{ow} = >5.0. Values above 3.0 are likely to bioaccumulate in aquatic organisms.

Routes of Entry: Absorbed through the unbroken skin. Inhalation, ingestion.

Harmful Effects and Symptoms

Short Term Exposure: Irritates and possibly burns the skin, eyes, and respiratory tract. Eye contact may cause irritation, burning sensation, burns, and visual damage; inflammation of the conjunctiva, corneal opacity and slight physiologic dilatation of the pupils. Dermal contact causes irritation and possible burns. Rapidly absorbed through the unbroken skin and can be fatal. Causes irritation of the mucous membrane and upper respiratory tract. May cause violent sneezing and coughing. May cause increased perspiration, elevated temperature, breathing, and heart rate; headache, weakness, nausea, abdominal pain, vomiting. Systemic intoxication is cumulative and has been fatal. High levels of exposure may be fatal. Inhalation may cause damage to the circulatory system and heart resulating in possible death due to cardiac failure. May be fatal if swallowed. Causes gastrointestinal irritation with nausea, vomiting and diarrhea. Symptoms are similar to those of acute inhalation. May cause liver and kidney damage. LD_{50} (oral, rat) = 1050–3180 mg/kg; LD_{50} (dermal, rat) = >2 g/kg.

Long Term Exposure: May cause tumors. Thyroid toxin. This material is capable of bioaccumulating. May cause cancer. Skin sensitizer.

Points of Attack: Thyroid gland. Skin, kidneys, liver.

Medical Surveillance: Preliminary medical exam to detect chronic diseases of central nervous system, liver, heart, kidneys, lung and skin, as well as endocrinological or immunological disturbances, should protect susceptible individuals. Periodical medical exams of internal organs, skin and eyes are important to avoid chronic occupational intoxications. They should include lab and patch tests when necessary[83]. This chemical is a suspected or known human carcinogen. Exposed persons should contact a physician for advice regarding the possible long term health effects and advice for medical monitoring. Evaluation of thyroid function. Consult a physician if poisoning is suspected or if redness, itching, or burning of the eyes or skin develops. Evaluation by a qualified allergist, including exposure history and testing, may help diagnose allergy.

First Aid: If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least 15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately. If this chemical contacts the skin, remove contaminated clothing and wash immediately with soap and water. Seek medical attention immediately. If this chemical has been inhaled, remove from exposure, begin rescue breathing (using universal precautions) if breathing has stopped, and CPR if heart action has stopped. Transfer promptly to a medical facility. When this chemical has been swallowed, get medical attention. Give large quantities of water and induce vomiting. Do not make an unconscious person vomit. Do not induce vomiting when formulations containing petroleum solvents are ingested

Personal Protective Methods: Reacts with the following absorbent materials: Cellulose-Based; Mineral- and Clay-Based; Expanded Polymeric[88]. Wear protective gloves and clothing to prevent any reasonable probability of dermal and/or eye contact. Safety equipment suppliers/manufacturers can provide recommendations on the most protective glove/clothing material for your operation. All protective clothing (suits, gloves, footwear, headgear) should be clean, available each day, and put on before work. Contact lenses should not be worn when working with this chemical. Wear dust-proof chemical goggles and face shield unless full facepiece respiratory protection is worn. Employees should wash immediately with soap when skin is wet or contaminated. Provide emergency showers and eyewash.

Respirator Selection: *At any detectable concentration:* SCBAF: Pd,Pp (APF = 10,000) (any NIOSH/MSHA- or European Standard EN 149-approved self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode); or SaF: Pd,Pp: ASCBA (APF = 10,000) (any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary, self-contained breathing apparatus operated in a pressure-demand or other positive-pressure mode). *Escape:* 100F (APF = 50) (any air-purifying, full facepiece respirator with an N100, R100, or P100 filter k-mounted organic vapor canister having a high-efficiency particulate filter); or SCBAE (any appropriate escape-type, self-contained breathing apparatus).

Storage: (1) Color Code-Yellow Stripe: Reactivity Hazard; Store separately in a area isolated from flammables, combustibles, or other yellow-coded materials. (2) Color Code-Blue: Health Hazard/Poison. Store in a secure poison location. Prior to working with this chemical you should be trained on its proper handling and storage. Before entering confined space where this chemical may be present, check to make sure that an explosive concentration does not exist. Store in tightly closed containers in a cool, well-ventilated area away from oxidizers, strong acids; strong bases and other incompatible materials listed above. Metal containers involving the transfer of this chemical should be grounded and bonded. Drums must be equipped with self-closing valves, pressure vacuum bungs, and flame arresters. Use only non-sparking tools and equipment, especially when opening and closing containers of this chemical. If this material contains a flammable carrier, sources of ignition, such as smoking and open flames, are prohibited where this chemical is used, handled, or stored in a manner that could create a potential fire or explosion hazard. Wherever this chemical is used, handled, manufactured, or stored, use explosion-proof electrical equipment and fittings. Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: Dinitroanilines require a label of "poisonous materials." They usually fall into Hazard Group 6.1.

Spill Handling: First remove all sources of ignition. Evacuate persons not wearing protective equipment from area of spill or leak until clean up is complete. Do not dry sweep. Collect powdered material in the most convenient and safe manner and deposit in sealed containers. Ventilate area after clean up is complete. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable.

Fire Extinguishing: Poisonous gases released in fire included oxides of nitrogen and carbon. Use dry chemical, carbon dioxide; water spray; alcohol foam or polymer foam extinguishers. Heated vapors in confined spaces can explode. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies. Containers can explode in fire. From a secure, explosion-proof location, use water spray to cool exposed containers. If cooling streams are ineffective (venting sound increases in volume and pitch, tank discolors, or shows any signs of deforming), withdraw immediately to a secure position. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode.

Disposal Method Suggested: It is the responsibility of chemical waste generators to determine if a discarded chemical is classified as a hazardous waste. See 40 CFR Parts 261.3 for U.S. EPA guidelines for the classification determination. Additionally, in order to ensure complete and accurate classification, waste generators must consult state and local hazardous waste regulations. Organic pesticides, whether of botanical or synthetic origin, can be destroyed by incineration equipped with scrubbers to remove acid wastes.

References:

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- USEPA, "Reregistration Eligibility Decision (RED), Pendimethalin," Office of Prevention, Pesticides and Toxic Substances, Washington DC (June 1997). http://www.epa.gov/REDs/0187red.pdf
- EXTOXNET, Extension Toxicology Network, "Pesticide Information Profile, Pendimethalin," Oregon State University, Corvallis, OR (June 1996). http://extoxnet.orst.edu/pips/pendimet.htm

Pentachlorophenol P:0240

Use Type: Fungicide, Herbicide, Slimicide, Wood preservative

CAS Number: 87-86-5

Formula: C_6HCl_5O; C_6Cl_5OH

Synonyms: 1-Hydroxypentachlorobenzene; NCI-C54933; NCI-C55378; NCI-C56655; PCP; Penchlorol; Penta; Pentachlorofenol; Pentachlorophenate; 2,3,4,5,6-Pentachlorophenol; Pentachlorophenol, technical; Pentaclorofenol (Spanish); Phenol, pentachloro-

Trade Names: (The U.S. EPA lists 626 active and canceled/transferred labels for this chemical) CHEM-TOL®; CHLON®; CHLOROPHEN®; CRYPTOGIL OL®; DOWCIDE® 7; DOWICIDE® 7; DOW PENTACHLOROPHENOL DP-2 ANTIMICROBIAL®; DURA TREET II®; DUROTOX®; EP 30®; FORPEN-50®; FUNGIFEN®; GLAZD-PENTA®; GRUNDIER ARBEZOL®; LAUXTOL®; LIROPREM®; ONTRACK WE HERBICIDE®; ORTHO TRIOX®; OSMOSE WPC®; PENTACHLOROPHENOL, DOWICIDE EC-7®; PENTACHLOROPHENOL, DP-2®; PENTACON®; PENTA-KIL®; PENTA READY®; PENTASOL®; PENWAR®; PERATOX®; PERMACIDE®; PERMAGARD®; PERMASAN®; PERMATOX DP-2®;

PERMATOX PENTA®; PERMITE®; POL NU®; PREVENTOL P®; PRILTOX®; SANTOBRITE®; SANTOPHEN®; SINITUHO®; TERM-I-TROL®; THOMPSON'S WOOD FIX®; WATERSHED WP®; WEEDONE®; WOODTREAT A®

Chemical class: Chlorinated phenol

EPA/OPP PC Code: 063001 and 600021

California DPR Chemical Code: 465 Not registered

HSDB Number: 894

UN/NA & ERG Number: UN3155/154

RTECS® Number: SM6300000

EC Number: 201-778-6 [*Annex I Index No.:* 604-002-00-8]

Uses: Pentachlorophenol (PCP) is a commercially produced insecticide, fungicide, and slimicide. Since 1984 it has been restricted to certified applicators and is no longer available to the general public. It is primarily used to protect timber from fungal rot and wood-boring insects, but may also be used as a pre-harvest defoliant in cotton, a general pre-emergence herbicide, and as a biocide in industrial water systems. Not approved for use in EU countries[115]. Not registered for use in the U.S. There are 48 global suppliers[97].

Regulatory Authority and Advisory Information:

Carcinogenicity[83]: EPA Group B2, Probable human carcinogen; EU GHS Category 2: Suspected human carcinogen.; ACGIH A3 Confirmed animal carcinogen with unknown relevance to humans

California Proposition 65 Chemical: Cancer (1/1/1990)

Health Advisory: Tumorigen, Mutagen, Reproductive Toxin, Skin irritant/sensitizer, Very toxic by Inhalation (EU); Endocrine disruptor (S!)

Acute Oral Category: 1, DANGER–POISON

List of priority pollutants (U.S. EPA)

Clean Air Act: Hazardous Air Pollutants (Title I, Part A, Section 112)

Clean Water Act: Section 311 Hazardous Substances/RQ 40CFR117.3 (same as CERCLA, see below); 40CFR401.15 Section 307 Toxic Pollutants; 40CFR423, Appendix A, Priority Pollutants; Section 313 Water Priority Chemicals (57FR41331, 9/9/92)

EPA Hazardous Waste Number (RCRA No.): D037

RCRA Toxicity Characteristic (Section 261.24), Maximum Concentration of Contaminants, regulatory level, 100 mg/L

RCRA 40CFR268.48; 61FR15654, Universal Treatment Standards: Wastewater (mg/L), 0.089; Non-wastewater (mg/kg), 7.4

RCRA 40CFR264, Appendix 9; TSD Facilities Ground Water Monitoring List. Suggested test method(s) (PQL μg/L): 8040(5); 8270(50)

Safe Drinking Water Act: MCL, 0.001 mg/L; MCLG, zero; Regulated chemical (47 FR 9352)

Superfund/EPCRA 40CFR302.4 RQ: CERCLA, 10 lb (4.54 kg)

EPCRA Section 313 Form R *de minimus* concentration reporting level: 1.0%

U.S. DOT Regulated Marine Pollutant (49CFR172.101, Appendix B), severe pollutant

Rotterdam Convention Annex III [Chemicals Subject to the Prior Informed Consent Procedure (PIC)] (as pentachlorophenol and its salts and esters)

European/International Regulations: Hazard Symbol: T+, Xi, N: risk phrases: R24/25; R26; R36/37/38; R40; R50/53; safety phrases: S1/2; S22; S36/37; S45; S52; S60; S61 (see Appendix 1)

WGK (German Aquatic Hazard Class): 3-Severe hazard to waters

Description: Pentachlorophenol is a colorless to white crystalline solid. It has a phenolic or benzene-like odor; pungent when hot. Commercial products may be flammable. The Odor Threshold in water = 1600 μg/L and the taste threshold in water is 30 μg/L. Molecular weight = 266.33; Specific gravity (H_2O:1) = 1.978 @ 22 °C; Boiling point = (decomposes) 308.9 °C; Freezing/Melting point = 174 °C; 188 °C (anhydrous); Vapor pressure = 0.0003 mmHg @ 25 °C; Flash point = 134 °C. Hazard Identification (based on NFPA-704 M Rating System): Health 3, Flammability 0, Reactivity 0. Practically insoluble in water; solubility in water = 14 mg/L @ 20 °C. Physical and toxicological properties may be affected by carrier solvents in commercial formulations.

Incompatibilities: Reacts violently with strong oxidizers, acids, alkalies and water. Decomposes >300 °C. Flammable hydrogen gas may be generated, and the heat from reaction may ignite the gas. May generate heat on contact with bases. Heating may initiate dangerous polymerization. Corrosive in the presence of moisture; contact with metals may cause the release of flammable and explosive hydrogen gas.

Permissible Exposure Limits in Air: Odor thresholds[83] for PCP solution @ 30 °C = 857 μg/L & @ 60 °C = 12,000 μg/L.

NIOSH IDLH: 2.5 mg/m^3

OSHA PEL: 0.5 mg/m^3 TWA[skin]

NIOSH REL: 0.5 mg/m^3 TWA[skin]

ACGIH TLV®[1]: 0.5 mg/m^3 TWA[skin]; BEI: 2 mg[total *PCP*]/g creatinine in urine/prior to last shift of work-week; 5 mg [free PCP]/L in plasma/end of shift; confirmed animal carcinogen with unknown relevance to humans.

Protective Action Criteria (PAC) Ver. 27[89]

PAC-1: 1.4 mg/m^3

PAC-2: 15 mg/m^3

PAC-3: 150 mg/m^3

DFG MAK: [skin] Carcinogen Category 2

Determination in Air: Sample collection by mixed cellulose ester membrane filter in series with ethylene glycol bubbler, analysis by high-performance liquid chromatography with ultraviolet detection. NIOSH IV, Method #5512[18]

Permissible Concentration in Water: Federal Drinking Water Guidelines: 0.9 ppb[93]; State Drinking Water Guidelines: Arizona 220 μg/L; Maine 3 μg/L; Minnesota 1 μg/L.

Determination in Water: Methylene chloride extraction followed by gas chromatography with electron capture or halogen specific detection (EPA Method 608) or gas chromatography plus mass spectrometry (EPA Method 625). Log K_{ow} = >4.0. Values at or above 3.0 are likely to bioaccumulate in marine organisms.

Routes of Entry: Inhalation, ingestion, skin and/or eye contact. Easily absorbed through the unbroken skin.

Harmful Effects and Symptoms

Short Term Exposure: Irritates the eyes, skin and respiratory tract. May affect the cardiovascular system. *Inhalation:* Levels of 1 mg/m^3 can cause severe irritation of the nose, throat and lungs. Higher exposures can cause pulmonary edema, a medical emergency that can be delayed for several hours. This can cause death. Breathing dust or particulates tainted with pentachlorophenol can give rise to sneezing. *Skin:* A 0.04% solution can cause pain and inflammation at point of contact. Chloracne, a skin disorder, has been observed in workers in pentachlorophenol manufacturing plants and wood-preserving operations. Profuse sweating and elevated temperature are symptoms of poisoning due to prolonged contact. Excessive skin exposure has caused human death. *Eyes:* Levels of 1 mg/m^3 may be irritating and excessive contact can lead to loss of sight due to corneal damage. *Ingestion:* The lethal human dose is approximately equal to 1 teaspoon for a 150 lb person. Ingestion of 4 to 8 ounces followed by prompt emergency treatment still produced symptoms of poisoning which included rapid breathing followed by a decrease in breathing rate, abdominal pain, reduced blood pressure, excessive and slurred speech and weakness. Heart failure may result from acute inhalation. LD_{50} (oral, rat) = <30 mg/kg; LD_{50} (dermal, rat) = 100–300 mg/kg.

Long Term Exposure: Irritation of eyes, throat, nose and upper lungs has been reported by individuals using pentachlorophenol as an insecticide for periods of a few years. Chemical acne has been associated with prolonged exposure to this compound. A liver and thyroid toxin. May affect the central nervous system, kidneys, liver, lungs. May be a carcinogen in humans. May damage the developing fetus. There is limited evidence that pentachlorophenol is a teratogen in animals. Increases in liver, adrenal gland, and nasal tumors have been found in laboratory animals exposed to high doses of pentachlorophenol. Possible cancer hazard based on tests with laboratory animals. The U.S. EPA has determined that pentachlorophenol is a probable human carcinogen and the International Agency for Cancer Research (IARC) considers it possibly carcinogenic to humans. Some studies have found an increase in cancer risk in workers exposed to high levels of technical-grade pentachlorophenol for a long period of time, but other studies have not found this. We do not know if exposure to pentachlorophenol will result in birth defects or other developmental effects in people. Death, low body weights, decreased growth, and skeletal effects have been observed in laboratory animals exposed to high levels of pentachlorophenol during development. Bioaccumulates in the body. Animal studies have reported that fetal effects/abnormalities may occur when maternal toxicity is seen. Chronic exposure has resulted in an increase prevalence of conjunctivitis, sinusitis, bronchitis, polyneuritis, and dermatitis. Exposure may cause blood effects and bone marrow damage. Chronic exposure may cause lung damage. Laboratory experiments have resulted in mutagenic effects.

Points of Attack: Eyes, skin, respiratory system, cardiovascular system, heart, liver, kidneys and central nervous system. Cancer site in animals: liver.

Medical Surveillance: This chemical is a suspected or known human carcinogen. Exposed persons should contact a physician for advice regarding the possible long term health effects and advice for medical monitoring. If symptoms develop or overexposure is suspected, the following may be useful: Urine test for pentachlorophenol. Liver and kidney function tests. Refer to the NIOSH Criteria Documents #78-174 and #76-147 on Manufacturing, formulating, and working safely with pesticide.

First Aid: If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least 15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately. If this chemical contacts the skin, remove contaminated clothing and wash immediately with soap and water. Seek medical attention immediately. If this chemical has been inhaled, remove from exposure, begin rescue breathing (using universal precautions) if breathing has stopped, and CPR if heart action has stopped. Transfer promptly to a medical facility. When this chemical has been swallowed, get medical attention. Give large quantities of water and induce vomiting. Do not make an unconscious person vomit. Medical observation is recommended for 24 to 48 hours following breathing overexposure, as pulmonary edema may be delayed. As first aid for pulmonary edema, a doctor or authorized paramedic may consider administering a corticosteroid spray.

Personal Protective Methods: Wear protective gloves and clothing to prevent any reasonable probability of dermal and/or eye contact. Safety equipment suppliers/manufacturers can provide recommendations on the most protective glove/clothing material for your operation. Nitrile, polyvinyl chloride, and Tychem® (from E.I. du Pont de Nemours & Company) are among the recommended protective materials. All protective clothing (suits, gloves, footwear, headgear) should be clean, available each day, and put on before work. Contact lenses should not be worn when working with this chemical. Wear dust-proof chemical goggles and face shield unless full facepiece respiratory protection is worn. Employees should wash immediately with soap when skin is wet or contaminated. Provide emergency showers and eyewash.

Respirator Selection: SCBA >1.4 mg/m^3. NIOSH: *2.5 mg/m^3:* CcrOv95 (APF = 10) [any air-purifying half-mask respirator with organic vapor cartridge(s) in combination with an N95, R95, or P95 filter. The following filters may also be used: N99, R99, P99, N100, R100, P100]; or PaprOvHie (APF = 25) (any powered air-purifying respirator with an organic vapor cartridge in combination with a high-efficiency particulate filter); or Sa (APF = 10) (any supplied-air respirator); or SCBAF (APF = 50) (any self-contained breathing apparatus with a full facepiece). *Emergency or planned entry into unknown concentrations or IDLH conditions:* SCBAF: Pd,Pp (APF = 10,000) (any self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode); or SaF: Pd,Pp: ASCBA (APF = 10,000) (any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary self-contained breathing apparatus operated in a pressure-demand or other positive-pressure mode). *Escape:* GmFOv100 (APF = 50) (any air-purifying, full facepiece respirator (gas mask) with a chin-style, front- or back-mounted organic vapor canister having an N100, R100, or P100 filter); or SCBAE (any appropriate escape-type, self-contained breathing apparatus). *Note:* Substance reported to cause eye irritation or damage; may require eye protection.

Storage: Color Code-Blue: Health Hazard/Poison: Store in a secure poison location. Prior to working with this chemical you should be trained on its proper handling and storage. Pentachlorophenol must be stored to avoid contact with strong oxidizers (such as chlorine, bromine, and fluorine) because violent reactions occur. Where possible, automatically transfer material from drums or other storage containers to process containers. If this material contains a flammable carrier, sources of ignition, such as smoking and open flames, are prohibited where this chemical is handled, used, or stored. Metal containers involving the transfer of this chemical should be grounded and bonded. A regulated, marked area should be established where this chemical is handled, used, or stored in compliance with OSHA Standard 1910.1045. Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: Pentachlorophenol requires a shipping label of "poisonous materials." It usually falls in Hazard Class 6.1 and Packing Group II.

Spill Handling: First remove all sources of ignition. Evacuate persons not wearing protective equipment from area of spill or leak until clean up is complete. Collect powdered material in the most convenient and safe manner and deposit in sealed containers. Ventilate area after clean up is complete. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable.

Fire Extinguishing: Hazardous decomposition includes hydrogen chloride, oxides of carbon, and chlorinated phenols. *Fire involving storage or vehicular tanks:* isolate for 800 meters/0.5 mile in all directions; also, consider initial evacuation for 800 meters/0.5 mile in all directions. *Small fire:* dry chemical, carbon dioxide or water spray. *Large fire:* dry chemical, carbon dioxide, alcohol-resistant foam or water spray. Move containers from fire area if you can do it without risk. Dike fire-control water for later disposal; do not scatter the material. *Fire involving tanks or car/trailer loads:* fight fire from maximum distance or use unmanned hose holders or monitor nozzles. Do not get water inside containers. Cool containers with flooding quantities of water until well after fire is out. Withdraw immediately in the case of rising sound from venting safety devices or discoloration of tank. Always stay away from tanks engulfed in fire. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies.

Disposal Method Suggested: Consult with environmental regulatory agencies for guidance on acceptable disposal practices. Generators of waste containing this contaminant (≥100 kg/mo) must conform with EPA regulations governing storage, transportation, treatment, and waste disposal. In accordance with 40CFR165, follow recommendations for the disposal of pesticides and pesticide containers. Containers must be disposed of properly by following package label directions or by contacting your local or federal environmental control agency, or by contacting your regional EPA office. Incineration (600° to 900 °C) coupled with acequate scrubbing and ash disposal facilities. Alternatively pentachlorophenol in wastewaters, for example, may be recovered and recycled.

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- U.S. Public Health Service, "Toxicological Profile for Pentachlorophenol," Atlanta, Georgia, Agency for Toxic Substances and Disease Registry (December 1988)
- New York State Department of Health, "Chemical Fact Sheet: Pentachlorophenol," Albany, NY, Bureau of Toxic Substance Assessment (Version 2-March 1986 and Version 3)

Peracetic acid P:0290

Use Type: Fungicide, Herbicide, Nematicide, Rodenticide, Microbiocide
CAS Number: 79-21-0
Formula: $C_2H_4O_3$; CH_3COOOH
Synonyms: Acido peracetico (Spanish); Acetic peroxide; Acetyl hydroperoxide; Ethaneperoxoic acid; Hydrogen peroxide and peroxyacetic acid mixture; Hydroperoxide, acetyl; Monoperacetic acid; Peroxyacetic acid
Trade Names: DESOXON 1®; ESTOSTERIL®; OSBON AC®; OXYMASTER®; PROXITANE®
Chemical class: Inorganic compound
EPA/OPP PC Code: 063201
California DPR Chemical Code: 2291
HSDB Number: 1106
UN/NA & ERG Number: UN3107/145
RTECS® Number: SD8750000
EC Number: 201-186-8 [*Annex I Index No.:* 607-094-00-8]
Uses: This compound is used as bactericide and fungicide, especially in food processing, a reagent in making caprolactam and glycerol; an oxidant for preparing epoxy compounds; a bleaching agent; a sterilizing agent; and a polymerization catalyst for polyester resins. Not approved for use in EU countries[115]. Registered for use in the U.S. and Canada.
U.S. Maximum Allowable Residue Levels for Peracetic acid [40 CFR 180-940(a)]: Residues are exempted from the requirement of a tolerance when used in accordance with good manufacturing practice as ingredients in an antimicrobial pesticide formulation, provided that the substance is applied on a semi-permanent or permanent food-contact surface (other than being applied on food packaging) with adequate draining before contact with food. (a) When used as ingredients in an antimicrobial pesticide formulation may be applied to: Food-contact surfaces in public eating places, dairy-processing equipment, and food-processing equipment and utensils. Limit: When ready for use, the end-use concentration is not to exceed 58 ppm. ***[40 CFR 180-940(b)]***: (b) When used as ingredients in an antimicrobial pesticide formulation may be applied to: Dairy processing equipment, and food-processing equipment and utensils. Limit: When ready for use, the end-use concentration is not to exceed 315 ppm. ***[40 CFR 180-940 (c)]:*** (c) When used as ingredients in an antimicrobial pesticide formulation may be applied to: Food-processing equipment and utensils. Limit: When ready for use, the end-use concentration is not to exceed 315 ppm.
Regulatory Authority and Advisory Information:
Health Advisory: Skin irritant/sensitizer; Highly Reactive Substance and Explosive[15].
Acute Oral Category: 3, CAUTION
Clean Air Act: Accidental Release Prevention/Flammable substances (Section 112[r], Table 3), TQ = 10,000 lb (4540 kg)
Superfund/EPCRA 302 Extremely Hazardous Substances: TPQ = 500 lb (227 kg)
Superfund/EPCRA 40CFR302.4 RQ: EHS, 1 lb (0.454 kg)
EPCRA Section 313 Form R *de minimis* concentration reporting level: 1.0%
European/International Regulations: Hazard Symbol: T, H; risk phrases: R5; R23/24/25; R34; safety phrases: S1/2; S3; S27; S36 (see Appendix 1)
WGK (German Aquatic Hazard Class): 2-Hazard to waters
Description: Peracetic acid is a flammable colorless liquid. Transported and stored in diluted solution with acetic acid (often 40%) and hydrogen peroxide (usually 5%) to prevent explosion. Molecular weight = 76.06; Specific gravity (H_2O:1) = 1.15 @ 20 °C; Boiling point = 105 °C (violent decomposition @ 110 °C); Freezing/Melting point = 0.1 °C; Flash point = 41.3 °C (oc); 56 °C (32% in dilute acetic acid and <6% hydrogen peroxide); LEL (Lower Explosive Limit) = 16,000 ppm; Autoignition temperature = 198 °C. Hazard Identification (based on NFPA-704 M Rating System): Health 3, Flammability 2, Reactivity 4 (Oxidizer). Highly soluble in water.
Incompatibilities: Peracetic acid is a powerful oxidizer. Keep away from combustible materials. Thermally unstable, it decomposes violently @ 110 °C. Concentrated material is shock- and friction-sensitive. May explode if concentration exceeds 56% of carrier, due to evaporation. Isolate from other stored material, particularly accelerators, oxidizers, organic or combustible materials, olefins, hydrogen peroxide, acetic anhydride, reducing substances. Keep away from acids, alkalies, heavy metals, organic material.
Permissible Exposure Limits in Air: Protective Action Criteria (PAC) Ver. 27[89]
PAC-1: $\mathbf{0.52}_{\mathbf{A}}$ mg/m^3
PAC-2: $\mathbf{1.6}_{\mathbf{A}}$ mg/m^3
PAC-3: $\mathbf{15}_{\mathbf{A}}$ mg/m^3
Subscript "**A**" signifies 60-minute AEGL (Acute Emergency Guideline Level) values.
DFG MAK: Carcinogen Category 3B; See section X(a)
Permissible Concentration in Water: Runoff from spills or fire control may cause water pollution.
Determination in Water: Log K_{ow} = –1.07 (est.)[83]. Unlikely to bioaccumulate in marine organisms.
Routes of Entry: Inhalation, ingestion, skin and/or eye contact.
Harmful Effects and Symptoms
Short Term Exposure: Eye contact can cause severe irritation and burns; may cause permanent damage. Irritates the

respiratory tract. Contact may burn the skin. Higher exposures can cause pulmonary edema, a medical emergency that can be delayed for several hours. This can cause death. Signs and symptoms of acute ingestion of peracetic acid may include corrosion of mucous membranes of mouth, throat, and esophagus with immediate pain and dysphagia (difficulty swallowing), ingestion may cause gastrointestinal tract irritation. This is a very toxic compound. The probable human oral lethal dose is 50–500 mg/kg, or between 1 teaspoon and 1 ounce for a 150 lb persons. LD_{50} (oral, rat) = <2000 mg/kg; LD_{50} (dermal, rabbit) = 500 mg/kg. May cause severe gastrointestinal tract irritation and renal failure, Vapours may cause dizzines.

Long Term Exposure: There is limited evidence that PAA causes cancer of the lungs. High or repeated exposure may affect the liver and kidney. May cause tumors.

Points of Attack: Liver, kidneys and lungs.

Medical Surveillance: Liver and kidney function tests. Consider chest x-ray following acute overexposure.

First Aid: If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least 15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately. If this chemical contacts the skin, remove contaminated clothing and wash immediately with soap and water. Seek medical attention immediately. If this chemical has been inhaled, remove from exposure, begin rescue breathing (using universal precautions) if breathing has stopped, and CPR if heart action has stopped. Transfer promptly to a medical facility. When this chemical has been swallowed, get medical attention. If victim is *conscious*, administer water, or milk. Do not induce vomiting. Medical observation is recommended for 24 to 48 hours following breathing overexposure, as pulmonary edema may be delayed. As first aid for pulmonary edema, a doctor or authorized paramedic may consider administering a corticosteroid spray.

Personal Protective Methods: Wear protective gloves and clothing to prevent any reasonable probability of dermal and/or eye contact. Safety equipment suppliers/manufacturers can provide recommendations on the most protective glove/clothing material for your operation. Butyl rubber and Viton are recommended. All protective clothing (suits, gloves, footwear, headgear) should be clean, available each day, and put on before work. Contact lenses should not be worn when working with this chemical. Wear splash-proof chemical goggles and face shield unless full facepiece respiratory protection is worn. Employees should wash immediately with soap when skin is wet or contaminated. Provide emergency showers and eyewash.

Respirator Selection: SCBA $> 0.52_A$ mg/m^3 Subscript "**A**" signifies 60-minute AEGL (Acute Emergency Guideline Level) values. *Where there is no REL, at any detectable concentration:* Sa:Cf (APF = 25) (any supplied-air respirator operated in a continuous-flow mode); or PaprOv (APF = 25) [any powered, air-purifying respirator with organic vapor cartridge(s)]; CcrFOv (APF = 50) [any air-purifying, full facepiece respirator (gas mask) with a chin-style, front- or back-mounted acid gas canister]; or GmFOv (APF = 50) [any air-purifying, full facepiece respirator (gas mask) with a chin-style, front- or back-mounted organic vapor canister]; or SCBAF (APF = 50) (any self-contained breathing apparatus with a full facepiece); or SaF (APF = 50) (any supplied-air respirator with a full facepiece). *Emergency or planned entry into unknown concentrations or IDLH conditions:* SCBAF: Pd,Pp (APF = 10,000) (any self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode); or SaF: Pd,Pp: ASCBA (APF = 10,000) (any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary self-contained breathing apparatus operated in a pressure-demand or other positive-pressure mode). *Escape:* GmFOv (APF = 50) [any air-purifying, full facepiece respirator (gas mask) with a chin-style, front- or back-mounted organic vapor canister]; or SCBAE (any appropriate escape-type, self-contained breathing apparatus).

Storage: Color Code-Red Stripe: Flammability Hazard: Do not store in the same area as other flammable materials. This chemical is also corrosive and caustic. Prior to working with this chemical you should be trained on its proper handling and storage. Keep in a cool, well-ventilated area, separated from organic and combustible materials. If this material contains a flammable carrier, sources of ignition, such as smoking and open flames, are prohibited where this chemical is handled, used, or stored. Metal containers involving the transfer of 5 gallons or more of this chemical should be grounded and bonded. Drums must be equipped with self-closing valves, pressure vacuum bungs, and flame arresters. Use only non-sparking tools and equipment, especially when opening and closing containers of this chemical. Wherever this chemical is used, handled, manufactured, or stored, use explosion-proof electrical equipment and fittings. See OSHA Standard 1910.104 and NFPA 43A *Code for the Storage of Liquid and Solid Oxidizers* for detailed handling and storage regulations. Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: Organic peroxides type E, liquid, require a shipping label of "ORGANIC PEROXIDE." They fall in DOT Hazard Class 5.2.

Spill Handling: Evacuate and restrict persons not wearing protective equipment from area of spill or leak until clean up is complete. Ventilate area of spill or leak. Avoid breathing vapors. Do not touch the spilled material; shut off all ignition sources and stop the leak if this can be done without risk. Absorb liquids in vermiculite, dry sand, earth, peat, carbon, or a similar material and deposit in sealed containers. Do not use spark-generating metals or organic materials for sweeping up or handling spilled material. Dispose of the absorbed peroxyacetic acid solution, in small quantities at a time, by placing it on the ground in a remote outdoor area and igniting with a long torch. Empty containers should be washed with a 10% sodium hydroxide solution. Keep this chemical out of a confined space, such as a sewer, because of the possibility of an explosion, unless the sewer is designed to prevent the build-up of explosive concentrations. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable.

Fire Extinguishing: This chemical is a combustible liquid and a powerful oxidizer that can increase the activity of an existing fire. Containers may explode in fire. It explodes @ 110 °C and is shock-sensitive, particularly if organic solvents are used in place of acetic acid as a carrier. Hazardous decomposition includes oxides of carbon. Fight fires from an explosion-resistant location. In advanced or massive fires, area should be evacuated. *For small fires:* use dry chemical, carbon dioxide; water spray; or foam. *For large fires:* flood area with water. If fire occurs in the vicinity of this compound, water should be used to keep containers cool. Clean up and salvage operations should not be attempted until all of the peroxyacetic acid solution has cooled completely. Keep unnecessary people away; wear self-contained breathing apparatus and full protective clothing. Vapors are heavier than air and will collect in low areas. Vapors may travel long distances to ignition sources and flashback. Vapors in confined areas may explode when exposed to fire. Storage containers and parts of containers may rocket great distances, in many directions. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies. From a secure, explosion-proof location, use water spray to cool exposed containers. If cooling streams are ineffective (venting sound increases in volume and pitch, tank discolors, or shows any signs of deforming), withdraw immediately to a secure position. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- USEPA, "Chemical Profile: Peracetic Acid," Washington DC, Chemical Emergency Preparedness Program (Nov.30, 1987)
- New Jersey Department of Health and Senior Services, "Hazardous Substance Fact Sheet, Peroxyacetic acid," Trenton, NJ (March 1998, revised March 1998). http://www.state.nj.us/health/eoh/rtkweb/1482.pdf
- New York State Department of Health, "Chemical Fact Sheet: Peracetic Acid," Albany, NY, Bureau of Toxic Substance Assessment (April 1986)

Phenmedipham P:0335

Use Type: Herbicide

CAS Number: 13684-63-4

Formula: $C_{16}H_{16}N_2O_4$

Synonyms: Carbamic acid, (3-methylphenyl)-, 3-[(methoxycarbonyl)amino]phenyl ester; 3-[(Methoxycarbonyl)amino]phenyl *N*-(3-methylphenyl)carbamate; Carbanilic acid, *m*-methyl-, ester with methyl-*m*-hydroxycarbanilate (8CI); Fenmedifam; Carbanilic acid, *m*-hydroxy-, metnyl ester, *m*-methylcarbanilate (ester) (8CI); *m*-Hydroxycarbanilic acid methyl ester *m*-methylcarbanilate; Methyl *m*-hydroxycarbanilate m-methylcarbanilate; 3-(Methylphenyl)carbamic acid 3-[(methoxycarbonyl)amino]phenyl ester; Methyl 3-(*m*-tolylcarbamoyloxy)phenylcarbamate; 3-Methoxycarbonylaminophenyl *N*-3'-methylphenylcarbamate; Phenmediphame

Trade Names: AIMSAN®; BETAMIX® (phenmedipham+desmedipham); BETANAL®; CQ 1451® (phenmedipham+desmedipham+ethofumesate); EC herbicide (phenmedipham+desmedipham+ethofumesate); EP 452®; KEEPER®; KEMIFAM®; MSS HERBASAN®; NA 305® (phenmedipham+desmedipham+ethofumesate); NA 308® (phenmedipham+desmedipham+ethofumesate); POWERTWIN® (phenmedipham+ethofumesate); PROGRESS® (phenmedipham+desmedipham+ethofumesate); S-4075®; SCHERING 4072®; SN 38584®; SPIN-AID®; SYNBETAN-P®; TWIN®; VANGARD®

Chemical class: Bis-Carbamate; Carbamate

EPA/OPP PC Code: 098701

California DPR Chemical Code: 675

HSDB Number: 1402 as Betanal

UN/NA&ERG Number: UN2757 (solid)/151; UN3077(solid)/171; UN3082 (liquid)/171

RTECS® Number: FD9050000

EC Number: 237-199-0 [*Annex I Index No.:* 616-106-00-0]

Uses: A post-emergence herbicide for control of annual broadleaf weeds and grasses in sugar beets, spinach, strawberries, and sunflowers.

U.S. Maximum Allowable Residue Levels for Phenmedipham (40 CFR 180.278): beet, garden, roots (N) negligible residue 0.2 ppm; beet, sugar, rootd, and tops 0.1 ppm; spinach 0.5 ppm. (N) = negligible amount of residue.

Regulatory Authority and Advisory Information:

Carcinogenicity[83]: EPA Group D, Not classifiable as a human carcinogen

Health Advisory: Mutagen, Developmental/Reproductive Toxin

Acute Oral Category: 4, Caution, Not acutely toxic

European/International Regulations: Hazard Symbol: N; risk phrases: R50/53; safety phrases: S2; S60; S61 (see Appendix 1)

Description: Colorless crystalline solid, or needles; white powder. Odorless. Commercial product is available as an emulsifiable concentrate. Molecular weight = 300.31; Specific gravity (H_2O:1) = 0.28 g/cm^3 @ 20 °C; Boiling point = (decomposes) 145 °C; Freezing/Melting point = 139–144 °C; Vapor pressure = 1×10^{-11} mmHg @ 25 °C; Flash point = 73 °C. Very slightly soluble in water; solubility = 1 to 5 mg/mL @ 21 °C; 4.7 mg/L @ 25 °C. Physical and toxicological properties may be affected by carrier solvents in commercial formulations.

Incompatibilities: Decomposes >145 °C. Esters react with acids to liberate heat along with alcohols and acids. Strong oxidizing acids may cause a vigorous reaction that is sufficiently exothermic to ignite the reaction products. Heat is also generated by the interaction of esters with caustic solutions. Flammable hydrogen is generated by mixing esters with alkali metals and hydrides. Carbamates are incompatible with reducing agents, strong acids, oxidizing acids, peroxides, and bases. Contact with active metals or nitrides causes the release of flammable, and potentially explosive, hydrogen gas. Forms carbon monoxide and toxic nitrogen oxides when heated to decomposition.

Determination in Water: Log K_{ow} = >3.5. Values above 3.0 are likely to bioaccumulate in aquatic organisms.

Routes of Entry: Skin absorption, ingestion, inhalation.

Harmful Effects and Symptoms

Short Term Exposure: Eye pupils are small, blurred vision, eye watering, runny nose, cough, shortness of breath, salivation, nausea, stomach cramps, diarrhea, and vomiting, increased blood pressure, profuse sweating, hypermotility, hallucinations, agitation, tingling of the skin, slow heartbeat, convulsions, fluid in lungs, loss of consciousness, incontinence, breathing stops, death. Carbamates inhibit the acetylcholinesterase enzymes and alter the way in which nervous impulses are transmitted. However, within several hours carbamates spontaneously detach from the enzymes. LD_{50} (oral, rat) = >7 g/kg; LD_{50} (dermal, rat) = >2 g/kg.

Long Term Exposure: A potent acetylcholinesterase (AChE) inhibitor; cumulative effect is possible. This chemical may damage the nervous system with repeated exposure, resulting in convulsions, respiratory failure. Frequent expsure may cause liver damage. May cause skin dermatitis or allergy.

Points of Attack: Respiratory system, lungs, central nervous system, cardiovascular system, skin, eyes, plasma and red blood cell cholinesterase. Evaluation by a qualified allergist, including exposure history and testing, may help diagnose allergy.

Medical Surveillance: Preliminary medical exam to detect chronic diseases of central nervous system, liver, heart, kidneys, lung and skin, as well as endocrinological or immunological disturbances, should protect susceptible individuals. Periodical medical exams of internal organs, skin and eyes are important to avoid chronic occupational intoxications. They should include lab and patch tests when necessary[83]. Medical observation is recommended for 24 to 48 hours following breathing overexposure, as pulmonary edema may be delayed. Cigarette smoking may exacerbate pulmonary injury and should be discouraged for at least 72 hours following exposure. Before employment and at regular times after that, the following are recommended: Plasma and red blood cell cholinesterase levels (tests for the enzyme poisoned by this chemical). If exposure stops, plasma levels return to normal in 1–2 weeks while red blood cell levels may be reduced for 1–3 months. When acetylcholinesterase enzyme levels are reduced by 25% or more below preemployment levels, risk of poisoning is increased, even if results are in lower ranges of "normal." Reassignment to work not involving carbamate pesticides is recommended until enzyme levels recover. If symptoms develop or overexposure occurs, repeat the above tests as soon as possible and get an exam of the nervous system. Also consider complete blood count and chest x-ray following acute overexposure

First Aid: Speed in removing material from eyes and skin is of extreme importance. *Eyes:* Eye contact can cause dangerous amounts of these chemicals to be quickly absorbed through the mucous membrane into the bloodstream. Immediately and gently flush eyes with plenty of warm or cold water (NO hot water) for at least 15 minutes, occasionally lifting the upper and lower eyelids. Get medical aid immediately. *Skin:* Get medical aid. Dermal contact can cause dangerous amounts of these chemicals to be absorbed into the bloodstream. Wearing the appropriate PPE equipment and respirator for carbamate pesticides, immediately flush skin with plenty of soap and water for at least 15 minutes while removing contaminated clothing and shoes. Shampoo hair promptly if contaminated; protect eyes. *Ingestion:* Call poison control. Loosen all clothing. Never give anything by mouth to an unconscious person. Get medical aid. Do NOT induce vomiting. * If conscious, alert, and able to swallow, rinse mouth and have victim drink 4 to 8 ounces of water. Check to see if poison control instructs you to use ipecac syrup, otherwise administer slurry of activated charcoal (2 oz in 8 oz of water). If victim is *UNCONSCIOUS OR HAVING CONVULSIONS,* do nothing except keep victim warm. **In some cases you may be specifically instructed by poison control to induce vomiting by way of 2 tablespoons of syrup of ipecac (adult) washed down with a cup of water*. Do NOT give activated charcoal before or with ipecac syrup. *Inhalation:* Get medical aid. Do not contaminate yourself. Wearing the appropriate PPE equipment and respirator for carbamate pesticides, immediately remove the victim from the contaminated area to fresh air. If the victim is not breathing, administer artificial respiration. Do not use mouth-to-mouth method if victim ingested or inhaled the substance; give artificial respiration with the aid of a pocket mask equipped with a one-way valve or other proper respiratory medical device. If breathing is difficult, administer oxygen through bag/mask apparatus until medical help arrives. Do not leave victim unattended. *Note to physician or authorized medical personnel.* Administer atropine, 2 mg (1/30 gr) intramuscularly or intravenously as soon as any local or systemic signs or symptoms of an intoxication are noted; repeat the administration of atropine every 3 to 8 minutes until signs of atropinization (mydriasis, dry mouth, rapid pulse, hot and dry skin) occur; initiate treatment in children with 0.05 mg/kg of atropine; repeat at 5 to 10 minute intervals. Watch respiration, and remove bronchial secretions if they appear to be obstructing the airway; intubate if necessary. *Medical note:* 2-PAMCI may be contraindicated in the case of some carbamate poisonings. As first aid for pulmonary edema, a doctor or authorized paramedic might consider administering a corticosteroid spray.

Storage: Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: This is a solid toxic carbamate and should be labeled "poisonous materials." It falls into Hazard Class 6.1. This material may also be classified as environmentally hazardous substances, solid or liquid, n. o. s. It usually falls in Hazard Class 9.

Spill Handling: First remove all sources of ignition. in all directions for at least 25 meters/75 feet. Increase, in the downwind direction, as necessary. Do not touch damaged containers or spilled material unless wearing appropriate protective clothing. Stop leak if you can do it without risk. Prevent entry into waterways, sewers, basements or confined areas. Cover with plastic sheet to prevent spreading. Absorb or cover with dry earth, sand or other non-combustible material and transfer to containers. Do not allow water to get inside containers.

Fire Extinguishing: Hazardous decomposition includes oxides of nitrogen and carbon. *On small fire:* use dry chemical powder, carbon dioxide, water spray, or foam. *On large fire:* use water spray, fog or alcohol-resistant foam. Do not scatter material using straight water jet streams. Dike fire control water for later disposal; do not scatter the material. Move containers from fire area if you can do it without risk. *Fire involving storage or vehicular tanks:* isolate for 800 meters/0.5 mile in all directions; also, consider initial evacuation for 800 meters/0.5 mile in all directions. Fight fire from maximum distance or use unmanned hose holders or monitor nozzles. Do not allow water to get inside containers. Cool containers with flooding quantities of water until well after fire is out. Withdraw immediately in the case of rising sound from venting safety devices or discoloration of tank. *Always* stay away from tanks engulfed in fire. For massive fire, use unmanned hose holders or monitor nozzles; if this is impossible, withdraw from area and let fire burn.

Disposal Method Suggested: Do not discharge into drains or sewers. Dispose of waste material as hazardous waste using a licensed disposal contractor to an approved landfill. Consult with environmental regulatory agencies for guidance on acceptable disposal practices. Incineration with effluent gas scrubbing is recommended. Containers must be disposed of properly by following package label directions or by contacting your local or federal environmental control agency, or by contacting your regional EPA office.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- USEPA, Office of Pesticide Programs, Pesticide Residue Limits, "Phenmedipham," 40 CFR 180.278 http://www.epa.gov/pesticides/food/viewtols.htm
- Pesticide Management Education Program, "Phenmedipham (Betanal, Spin-Aid) herbicide Profile 2/85," Cornell University, Ithaca, NY (February 1985). http://pmep.cce.cornell.edu/profiles/herb-growthreg/naa-rimsulfuron/phenmedipham/herb-prof-phenmedipham.html

d-Phenothrin P:0364

Use Type: Insecticide

CAS Number: 26002-80-2

Formula: $C_{23}H_{26}O_3$

Synonyms: AI3-29062; Caswell No. 652B; Cyclopropanecarboxylic acid, 2,2-dimethyl-3-(2-methyl-1-propenyl)-,(3-phenoxyphenyl) methyl ester; Cyclopropanecarboxylic acid, 2,2-dimethyl-3-(2-methylpropenyl)-, *m*-phenoxybenzyl ester; Cyclopropanecarboxylic acid, 2,2-dimethyl-3-(2-methyl-1-propenyl)-, (3-phenoxyphenyl)methyl ester; 2,2-Dimethyl-3-(2-methyl-1-propenyl) cyclopropanecarboxylic acid (3-phenoxyphenyl)methyl ester; ENT 27972; EPA Fenotrina (Spanish); Fenothrin, (±)-; (+)-*cis-,trans*-Fenothrin; Fenothrin, (+)-*cis,trans*-; Fenothrin, Forte; (+)-*cis,trans*-phenothrin; Phenothrin; 3-Phenoxybenzyld-*Z/E* chrysanthemate; 3-Phenoxybenzyl *d-Z/E* chrysanthemate; 3-Phenoxybenzyl *D-cis,trans*-chrysanthemate; 3-Phenoxybenzyl *cis,trans*-chrysanthemate; 3-Phenoxybenzyl (1RS)-*cis,trans*-chrysanthemate; 3-Phenoxybenzyl (±)-*cis,trans*-chrysanthemate; *m*-Phenoxybenzyl 2,2-dimethyl-3-(2-methylpropenyl)cyclopropanecarboxylate; 3-Phenoxybenzyl 2-dimethyl-3-(methylpropenyl) cyclopropanecarboxylate; 3-Phenoxybenzyl (1RS,3RS; 1RS,3SR)-2,2-dimethyl-3-(2-methylprop-1-enyl)cyclopropanecarboxylate; 3-Phenoxybenzyl(1RS)-*cis,trans*-2,2-dimethyl-3-(2-methylprop-1-enyl)cyclopropanecarboxylate; 3-Phenoxybenzyl(1RS)-*(Z),(E)*-2,2-dimethyl-3-(2-methylprop-1-enyl)cyclopropanecarboxylate

Trade Names: FORTE®; MULTICIDE-2154®; OMS 1809®; OMS 1810®; PHENOXYTHRIN®; PT-515; S-2539®; SUMETHRIN®; SUMITHRIN®; WELLCIDE®

Note: The U.S. EPA currently lists 724 active or canceled products, 242 of which are active. Most products are for residential flying insect control, e.g., fleas, wasps, flies, mosquitoes. Not approved for use in EU countries[115]. Registered for use in the U.S. and Canada.

Chemical class: Pyrethroid

EPA/OPP PC Code: 069005

California DPR Chemical Code: 2093

HSDB Number: 3922

UN/NA & ERG Number: UN3352 (liquid)/151; UN3349 (solid)/151

RTECS® Number: GZ1975000

EC Number: 207-404-5

Uses: Used world-wide to control household insects and to protect stored grain. It is frequently formulated with other insecticides and is formulated in a number of carriers (aerosols, oil, dust, emulsifiable concentrates), and in powders, shampoos and lotion.

Regulatory Authority and Advisory Information: Health Advisory: Mutagen, Endocrine disruptor (S!)
Acute Oral Category: 4, Caution
EPCRA Section 313 Form R *de minimis* concentration reporting level: 1.0%
European/International Regulations: Hazard Symbol: Xi; risk phrases: R36; R38; safety phrases: S2 (see Appendix 1)

Description: Pale yellow to yellow-brown liquid. Molecular weight = 350.44; Specific gravity (H_2O:1) = 1.06 @ 20 °C; Boiling point = 293 °C; Vapor pressure = 1×10^{-7} mmHg @ 25 °C; Flash point =105. Henry's Law constant = 6.8×10^{-6} atm-m^3/mol @ 25 °C (est)[83]. Practically insoluble in water.

Incompatibilities: Keep away from alkaline materials. May react violently with strong oxidizers, bromine, 90% hydrogen peroxide, phosphorus trichloride, silver powders or dust. Incompatible with silver compounds. Mixture with some silver compounds forms explosive salts of silver oxalate.

Permissible Exposure Limits in Air: NIOSH[2]
IDLH = 5,000 ppm
OSHA PEL: 5 mg/m^3 TWA
NIOSH REL: 5 mg/m^3 TWA
ACGIH TLV®[1]: 5 mg/m^3 TWA
STEL set by HSE[33] = 10 mg/m^3.

Determination in Air: Collection by impinger or fritted bubbler, analysis by gas-liquid chromatography/ultraviolet. See NIOSH IV, Method #5008[18], as pyrethroid.

Permissible Concentration in Water: Acceptable Daily Intake (ADI) =0.02 mg/kg as pyrethroid

Determination in Water: Log K_{ow} = >6.0. Values above 3.0 are likely to bioaccumulate in aquatic organisms.

Harmful Effects and Symptoms

Short Term Exposure: Pyrethroids can affect you when breathed in and by passing through your skin. Irritates the eyes and respiratory tract. High exposure can affect the nervous system, causing headache, nausea, vomiting, fatigue, and restlessness, rhinorrhea (discharge of thin nasal mucous). Skin irritant/sensitizer. LD_{50} (oral, rat) = >5 g/kg[83]; LD_{50} (dermal, rat) = >2 g/kg[83].

Long Term Exposure: High or repeated exposure can cause lung allergy (with cough, wheezing and/or shortness of breath) or hay fever symptoms (sneezing, runny or stuffy nose). Allergic "pneumonia" can also occur with cough, chest pain, breathing difficulty and abnormal chest x-ray. Repeated attacks may lead to permanent scarring. Skin allergy may also develop with rash and itching, even with lower exposures. Dermal contact can cause rash with redness, blisters and intense itching. A severe generalized allergy can occur with weakness and collapse

Points of Attack: Respiratory system, skin, central nervous system, liver and kidneys.

Medical Surveillance: Before beginning employment and at regular times after that, the following are recommended: Employees should be screened for history of certain medical conditions which might place the employee at increased risk from pyrethroid exposure. Chronic respiratory disease: In persons with chronic respiratory disease, especially asthma, the inhalation of pyrethroids might cause exacerbation of symptoms due to their sensitizing properties. Lung function tests. These may be normal if the person is not having an attack at the time of the test. Consider chest x-ray if lung symptoms are present. Skin disease: Pyrethroids can cause dermatitis which may be allergic in nature. Persons with pre-existing skin disorders may be more susceptible to the effects of this agent. Evaluation by a qualified allergist, including exposure history and testing, may help diagnose allergy. Any employee developing the above-listed conditions should be referred for further medical examination[9].

First Aid: If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least 15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately. If this chemical contacts the skin, remove contaminated clothing and wash immediately with soap and water. Seek medical attention immediately. If this chemical has been inhaled, remove from exposure, begin rescue breathing (using universal precautions) if breathing has stopped, and CPR if heart action has stopped. Transfer promptly to a medical facility. When this chemical has been swallowed, get medical attention. Give large quantities of water and induce vomiting. Do not make an unconscious person vomit.

Personal Protective Methods: Applicators and other handlers must wear: Coveralls worn over long-sleeved shirt and long pants; Chemical-resistant gloves such as DuPont™ Tychem® suit fabrics, barrier laminate, or Viton®; Chemical-resistant footwear plus socks; Protective eye wear; Chemical-resistant headgear for overhead exposure; Chemical-resistant apron when cleaning equipment, mixing, or loading[83]. Agricultural Use/Engineering Controls: When handlers use closed systems, enclosed cabs, or aircraft in a manner that meets the requirements listed in the Worker Protection Standard (WPS) for agricultural pesticides, ***40 CFR 170.240(d)(4-6)***, the handler PPE requirements may be reduced or modified as specified in the Worker Protection Standard. Firefighters should wear NIOSH-approved self-contained breathing apparatus and full protective clothing.

Respirator Selection: NIOSH/OSHA *for pyrethrum*: *50 mg/m^3:* CcrOv95 (APF = 10) [any air-purifying half-mask respirator equipped with an organic vapor cartridge(s) in combination with an N95, R95, or P95 filter. The following filters may also be used: N99, R99, P99, N100, R100, P100]; or Sa (APF = 10) (any supplied-air respirator). *125 mg/m^3:* Sa:Cf (APF = 25) (any supplied-air respirator operated in a continuous-flow mode); or PaprOvHie (APF = 25) (any air-purifying full facepiece respirator equipped with an organic vapor cartridge in combination with a high-efficiency particulate filter). *250 mg/m^3:* CcrFOv100 (APF = 50) [any air-purifying full facepiece respirator equipped with organic vapor cartridge(s) in combination with an N100, R100, or P100 filter]; or PaprTOvHie (APF = 50) [any powered, air-purifying respirator with a tight-fitting face-piece and organic vapor cartridge(s) in combination with a high-efficiency particulate filter]; or SCBAF (APF = 50) (any self-contained breathing apparatus with full facepiece); or SaF (APF = 50) (any supplied-air respirator with a full facepiece). *5000 mg/m³:* SaF:Pd,Pp (APF = 2000) (any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode). *Emergency or planned entry into unknown concentrations or IDLH conditions:* SCBAF:Pd,Pp (APF = 10,000) (any self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode); or SaF:Pd,Pp:ASCBA (APF = 10,000) (any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary self-contained breathing apparatus operated in a pressure-demand or other positive-pressure mode). *Escape:* GmFOv100 (APF = 50) [any air-purifying, full facepiece respirator (gas mask) with a chin-style, front- or back-mounted organic vapor canister having an N100, R100, or P100 filter]; or SCBAE (any appropriate escape-type, self-contained breathing apparatus). *Note:* Substance reported to cause eye irritation or damage; may require eye protection.

Storage: Color Code-Blue: Health Hazard/Poison. Store in a secure poison location at temperature <35 °C and away from alkaline materials. Prior to working with this chemical you should be trained on its proper handling and storage. Store in tightly closed containers in a cool, well-ventilated area. Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: Should be labeled "poisonous materials." It falls into Hazard Class 6.1.

Spill Handling: First remove all sources of ignition. Evacuate persons not wearing protective equipment from area of spill or leak until clean up is complete. Ventilate area of spill or leak. Use water spray to reduce vapor. Absorb liquids in vermiculite, dry sand, earth, or a similar material and deposit in sealed containers. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable.

Fire Extinguishing: Hazardous decomposition includes oxides of carbon. *On a small fire:* use dry chemical, CO_2 or water spray. *On a large fire:* use water spray, fog or regular foam. Move containers from fire area if you can do it without risk. Dike fire-control water for later disposal; do not scatter the material. Use water spray or fog; do not use straight streams. *Fire involving storage or vehicular tanks:* isolate for 800 meters/0.5 mile in all directions; also, consider initial evacuation for 800 meters/0.5 mile in all directions. Fight fire from maximum distance or use unmanned hose holders or monitor nozzles. Do not get water inside containers. Cool containers with flooding quantities of water until well after fire is out. Withdraw immediately in the case of rising sound from venting safety devices or discoloration of tank. ALWAYS stay away from tanks engulfed in fire. For massive fire, use unmanned hose holders or monitor nozzles; if this is impossible, withdraw from area and let fire burn. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies.

Disposal Method Suggested: Incineration would be an effective disposal procedure where permitted. If an efficient incinerator is not available, the product should be mixed with large amounts of combustible material and contact with the smoke should be avoided. In accordance with 40CFR165, follow recommendations for the disposal of pesticides and pesticide containers.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- International Programme on Chemical Safety (IPCS), "Environmental Health Criteria, d-Phenothrin," Geneva, Switzerland. (1990). http://www.inchem.org/documents/ehc/ehc/ehc96.htm
- *Journal of Pesticide Reform*, "Insecticide Factsheet, Sumithrin (d-Phenothrin)," Northwest Coalition for Alternatives to Pesticides, Eugene, OR, Summer 2003, Vol 23, No. 2. http://www.pesticide.org/sumithrin.pdf
- Jackson, D.; Luukinen, B.; Gervais, J.; Buhl, K.; Stone, D., *d-Phenothrin Technical Fact Sheet*; National Pesticide Information Center, Oregon State University Extension Services, Corvallis, OR (2011)

o-Phenylphenol P:0470

Use Type: Fungicide, Disinfectant, Microbiocide

CAS Number: 90-43-7

Formula: $C_{12}H_{10}O$

Synonyms: (1,1'-Biphenyl)-2-ol; 2-Biphenylol; *o*-Biphenylol; (1,1'-biphenyl)-2-ol; *o*-Diphenylol; *o*-Hydroxybiphenyl; 2-Hydroxybiphenyl; *o*-Hydroxydiphenyl; 2-Hydroxydiphenyl; 2-Hydroxy-1,1'-biphenyl; NCI-C50351; OPP; Orthohydroxydiphenyl; Orthophenylphenol; Orthoxenol; 2-Phenylphenol; *o*-Xenol

Trade Names: ANTHRAPOLE 73®; DOWCIDE-1®; Invalon OP®; KIWI LUSTR-277®; NECTRYL®; PREVENTOL-O Extra®; REMOL TRF®; TETROSIN OE®; TETROSIN OE-N®; TORSITE®; TUMESCAL OPE®

Chemical class: Phenol; Alkylphenol

EPA/OPP PC Code: 064103

California DPR Chemical Code: 448

HSDB Number: 1753
UN/NA & ERG Number: UN2430/153
RTECS® Number: DV5775000
EC Number: 201-993-5 [*Annex I Index No.:* 604-020-00-6]
Uses: Used to make fungicides. Also used to make dye stuffs and rubber chemicals, but used primarily as a disinfectant cleaner. Registered for use in the U.S. and U.K.
U.S. Maximum Allowable Residue Level o-Phenylphenol [40 CFR 180.129(a)]: Tolerances are established for combined residues of the fungicide *o*-phenylphenol and sodium *o*-phenylphenate, each expressed as *o*-phenylphenol, from post-harvest application in or on the following crops: Apple 25 ppm; cantaloupe (NMT 10 ppm in edible portion) 125 ppm; cantaloupe, pulp 10 ppm; carrot, roots 20 ppm; cherry 5 ppm; citus fruits 10 ppm; cucumber 10 ppm; lemon 10 ppm; nectarine 5 ppm; orange 10 ppm; pepper, bell 10 ppm; peach 20 ppm; pear 25 ppm; pineapple 10 ppm; plum, fresh prune 20 ppm; sweet potato, roots 15 ppm; tomato 10 ppm.
Regulatory Authority and Advisory Information:
Carcinogenicity[83]: EPA Group B2, Probable human carcinogen; IARC, Group 3 not classifiable as to its carcinogenicity in humans
California Proposition 65 Chemical: Carcinogen (8/4/2000).
Health Advisory: Mutagen, Reproductive & Developmental Toxin (TRI), Skin irritant/sensitizer
Acute Oral Category: 3, CAUTION
EPCRA Section 313 Form R *de minimis* concentration reporting level: 1.0%
California Proposition 65 Chemical: Cancer (8/4/2000)
European/International Regulations: Hazard Symbol: Xi, N; risk phrases: R36/37/38; R50; safety phrases: S2; S22; S61 (see Appendix 1)
WGK (German Aquatic Hazard Class): 2-Hazard to waters
Description: *o*-Phenylphenol is a white to lavender crystalline solid. Combustible. Molecular weight = 170.21; Specific gravity (H_2O:1) = 1.213 @ 25 °C; Boiling point = 275 °C @ 760 mmHg[88]; Freezing/Melting point = 57.5 °C; Vapor pressure = 1 mmHg @ 100 °C[88]; Flash point = 123.9 °C(cc)[88]; Autoignition temperature = 530 °C; Explosive limits: LEL = 1.4%; UEL = 9.5%. Hazard Identification (based on NFPA-704 M Rating System): Health 3, Flammability 1, Reactivity 0. Soluble in water; solubility = <0.1 mg/mL @ 20.5 °C.
Incompatibilities: Reacts with boranes, alkalies, aliphatic amines, amides, nitric acid, sulfuric acid. Keep away from oxidizers (chlorates, nitrates, peroxides, permanganates, perchlorates, chlorine, bromine, fluorine, etc.).
Permissible Concentration in Air: NIOSH IDLH = 2.5 mg/m^3
Protective Action Criteria (PAC) Ver. 27[89]
PAC-1: 10 mg/m^3
PAC-2: 110 mg/m^3
PAC-3: 400 mg/m^3
DFG MAK: No numerical value established. Other data may be available.
Permissible Concentration in Water: State Drinking Water Guidelines: Florida 18 μg/L. Runoff from spills or fire control may cause water pollution.
Routes of Entry: Inhalation, dermal contact, ingestion.
Harmful Effects and Symptoms
Short Term Exposure: This material can cause skin irritation. It can cause serious eye irritation with burning; may cause damage to the corneas. Ingestion may cause irritation of the gastro-intestinal tract; nausea, vomiting and diarrhea. Inhalation of dust may cause irritation of the mucous membrane and upper respiratory tract. Based on animal studies, 5 oz would be lethal to a 150 lb healthy adult. LD_{50} (oral, rat) = 550–850 mg/kg[83]; LD_{50} (dermal, rat) = >500 mg/kg[83].
Long Term Exposure: Bladder, kidney and liver toxin. May cause reproductive and fetal effects. Tests on laboratory animals have resulted in tumors and mutagenic effects. May cause reproductive and fetal effects. May cause contact dermatitis.
Points of Attack: Eyes, bladder, kidneys, liver, reproductive system.
Medical Surveillance: This chemical is a suspected or known human carcinogen. Exposed persons should contact a physician for advice regarding the possible long term health effects and advice for medical monitoring. Evaluation by a qualified allergist, including exposure history and testing, may help diagnose allergy. Bladder, kidney, and liver tests.
First Aid: If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least 15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately. If this chemical contacts the skin, remove contaminated clothing and wash immediately with soap and water. Seek medical attention immediately. If this chemical has been inhaled, remove from exposure, begin rescue breathing (using universal precautions) if breathing has stopped, and CPR if heart action has stopped. Transfer promptly to a medical facility. When this chemical has been swallowed, get medical attention. Give large quantities of water and induce vomiting. Do not make an unconscious person vomit. Do not induce vomiting when formulations containing petroleum solvents are ingested
Personal Protective Methods: Wear protective gloves and clothing to prevent any reasonable probability of dermal and/or eye contact. Safety equipment suppliers/manufacturers can provide recommendations on the most protective glove/clothing material for your operation. All protective clothing (suits, gloves, footwear, headgear) should be clean, available each day, and put on before work. Contact lenses should not be worn when working with this chemical. Wear dust-proof chemical goggles and face shield unless full facepiece respiratory protection is worn. Employees should wash immediately with soap when skin is wet or contaminated. Provide emergency showers and eyewash.
Respirator Selection: *At any detectable concentration:* SCBAF: Pd,Pp (APF = 10,000) (any NIOSH/MSHA- or

European Standard EN 149-approved self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode); or SaF: Pd,Pp: ASCBA (APF = 10,000) (any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary, self-contained breathing apparatus operated in a pressure-demand or other positive-pressure mode). *Escape:* 100F (APF-50) (any air-purifying, full facepiece respirator with an N100, R100, or P100 filter k-mounted organic vapor canister having a high-efficiency particulate filter); or SCBAE (any appropriate escape-type, self-contained breathing apparatus).

Storage: Color Code-White: Corrosive or Contact Hazard; Store separately in a corrosion resistant location. Prior to working with this chemical you should be trained on its proper handling and storage. Store in tightly closed containers in a cool, well-ventilated area. Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: Alkylphenols, solid, n.o.s. (including C2-C12 homologues) require a level of "corrosive material." They fall in Hazard Class 8.

Spill Handling: Evacuate persons not wearing protective equipment from area of spill or leak until clean up is complete. Collect powdered material in the most convenient and safe manner and deposit in sealed containers. Ventilate area after clean up is complete. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable.

Fire Extinguishing: This chemical is a combustible solid. Hazardous decomposition includes oxides of carbon. As an immediate precautionary measure, isolate spill or leak area in all directions for at least 50 meters/150 feet for liquids and at least 25 meters/75 feet for solids. *Fire involving storage or vehicular tanks:* isolate for 800 meters/0.5 mile in all directions; also, consider initial evacuation for 800 meters/0.5 mile in all directions. *On a small fire:* use dry chemical, CO_2 or water spray. *On a large fire:* use dry chemical, carbon dioxide, alcohol-resistant foam or water spray. Do not scatter spilled material with high-pressure streams of water. Move containers from fire area if you can do it without risk. Dike fire-control water for later disposal. *Fire involving tanks:* from a secure, explosion-proof location, use water spray to cool exposed containers. If cooling streams are ineffective (venting sound increases in volume and pitch, tank discolors, or shows any signs of deforming), withdraw immediately to a secure position. Always stay away from tanks engulfed in fire. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode.

Disposal Method Suggested: In accordance with 40CFR165, follow recommendations for the disposal of pesticides and pesticide containers. Containers must be disposed of properly by following package label directions or by contacting your local or federal environmental control agency, or by contacting your regional EPA office.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- USEPA, Office of Pesticide Programs, Pesticide Residue Limits, "o-Phenylphenol," 40 CFR 180.129. http://www.epa.gov/pesticides/food/viewtols.htm
- New Jersey Department of Health and Senior Services, "Hazardous Substance Fact Sheet, o-Phenylphenol," Trenton, NJ (September 1986, rev. December 2000). http://www.state.nj.us/health/eoh/rtkweb/1439.pdf

Phorate P:0520

Use Type: Insecticide, Acaricide, Nematicide

CAS Number: 298-02-2

Formula: $C_7H_{17}O_2PS_3$

Synonyms: *O,O*-Diethyl *S*-ethylmercaptomethyl dithiophosphonate; *O,O*-Diethyl *S*-ethylthio methyldithiophosphonate; *O,O*-Diethylethylthiomethyl phosphorodithioate; *O,O*-Diethyl *S*[(ethylthio)methy] phosphorodithioate; *O,O*-Diethyl *S*-(ethylthio)methyl phosphorodithioate; *O,O*-Diethyl *S*-ethylthiomethyl thiothionophosphate; ENT 24,042; Forato (Spanish)

Trade Names: AASTAR®[C]; AC 3911®; AGRIMET®; AMERICAN CYANAMID 3,911®; EL 3911®; EXPERIMENTAL INSECTICIDE 3911®; GEOMET®; GRAMTOX®; GRANUTOX®; L 11/6®; METAPHOR®; PHORATE-10G®; PHORIL®; RAMPART®; TERRACLOR®; TERRATHION GRANULES®; THIMENOX®; THIMET®; THEMET®; UMET®; VEGFRU®; VERGFRU FORATOX®

Chemical class: Organophosphate

EPA/OPP PC Code: 057201

California DPR Chemical Code: 478

HSDB Number: 1183

N/NA & ERG Number: UN2783 (solid)/152; UN3018 (liquid)/152

RTECS® Number: TD9450000

EC Number: 206-052-2 [*Annex I Index No.:* 015-033-00-6]

Uses: Phorate is an organophosphorus insecticide and acaricide used to control a wide variety of sucking and chewing insects, leafhoppers, leafminers, mites, some nematodes, and rootworms. It is used on many crops, including root and field crops such as corn, cotton, coffee, potatoes, sugar beets, beans, peanuts, wheat, some ornamental and herbaceous plants, and bulb. In the U.S., 80% of the annual use of phorate is applied to corn, potatoes and cotton. It is available in granular and emulsifiable concentrate formulations. Phorate has been shown to be responsible for a large number of bird kills and it is extremely toxic to mammals. Not approved for use in EU countries[115]. A U.S. EPA restricted Use Pesticide (RUP).

U.S. Maximum Allowable Residue Levels for Phorate (40 CFR 180.206): bean 0.1 ppm; beet, sugar, roots 0.3 ppm; beet, sugar, tops 3 ppm; coffee, bean 0.02 ppm; corn, forage 0.5 ppm; corn, grain 0.1 ppm; corn, sweet, kernel plus 0.1 ppm; cob with husks removed ppm; cotton, undelinted seed 0.05 ppm; hop 0.5 ppm; peanut 0.1 ppm; potato 0.5 ppm; sorghum, grain, grain 0.1 ppm; sorghum, grain, stover 0.1 ppm; soybean 0.1 ppm; sugarcane, cane 0.1 ppm; wheat, grain 0.05 ppm; wheat, hay 1.5 ppm; wheat, straw 0.05 ppm.

Human toxicity (long-term)[101]: High–3.50 ppb, Health Advisory

Regulatory Authority and Advisory Information:

Carcinogenicity[83]: EPA Group E, evidence of non-carcinogenicity for humans; ACGIH A4, not classified as a human carcinogen

Health Advisory: Nerve Toxin, Mutagen, Developmental/Reproductive Toxin

Acute Oral Category: 1, DANGER–POISON

Potential Ground Water Pollutant [California FAC Section 13145(d)/12811, active]

EPA Hazardous Waste Number (RCRA No.): P094

RCRA 40CFR268.48; 61FR15654, Universal Treatment Standards: Wastewater (mg/L), 0.021; Non-wastewater (mg/kg), 4.6

RCRA 40CFR264, Appendix 9; TSD Facilities Ground Water Monitoring List. Suggested test method(s) (PQL μg/L): 8140(2); 8270(10)

Superfund/EPCRA 302 Extremely Hazardous Substances: TPQ = 10 lb (4.54 kg)

Superfund/EPCRA 40CFR302.4 RQ: CERCLA, 10 lb (4.54 kg)

U.S. DOT 49CFR172.101, Inhalation Hazard Chemical as organophosphates

U.S. DOT Regulated Marine Pollutant (49CFR172.101, Appendix B), severe pollutant

European/International Regulations: Hazard Symbol: T+, N; risk phrases: R27/28; R50/53; safety phrases: S1/2; S28; S36/37; S45; S60; S61 (see Appendix 1)

Description: Phorate is a clear mobile liquid. Offensive, skunk-like odor. Molecular weight = 260.39; Specific gravity (H_2O:1) = 1.156 @ 25 °C; Boiling point = 125–127.22 °C @ 2 mmHg[83]; 143 °C; Freezing/Melting point = –42.78 °C; Vapor pressure = 8.4×10^{-4} @ 20 °C; Flash point = 160 °C[9]. Hazard Identification (based on NFPA-704 M Rating System): Health 4, Flammability 1, Reactivity 0. Practically insoluble in water; solubility = 50 0.005%[9].

Incompatibilities: Keep away from water, alkalis. Hydrolyzed in the presence of moisture and by alkalis; may produce toxic oxides of phosphorus and sulfur. May react violently with antimony(V) pentafluoride. Incompatible with lead diacetate, magnesium, silver nitrate. In the presence of strong reducing agents such as hydrides, organophosphates form highly toxic and flammable phosphine gas. Contact with oxidizers can cause the release of toxic oxides of phosphorus.

Permissible Exposure Limits in Air: OSHA PEL: None

NIOSH REL: 0.05 mg/m^3 TWA; 0.2 mg/m^3 STEL [skin]

ACGIH TLV®[1]: 0.05 mg/m^3 TWA, inhalable fraction and vapor; [skin] not classifiable as a human carcinogen; BEI_A issued for Acetylcholinesterase inhibiting pesticides.

Protective Action Criteria (PAC) Ver. 27[89]

PAC-1: 0.04 mg/m^3

PAC-2: **0.040**$_{\mathbf{A}}$ mg/m^3

PAC-3: **0.12**$_{\mathbf{A}}$ mg/m^3

Subscript $_A$ = 60 minute AEGL.

Subscript "**A**" signifies 60-minute AEGL (Acute Emergency Guideline Level) values.

Determination in Air: OSHA versatile sampler-2; Toluene/Acetone; Gas chromatography/Flame photometric detection for sulfur, nitrogen, or phosphorus; NIOSH IV, Method #5600, Organophosphorus pesticides[18].

Permissible Concentration in Water: Federal Drinking Water Guidelines: 1.0 ppb[107]. State Drinking Water Guidelines: Maine 3.5 μg/L; Florida 1.4 μg/L.

Determination in Water: Log K_{ow} = >3.5. Values at or above 3.0 are likely to bioaccumulate in marine organisms.

Routes of Entry: Inhalation, ingestion, skin and/or eye contact. Absorbed through the skin.

Harmful Effects and Symptoms

Short Term Exposure: Acute exposure to phorate may produce the following signs and symptoms: pinpoint pupils, blurred vision, headache, dizziness, muscle spasms, and profound weakness. Vomiting, diarrhea, abdominal pain, seizures, and coma may also occur. The heart rate may decrease following oral exposure or increase following dermal exposure. Chest pain may be noted. Hypotension (low blood pressure) may occur, although hypertension (high blood pressure) is not uncommon. Dyspnea (shortness of breath) may be followed by respiratory collapse. Giddiness is common. This material is one of the more toxic organophosphorus insecticides. It is a cholinesterase inhibitor that acts on the nervous system, and produces toxicity similar to parathion. Delayed pulmonary edema may occur after inhalation. LD_{50} (oral, rat) = 2 mg/kg; LD_{50} (dermal, rat) = 3–6 mg/kg.

Long Term Exposure: Cholinesterase inhibitor; cumulative effect is possible. A nerve toxin; phorate may damage the nervous system with repeated exposure, resulting in convulsions, respiratory failure. May cause liver damage.

Points of Attack: Respiratory system, lungs, central nervous system, cardiovascular system, skin, eyes, plasma and red blood cell cholinesterase. May cause brain damage.

Medical Surveillance: Medical observation is recommended for 24 to 48 hours following breathing overexposure, as pulmonary edema may be delayed. Routine biological monitoring of pesticide applicators and field workers includes testing of plasma and red blood cell acetylcholinesterase levels (for enzyme poisoned by this chemical). These tests are normally accurate only if done within about two hours of exposure. If exposure stops, plasma levels return to normal in 1–2 weeks while red blood cell levels may be reduced for 1–3 months. When acetylcholinesterase enzyme levels are reduced by 25% or more below preemployment levels, risk of poisoning is increased, even if results are in lower ranges of "normal." Reassignment to work not involving organophosphate pesticides is recommended until enzyme levels recover. Do not drink any alcoholic beverages before or during use as it promotes absorption of organophosphates.

First Aid: **Treatment for organophosphate poisoning consists of thorough decontamination, cardiorespiratory support, and administration of the antidotes atropine and pralidoxime. In cases of severe poisoning, diazepam, an anticonvulsant, should also be administered. Antidotes should be administered as prevention even if the diagnosis is in doubt**. Speed in removing material from eyes and skin is of extreme importance. *Eyes:* Eye contact can cause dangerous amounts of these chemicals to be quickly absorbed through the mucous membrane into the bloodstream. Immediately and gently flush eyes with plenty of warm or cold water (NO hot water) for at least 15 minutes, occasionally lifting the upper and lower eyelids. Get medical aid immediately. *Skin:* Get medical aid. Dermal contact can cause dangerous amounts of these chemicals to be absorbed into the bloodstream. Wearing the appropriate PPE equipment and respirator for organophosphate pesticides, immediately flush skin with plenty of soap and water for at least 15 minutes while removing contaminated clothing and shoes. Shampoo hair promptly if contaminated. The removed, contaminated clothing and shoes should be double-bagged and left in Hot Zone for later disposal by hazardous materials experts. Skin may also be decontaminated with diluted hypochlorite solution. *Inhalation:* Get medical aid. Do not contaminate yourself. Wearing the appropriate PPE equipment and respirator for organophosphate pesticides, immediately remove the victim from the contaminated area to fresh air. If the victim is not breathing, administer artificial respiration. Do not use mouth-to-mouth method if victim ingested or inhaled the substance; give artificial respiration with the aid of a pocket mask equipped with a one-way valve or other proper respiratory medical device. If breathing is difficult, administer oxygen through bag/mask apparatus until medical help arrives. Do not leave victim unattended. *Ingestion:* Call poison control. Loosen all clothing. Never give anything by mouth to an unconscious person. If victim is *unconscious or having convulsions,* do nothing except keep victim warm. Get medical aid. Transfer promptly to a medical facility. In cases of ingestion, **do not induce vomiting**. If the victim is alert and asymptomatic, administer a slurry of activated charcoal at a dose of 1 g/kg (infant, child, and adult dose). A soda can and straw may be of assistance when offering charcoal to a child. *In some cases you may be specifically instructed by poison control to induce vomiting by way of 2 tablespoons of syrup of ipecac (adult) washed down with a cup of water*. Do NOT give activated charcoal before or with ipecac syrup

Note to physician or authorized medical personnel: Treat cases of respiratory compromise, coma, or excessive pulmonary secretions with respiratory support using protocols and techniques available and within the scope of training. Some cases may necessitate procedures such as endotracheal intubation or cricothyrotomy by properly trained and equipped personnel. When possible, atropine (see *Antidotes*, below) should be given under medical supervision. Patients who are comatose, hypotensive, or having seizures or cardiac arrhythmias should be treated according to advanced life support protocols. *Antidotes:* Two antidotes are administered to treat organophosphate poisoning. Atropine is a competitive antagonist of acetylcholine at muscarinic receptors and is used to control the excessive bronchial secretions which are often responsible for death. Pralidoxime relieves both the nicotinic and muscarine effects of organophosphate poisoning by regenerating acetylcholinesterase and can reduce both the bronchial secretions and the muscle weakness associated with poisoning. The initial intravenous dose of atropine in adults should be determined by the severity of symptoms: An initial adult dose of 1.0 to 2.0 mg or pediatric dose of 0.01 mg/kg (minimum 0.01 mg) should be administered intravenously. If intravenous access cannot be established, atropine may also be given intramuscularly, subcutaneously or via endotracheal tube. Doses should be repeated every 15 minutes until excessive secretions and sweating have been controlled. Once bronchial secretion has been controlled, atropine administration should be repeated whenever the secretions begin to recur. In seriously poisoned patients, very large doses may be required. Alterations of pulse rate and pupillary size should not be used as indicators of treatment adequacy. Pralidoxime should be administered as early in poisoning as possible as its efficacy may diminish when given more than 24 to 36 hours after exposure. Doses are as follows: adult 1.0 g; pediatric 25 to 50 mg/kg. The drug should be administered intravenously over 30 to 60 minutes, but in a life-threatening situation one-half of the total dose can be given per minute for a total administration time of 2 minutes. Treatment should begin to take effect within 40 minutes with a reduction in symptoms and the amount of atropine necessary to control bronchial secretion. The initial dose can be repeated in 1 hour and then every 8 to 12 hours until the patient is clinically well and no longer requires atropine. If intravenous access cannot be established, pralidoxime may also be given intramuscularly. Early administration of diazepam in addition to the combined atropine and pralidoxime treatment may help prevent the onset of seizures and potential brain and cardiac morphologic damage following high-level organophosphate poisoning.

Personal Protective Methods: Wear protective gloves and clothing to prevent any reasonable probability of dermal and/or eye contact. Safety equipment suppliers/manufacturers can provide recommendations on the most protective glove/clothing material for your operation. One recommendation is the use of DuPont^{TM} Tychem® suit fabrics[88]. All protective clothing (suits, gloves, footwear, headgear) should be clean, available each day, and put on before work. Contact lenses should not be worn when working with this chemical. Wear splash-proof chemical goggles and face shield unless full facepiece respiratory protection is worn. Employees should wash immediately with soap when skin is wet or contaminated. Provide emergency showers and eyewash.

Respirator Selection: SCBA >0.04 mg/m^3. Engineering controls should be used wherever feasible to maintain airborne concentrations of this chemical below the prescribed exposure limit. Respirators and protective equipment are less effective than engineering controls, and should be used only in non-routine or emergency situations which may result in exposure concentrations in excess of the TWA environmental limit. *At any concentrations above the NIOSH REL, or where there is no REL, at any detectable concentration:* SCBAF: Pd,Pp (APF = 10,000) (any NIOSH/MSHA- or European Standard EN 149-approved self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode); or SaF: Pd,Pp: ASCBA (APF = 10,000) (any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary, self-contained breathing apparatus operated in a pressure-demand or other positive-pressure mode).

Storage: Color Code-Blue: Health Hazard/Poison. Store in a secure poison location. Stable at room temperature for 2+ years. Prior to working with this chemical you should be trained on its proper handling and storage. Where possible, automatically transfer material from other storage containers to process containers. Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: Organophosphorus pesticides, solid or liquid (nonflammable), require a "poisonous materials" label. This chemical falls in Hazard Class 6.1.

Spill Handling: First remove all sources of ignition. Evacuate persons not wearing protective equipment from area of spill or leak until clean up is complete. Stay upwind; keep out of low areas. Ventilate area of spill or leak. Remove and isolate contaminated clothing at the site. Do not touch spilled material; stop leak if you can do so without risk. Use water spray to reduce vapors. *Small spills:* absorb with sand or other noncombustible absorbent material and place into containers for later disposal. *Large spills:* dike far ahead of spill for later disposal. Collect powdered material in the most convenient and safe manner and deposit in sealed containers. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable. Seek professional environmental engineering assistance from the U.S. EPA Environmental Response Team at (908) 548-8730 (24-hour response line).

Fire Extinguishing: Hazardous decomposition includes oxides of phosphorus, sulfur, and nitrogen. May be fatal if inhaled, ingested or absorbed through skin. Inhalation or contact with some of these materials will irritate or burn skin and eyes. Vapors may cause dizziness or suffocation. *Small fires*: use dry chemical, carbon dioxide or water spray. *Large fires:* use dry chemical, fog, or regular foam. Stay upwind; keep out of low areas. Ventilate closed spaces before entering them. Firefighting gear (including SCBA) may not provide adequate protection. If exposure occurs, remove and isolate gear immediately and thoroughly decontaminate personnel. Wear positive-pressure breathing apparatus and special protective clothing. Remove and isolate contaminated clothing at the site. Move container from fire area if you can do so without risk. Fight fire from maximum distance. Dike fire-control water for later disposal; do not scatter the material. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies. From a secure, explosion-proof location, use water spray to cool exposed containers. If cooling streams are ineffective (venting sound increases in volume and pitch, tank discolors, or shows any signs of deforming), withdraw immediately to a secure position. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode.

Disposal Method Suggested: Generators of waste containing this contaminant (≥100 kg/mo) must conform with EPA regulations governing storage, transportation, treatment, and waste disposal. Destruction by alkali hydrolysis or incineration. Containers must be disposed of properly by following package label directions or by contacting your local or federal environmental control agency, or by contacting your regional EPA office.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- EXTOXNET, Extension Toxicology Network, "Pesticide Information Profile, Phorate," Oregon State University, Corvallis, OR (June 1996). http://extoxnet.orst.edu/pips/phorate.htm
- USEPA, Office of Pesticide Programs, Pesticide Residue Limits, "Phorate," 40 CFR 180.206. http://www.epa.gov/pesticides/food/viewtols.htm
- New Jersey Department of Health, "Hazardous Substance Fact Sheet: Phorate," Trenton, NJ (April 1986, rev. September 2001). http://www.state.nj.us/health/eoh/rtkweb/1508.pdf

- USEPA, "Phorate, Health and Environmental Effects," Profile No. 145, Office of Solid Waste, Washington DC (April 30, 1980)
- USEPA, "Chemical Profile: Phorate," Washington DC, Chemical Emergency Preparedness Program (November 30, 1987)
- Agency for Toxic Substances and Disease Registry, U.S. Department of Health and Human Services, Public Health Service, "Managing Hazardous Materials Incidents," Atlanta, GA (June 2003)

Phosmet P:0560

Use Type: Insecticide, Acaricide
CAS Number: 732-11-6
Formula: $C_{11}H_{12}NO_4PS_2$
Synonyms: (*O,O*-Dimethyl-phthalimidiomethyl-dithiophosphate); *O,O*-Dimethyl *S*-(*N*-phthalimidomethyl)dithiophosphate; *O,O*-Dimethyl *S*-phthalimidomethylphosphorodi thioate; ENT 25,705; Fosmet (Spanish); *N*-(Mercaptomethyl) phthalimide *S*-(*O,O*-dimethyl phosphorodithioate); Phosphorodithioic acid, *S*-[(1,3-dihydro-1,3-dioxo-isoindol-2-yl)methyl] *O,O*-dimethyl ester; Phosphorodithioic acid, *O,O*-dimethyl ester, *S*-ester with *N*-(mercaptomethyl)phthalimide; Phthalimide, *N*-(mercaptomethyl)-, *S*-ester with *O,O*-dimethylphosphorodithioate; Phthalimido *O,O*-dimethyl phosphorodithioate; Phthalimidomethyl *O,O*-dimethyl phosphorodithioate
Trade Names: APPA®; DECEMTHION®; DELPHOS®; FESDAN®; FIREBAN®; FTALOPHOS®; IMIDAN®; KEMOLATE®; PERCOLATE®; PMC®; PROLATE®[C]; R 1504®; SAFIDON®; SMIDAN®; STARBAR CATTLE DUST®[C]; STAUFFER R 1504®; VET-KEM®; ZEOCON®
Chemical class: Organophosphate
EPA/OPP PC Code: 059201
California DPR Chemical Code: 335
HSDB Number: 1734
UN/NA & ERG Number: UN2783 (solid)/152; UN3018 (liquid)/152; UN3077(solid)/171; UN3082 (liquid)/17[88] depending on formulation.
RTECS® Number: TE2275000
EC Number: 211-987-4 [*Annex I Index No.:* 015-101-00-5]
Uses: Phosmet is a non-systemic insecticide used on both plants and animals. It is mainly used on apple trees for control of coddling moth, though it is also used on a wide range of crops including alfalfa, nuts, grapes, blueberries, peas, potatoes, fruit crops, ornamentals, and vines for the control of aphids, suckers, mites, fire ants and fruit flies. The compound is also an active ingredient in some dog collars. It is used as an insecticide on swine and cattle.
U.S. Maximum Allowable Residue Levels for Phosmet [40 CFR 180.261 (a)]: Alfalfa 40 ppm; almond, hulls 10 ppm; apple 10 ppm; apricot 5 ppm; blueberry 10 ppm; cattle, fat 0.2 ppm; cattle, meat 0.2 ppm; cattle, meat byproducts 0.2 ppm; cherry 10 ppm; cotton, undelinted seed 0.1 ppm; crabapple 20 ppm; cranberry 10 ppm; fruit, stone, group 12 5 ppm; goat, fat 0.2 ppm; goat, meat 0.2 ppm; goat, meat byproducts 0.2 ppm; grape 10 ppm; hog, fat 0.2 ppm; hog, meat 0.2 ppm; hog, meat byproducts 0.2 ppm; horse, fat 0.2 ppm; horse, meat 0.2 ppm; horse, meat byproducts 0.2 ppm; kiwifruit 25 ppm; nectarine 5 ppm; nuts 0.1 ppm; pea 0.5 ppm; pea, field, hay 10 ppm; pea, field, vines 10 ppm; peach 10 ppm; pear 10 ppm; pistachio 0.1 ppm; plum, prune, fresh 5 ppm; potato 0.1 ppm; sheep, fat 0.2 ppm; sheep, meat 0.2 ppm; sheep, meat byproducts 0.2 ppm; sweet potato, roots 10 ppm. ***Regional registration, as defined in section 180.1(n) [40 CFR 180.261 (c)]:*** Crabapple 20 ppm; pistachio 0.1 ppm.
Regulatory Authority and Advisory Information:
Carcinogenicty: EPA Suspected human carcinogen; Suggestive evidence of carcinogenicity, but not sufficient to assess human carcinogenic potential
Acute Oral Category: 2, WARNING
Health Advisory: Nerve Toxin, Mutagen, Developmental/Reproductive Toxin
Superfund/EPCRA 302 Extremely Hazardous Substances: TPQ = 10/10,000 lb (4.54/4,540 kg), removed December 27, 2004
Superfund/EPCRA 40CFR302.4 RQ: EHS, 1 lb (0.454 kg). 12/27, 2004, deleted from EHS list
U.S. DOT 49CFR172.101, Inhalation Hazard Chemical as organophosphates
MARINE POLLUTANT (49CFR, Subchapter 172.101, Appendix B)
European/International Regulations: Not classified in Annex I, but the following may apply: Hazard Symbol: T+, N; risk phrases: R21/22; R25; R50/53; safety phrases: S2; S22; S36/37; S60; S61 (see Appendix 1)
Description: Phosmet is an off-white to pink crystalline solid. Commercial product is available in granular form or an emulsifiable concentrate. Offensive odor. Molecular weight = 317.32; Specific gravity (H_2O:1) = 1.03 @ 20 °C; Boiling point = (decomposes); Freezing/Melting point = 71.67 °C. Hazard; Vapor pressure = 1×10^{-3} mmHg @ 50 °C; Flash point = ~200 °C. Hazard Identification (based on NFPA-704 M Rating System): Health 3, Flammability 1, Reactivity 2. Slightly soluble in water. Physical and toxicological properties may be affected by carrier solvents in commercial formulations.
Incompatibilities: Not compatible with other pesticides under alkaline conditions. Contact with water, steam or moisture forms phthalic acids. May react violently with antimony(V) pentafluoride. Incompatible with lead diacetate, magnesium, silver nitrate. In the presence of strong reducing agents such as hydrides, organophosphates form highly toxic and flammable phosphine gas. Contact with oxidizers can cause the release of toxic oxides of phosphorus. Slightly corrosive to metals in the presence of moisture. Imides react with azo and diazo compounds to generate toxic gases. Flammable gases are formed by the reaction of organic imides with strong reducing agents. Imides are extremely weak bases (weaker than water). React with strong bases to form salts. That is, they can react as acids.
Permissible Exposure Limits in Air: Protective Action Criteria (PAC) Ver. 27[89]

PAC-1: 0.049 mg/m^3
PAC-2: 0.54 mg/m^3
PAC-3: 55 mg/m^3

Determination in Air: OSHA versatile sampler-2; Toluene/Acetone; Gas chromatography/Flame photometric detection for sulfur, nitrogen, or phosphorus; NIOSH Method IV Method #5600, Organophosphorus pesticides.[18].

Permissible Concentration in Water: State Drinking Water Guidelines: Florida 140 μg/L.

Determination in Water: NIOSH Method 1657. The determination of organophosphorus pesticides in municipal and industrial wastewater by gas chromatography. Detection limit = 6.0 ηg/L. Log K_{ow} = ~3.0. Values at or above 3.0 are likely to bioaccumulate in marine organisms.

Routes of Entry: Inhalation, ingestion, skin and/or eye contact. Absorbed by the eyes and unbroken skin.

Harmful Effects and Symptoms: Organophosphates are highly toxic. Symptoms may develop rapidly, or there may be a delay of several hours following exposure before they become noticeable. The delay tends to be longer in the case of some compounds that dissolve fats, lipids, oils and non-polar solvents such as toluene. Symptoms may increase in severity for more than a single day and last for several days. In severe cases of organophosphate intoxication, respiratory failure may occur.

Short Term Exposure: Irritates the eyes and skin on contact. This material is a highly toxic organophosphate; the probable oral lethal dose for humans is 50–500 mg/kg, or between 1 teaspoon and 1 oz for a 150 lb person. It is a cholinesterase inhibitor and has central nervous system effects. Oral lethal doses in humans have been reported at 50 mg/kg. Acute exposure to phosmet may produce the following signs and symptoms: pinpoint pupils, blurred vision, headache, dizziness, muscle spasms, and profound weakness. Vomiting, diarrhea, abdominal pain, seizures, and coma may also occur. The heart rate may decrease following oral exposure or increase following dermal exposure. Chest pain may be noted. Hypotension (low blood pressure) may occur, although hypertension (high blood pressure) is not uncommon. Dyspnea (shortness of breath) may be followed by respiratory collapse. Giddiness is common. Delayed pulmonary edema may occur after inhalation. LD_{50} (oral, rat) = >90 mg/kg; LD_{50} (dermal, rat) = >1000 mg/kg.

Long Term Exposure: Cholinesterase inhibitor; cumulative effect is possible. A nerve toxin; phosmet may damage the nervous system with repeated exposure, resulting in convulsions, respiratory failure. May cause liver damage.

Points of Attack: Respiratory system, lungs, central nervous system, cardiovascular system, skin, eyes, plasma and red blood cell cholinesterase.

Medical Surveillance: Medical observation is recommended for 24 to 48 hours following breathing overexposure, as pulmonary edema may be delayed. Routine biological monitoring of pesticide applicators and field workers includes testing of plasma and red blood cell acetylcholinesterase levels (for enzyme poisoned by this chemical). These tests are normally accurate only if done within about two hours of exposure. If exposure stops, plasma levels return to normal in 1–2 weeks while red blood cell levels may be reduced for 1–3 months. When acetylcholinesterase enzyme levels are reduced by 25% or more below preemployment levels, risk of poisoning is increased, even if results are in lower ranges of "normal." Reassignment to work not involving organophosphate pesticides is recommended until enzyme levels recover. Do not drink any alcoholic beverages before or during use as it promotes absorption of organophosphates.

First Aid: **Treatment for organophosphate poisoning consists of thorough decontamination, cardiorespiratory support, and administration of the antidotes atropine and pralidoxime. In cases of severe poisoning, diazepam, an anticonvulsant, should also be administered. Antidotes should be administered as prevention even if the diagnosis is in doubt**. Speed in removing material from eyes and skin is of extreme importance. *Eyes:* Eye contact can cause dangerous amounts of these chemicals to be quickly absorbed through the mucous membrane into the bloodstream. Immediately and gently flush eyes with plenty of warm or cold water (NO hot water) for at least 15 minutes, occasionally lifting the upper and lower eyelids. Get medical aid immediately. *Skin:* Get medical aid. Dermal contact can cause dangerous amounts of these chemicals to be absorbed into the bloodstream. Wearing the appropriate PPE equipment and respirator for organophosphate pesticides, immediately flush skin with plenty of soap and water for at least 15 minutes while removing contaminated clothing and shoes. Shampoo hair promptly if contaminated. The removed, contaminated clothing and shoes should be double-bagged and left in Hot Zone for later disposal by hazardous materials experts. Skin may also be decontaminated with diluted hypochlorite solution. *Inhalation:* Get medical aid. Do not contaminate yourself. Wearing the appropriate PPE equipment and respirator for organophosphate pesticides, immediately remove the victim from the contaminated area to fresh air. If the victim is not breathing, administer artificial respiration. Do not use mouth-to-mouth method if victim ingested or inhaled the substance; give artificial respiration with the aid of a pocket mask equipped with a one-way valve or other proper respiratory medical device. If breathing is difficult, administer oxygen through bag/mask apparatus until medical help arrives. Do not leave victim unattended. *Ingestion:* Call poison control. Loosen all clothing. Never give anything by mouth to an unconscious person. If victim is *unconscious or having convulsions,* do nothing except keep victim warm. Get medical aid. Transfer promptly to a medical facility. In cases of ingestion, **do not induce vomiting**. If the victim is alert and asymptomatic, administer a slurry of activated charcoal at a dose of 1 g/kg (infant, child, and adult dose). A soda can and straw may be of assistance when offering charcoal to a child. *In some cases you may be specifically instructed by poison control to induce vomiting by way of 2 tablespoons of syrup of ipecac (adult) washed down with a cup of water*. Do NOT give activated charcoal before or with ipecac syrup

Note to physician or authorized medical personnel: Treat cases of respiratory compromise, coma, or excessive pulmonary secretions with respiratory support using protocols and techniques available and within the scope of training. Some cases may necessitate procedures such as endotracheal intubation or cricothyrotomy by properly trained and equipped personnel. When possible, atropine (see *Antidotes*, below) should be given under medical supervision. Patients who are comatose, hypotensive, or having seizures or cardiac arrhythmias should be treated according to advanced life support protocols. *Antidotes:* Two antidotes are administered to treat organophosphate poisoning. Atropine is a competitive antagonist of acetylcholine at muscarinic receptors and is used to control the excessive bronchial secretions which are often responsible for death. Pralidoxime relieves both the nicotinic and muscarine effects of organophosphate poisoning by regenerating acetylcholinesterase and can reduce both the bronchial secretions and the muscle weakness associated with poisoning. The initial intravenous dose of atropine in adults should be determined by the severity of symptoms: An initial adult dose of 1.0 to 2.0 mg or pediatric dose of 0.01 mg/kg (minimum 0.01 mg) should be administered intravenously. If intravenous access cannot be established, atropine may also be given intramuscularly, subcutaneously or via endotracheal tube. Doses should be repeated every 15 minutes until excessive secretions and sweating have been controlled. Once bronchial secretion has been controlled, atropine administration should be repeated whenever the secretions begin to recur. In seriously poisoned patients, very large doses may be required. Alterations of pulse rate and pupillary size should not be used as indicators of treatment adequacy. Pralidoxime should be administered as early in poisoning as possible as its efficacy may diminish when given more than 24 to 36 hours after exposure. Doses are as follows: adult 1.0 g; pediatric 25 to 50 mg/kg. The drug should be administered intravenously over 30 to 60 minutes, but in a life-threatening situation one-half of the total dose can be given per minute for a total administration time of 2 minutes. Treatment should begin to take effect within 40 minutes with a reduction in symptoms and the amount of atropine necessary to control bronchial secretion. The initial dose can be repeated in 1 hour and then every 8 to 12 hours until the patient is clinically well and no longer requires atropine. If intravenous access cannot be established, pralidoxime may also be given intramuscularly. Early administration of diazepam in addition to the combined atropine and pralidoxime treatment may help prevent the onset of seizures and potential brain and cardiac morphologic damage following high-level organophosphate poisoning.

Respirator Selection: SCBA >0.049 mg/m^3 *At any detectable concentration:* SCBAF: Pd,Pp (APF = 10,000) (any NIOSH/MSHA- or European Standard EN 149-approved self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode); or SaF: Pd,Pp: ASCBA (APF = 10,000) (any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary, self-contained breathing apparatus operated in a pressure-demand or other positive-pressure mode). *Escape:* 100 F (APF = 50) (any air-purifying, full facepiece respirator with an N100, R100, or P100 filter k-mounted organic vapor canister having a high-efficiency particulate filter); or SCBAE (any appropriate escape-type, self-contained breathing apparatus).

Storage: Color Code-Blue: Health Hazard/Poison. Store in a secure poison location. Prior to working with this chemical, you should be trained on its proper handling and storage. Store in tightly closed containers in a cool, well-ventilated area away from strong bases. Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: Organophosphorus pesticides, solid or liquid (nonflammable), require a "poisonous materials" label. This chemical falls in Hazard Class 6.1; Environmentally hazardous substances, solid or liquid, usually fall in Hazard Class 9 and Packing Group III.

Spill Handling: First remove all sources of ignition. Evacuate persons not wearing protective equipment from area of spill or leak until clean up is complete. Stay upwind; keep out of low areas. Ventilate area of spill or leak. Remove and isolate contaminated clothing at the site. Do not touch spilled material; stop leak if you can do so without risk. Use water spray to reduce vapors. *Small spills:* absorb with sand or other noncombustible absorbent material and place into containers for later disposal. *Large spills:* dike far ahead of spill for later disposal. Collect powdered material in the most convenient and safe manner and deposit in sealed containers. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable. Seek professional environmental engineering assistance from the U.S. EPA Environmental Response Team at (908) 548-8730 (24-hour response line).

Fire Extinguishing: Hazardous decomposition includes oxides of phosphorus, sulfur, and nitrogen. This material may be combustible and containers may explode in fire. May be fatal if inhaled, ingested or absorbed through skin. Inhalation or contact with this material will irritate or burn skin and eyes. Vapors may cause dizziness or suffocation. *Small fires:* dry chemical, carbon dioxide; water spray; or foam. *Large fires:* water spray, fog, or foam. Stay upwind; keep out of low areas. Ventilate closed spaces before entering them. Firefighting gear (including SCBA) may not provide adequate protection. If exposure occurs, remove and isolate gear immediately and thoroughly decontaminate personnel. Wear positive-pressure breathing apparatus and special protective clothing. Remove and isolate contaminated clothing at the site. Move container from fire area if you can do so without risk. Fight fire from maximum distance. Dike fire control water for later disposal; do not scatter the material. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies. From a secure, explosion-proof location, use water spray to cool exposed containers. If cooling streams are ineffective (venting sound increases in volume and pitch, tank discolors, or shows any signs of deforming), withdraw immediately to a secure position. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode.

Disposal Method Suggested: Destruction by alkali hydrolysis or incineration. Containers must be disposed of properly by following package label directions or by contacting your local or federal environmental control agency, or by contacting your regional EPA office.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- EXTOXNET, Extension Toxicology Network, "Pesticide Information Profile, Phosmet," Oregon State University, Corvallis, OR (June 1996). http://extoxnet.orst.edu/pips/phosmet.htm
- USEPA, Office of Pesticide Programs, Pesticide Residue Limits, "Phosmet," 40 CFR 180.261. http://www.epa.gov/pesticides/food/viewtols.htm
- USEPA, "Chemical Profile: Phosmet," Washington DC, Chemical Emergency Preparedness Program (November 30, 1987)
- Agency for Toxic Substances and Disease Registry, U.S. Department of Health and Human Services, Public Health Service, "Managing Hazardous Materials Incidents," Atlanta, GA (June 2003)
- New Jersey Department of Health and Senior Services, "Hazardous Substance Fact Sheet, Decemthion," Trenton, NJ (March 1999). http://www.state.nj.us/health/eoh/rtkweb/0603.pdf

Phosphine P:0580

Use Type: Fumigant, Insecticide

CAS Number: 7803-51-2

Formula: H_3P; PH_3

Alert: Phosphine is extremely flammable and explosive; it may ignite spontaneously on contact with air.

Synonyms: Celphos; Delicia; Detia Gas-EX-B; Fosfamia (Spanish); Hydrogen phosphide; Phosphine gas; Phosphorus trihydride; Phosphorus hydride; Phosphorated hydrogen;Phostoxin

Trade names: ECO_2 FUME TM®; $VAPORPH_3OS$®

Chemical class: Inorganic compound

EPA/OPP PC Code: 066500

California DPR Chemical Code: 3541

HSDB Number: 1233

UN/NA & ERG Number: UN2199/119

RTECS® Number: SY7525000

EC Number: 232-260-8 [*Annex I Index No.:* 015-181-00-1]

Uses: Phosphine gas is used indoors to control a broad spectrum of insects for non-food/non-feed commodities in sealed containers or structures. There are no homeowner or agricultural row crop uses for this product. The end-use product is a poisonous liquefied gas under pressure, and is A U.S. EPA restricted Use Pesticide (RUP) due to the acute inhalation toxicity of phosphine gas. Phosphine is only occasionally used in industry, and exposure usually results accidentally as a byproduct of various processes. Exposures may occur when acid or water comes in contact with metallic phosphides (aluminum phosphide, calcium phosphide). These two phosphides are used as insecticides or rodenticides for grain, and phosphine is generated during grain fumigation. Phosphine may also evolve during the generation of acetylene from impure calcium carbide, as well as during metal shaving, sulfuric acid tank cleaning, rustproofing, and ferrosilicon, phosphoric acid and yellow phosphorus explosive handling. U.S. EPA restricted Use Pesticide (RUP). Currently listed as "pending" in the EU.

U.S. Maximum Allowable Residue Levels for Phosphine (40 CFR 180.225): Almond 0.1 ppm; animal feed 0.1 ppm; avocado 0.01 ppm; banana 0.01 ppm; barley, grain 0.1 ppm; cabbage, chinese, bok choy 0.01 ppm; cacao bean, dried bean 0.1 ppm; cashew 0.1 ppm; citron, citrus 0.01 ppm; coffee, bean 0.1 ppm; corn, field, grain 0.1 ppm; corn, pop, grain 0.1 ppm; cotton, undelinted seed 0.1 ppm; date, dried fruit 0.1 ppm; dill, seed 0.01 ppm; eggplant 0.01 ppm; endive 0.01 ppm; filbert 0.1 ppm; grapefruit 0.01 ppm; kumquat 0.01 ppm; lemon 0.01 ppm; lettuce 0.01 ppm; lime 0.01 ppm; mango 0.01 ppm; millet, grain 0.1 ppm; mushroom 0.01 ppm; nut, brazil 0.1 ppm; oat, grain 0.1 ppm; okra 0.01 ppm; orange 0.01 ppm; papaya 0.01 ppm; peanut 0.1 ppm; pecan 0.1 ppm; pepper, black, post-harvest 0.01 ppm; pepper, pimento 0.01 ppm; pepper, red, post-harvest 0.01 ppm; pepper, white, post-harvest 0.01 ppm; persimmon 0.01 ppm; pistachio 0.1 ppm; processed food 0.01 ppm; raw agricultural commodities 0.01 ppm; rice, grain 0.1 ppm; rye, grain 0.1 ppm; safflower, seed 0.1 ppm; salsify, tops 0.01 ppm; sesame, post-harvest 0.1 ppm; sorghum, grain 0.1 ppm; soybean, seed 0.1 ppm; sunflower, seed 0.1 ppm; sweet potato 0.01 ppm; tangelo 0.01 ppm; tangerine 0.01 ppm; tomato 0.01 ppm; vegetable, legume, group 6 0.01 ppm; walnut 0.1 ppm; wheat, grain 0.1 ppm.

Regulatory Authority and Advisory Information:

Carcinogenicity[83]: EPA Group D, Not classifiable as a human carcinogen

Health Advisory: Mutagen, Lung Damaging agent

Acute Oral Category: 1, DANGER–POISON

87-86-5

CLEAN AIR ACT: Hazardous Air Pollutants (Title I, Part A, Section 112); Accidental Release Prevention/Flammable substances, (Section 112[r], Table 3), TQ = 5,000 lb (2270 kg)

EPA HAZARDOUS WASTE NUMBER (RCRA No.): P096

SUPERFUND/EPCRA 302 Extremely Hazardous Substances: TPQ = 500 lb (227 kg)

SUPERFUND/EPCRA 40CFR302.4 RQ: CERCLA, 100 lb (45.4 kg)

EPCRA Section 313 Form R *de minimis* concentration reporting level: 1.0%

US DOT 49CFR172.101, Inhalation Hazardous Chemical

European/International Regulations: Hazard Symbol: T+, F, H, N; risk phrases: R12; R17; R26; R34; R50; safety phrases: S1/2; S28; S36/37; S45; S61; S63 (see Appendix 1)

WGK (German Aquatic Hazard Class): 2-Hazard to waters

Description: Phosphine is colorless poisonous and flammable (extremely explosive) liquefied compressed gas that ignites at a very low temperature. Odorless when pure, otherwise, it has the odor of garlic or the foul odor of decaying fish. The Odor Threshold is 0.14 ppm, a level at which humans detect the odor of phosphine; *it does not provide sufficient warning of dangerous concentrations*. Molecular weight = 34.00; Specific gravity (H_2O:1) = 0.746 @ 90 °C[83]; Boiling point = –87.78 °C @ 760 mmHg; Freezing/Melting point = –132.78 °C[83]; Relative vapor density (air = 1): 1.18; Vapor pressure = >760 mmHg @ 20 °C; Flash point = (flammable gas) 104.4 °C; Autoignition temperature (depends on concentration and diluent) = 38–100 °C. Explosive limits: LEL = 1.7% Dangerous fire hazard from spontaneous chemical reaction.; UEL = 98% (est.)[17]. Dangerous fire hazard from spontaneous chemical reaction. Hazard Identification (based on NFPA-704 M Rating System): Health 4, Flammability 4, Reactivity 2. Slightly soluble in water; solubility = 25 ml/100 ml @ 17 °C.

Incompatibilities: Reacts with water*, air, acids, moisture, oxidizers, oxygen, chlorine, nitrogen oxides, metal nitrates, halogens, halogenated hydrocarbons, copper and many other substances, causing fire and explosion hazard. May ignite spontaneously on contact with air at or about 55 °C. Corrosive; attacks many metals.

Permissible Exposure Limits in Air: Odor threshold: 0.9 ppm

NIOSH IDLH: 50 ppm

Conversion factor: 1 ppm = 1.39 mg/m^3 @ 25 °C & 1 atm

OSHA PEL: 0.3 ppm/0.4 mg/m^3 TWA

NIOSH REL: 0.3 ppm/0.4 mg/m^3 TWA; 1 ppm/1 mg/m^3 STEL

ACGIH TLV®[1]: 0.3 ppm/0.42 mg/m^3 TWA; 1 ppm/1.4 mg/m^3 STEL

DFG MAK: 0.1 ppm/0.14 mg/m^3 TWA; Peak Limitation Category II(2); Pregnancy Risk Group C

Protective Action Criteria (PAC) Phosphine Ver. 27[89]

TEEL-0: 0.3 ppm

PAC-1: 1 ppm

PAC-2: $\mathbf{2.0}_A$ ppm

PAC-3: $\mathbf{3.6}_A$ ppm

Subscript "**A**" signifies 60-minute AEGL (Acute Emergency Guideline Level) values.

Determination in Air: Beaded carbon*; H_2O_2/buffer; Ion chromatography; OSHA Method #ID180. Collection on silver nitrate impregnated cellulose pad to give free silver which is converted to the nitrate, then to the sulfide which is analyzed colorimetrically; See also NIOSH #332, Phosphine

Permissible Concentration in Water: No criteria set, but EPA[32] has suggested a permissible ambient goal of 5.5 μg/L based on health effects.

Determination in Water: Log K_{ow} = <– 0.3. Unlikely to bioaccumulate in marine organisms.

Routes of Entry: Inhalation, skin and/or eye contact with the liquid. Most phosphine exposures occur by inhalation of the gas or ingestion of metallic phosphides, but dermal exposure to phosphides can also cause systemic effect.

Harmful Effects and Symptoms

Short Term Exposure: *Warning*: Highly toxic phosphine gas may evolve from vomitus and feces of victim. May be fatal if inhaled, ingested, or absorbed through the skin. *Inhalation:* Inhalation is the major route of phosphine toxicity. Phosphine is a respiratory tract irritant that attacks primarily the cardiovascular and respiratory systems causing cardiac arrhythmias and peripheral vascular collapse, cardiac arrest and failure, and pulmonary edema, a medical emergency that can be delayed for several hours. This can cause death. *Skin/eye contact:* Phosphides may be absorbed dermally, especially through unbroken skin, and can cause systemic toxicity by this route. Phosphine gas produces no adverse effects on the skin or eyes, and contact does not result in systemic toxicity. Phosphine is a super-toxic gas with a probable oral lethal dose of 5 mg/kg or 7 drops for a 150 lb person. An air concentration of 3 ppm is safe for long term exposure, 500 ppm is lethal in 30 minutes, and concentration of 1000 ppm is lethal after a few breaths. Contact with liquefied or compressed phosphine gas may cause frostbite. *Ingestion:* Ingestion of phosphine is unlikely because it is a gas at room temperature. Ingestion of metallic phosphides can produce phosphine intoxication when the solid phosphide contacts gastric acid. Contact with the liquid may cause frostbite. Phosphine interferes with enzymes and protein synthesis, primarily in the mitochondria of heart and lung cells. As a result, effects may include hypotension, reduction in cardiac output, tachycardia, oliguria, anuria, cyanosis, pulmonary edema, tachypnea, jaundice, hepatosplenomegaly, ileus, seizures, and diminished reflexes. Acute exposure to phosphine usually results in headache, cough, tightness and pain in the chest, shortness of breath, dizziness, lethargy, and stupor. Fatigue, muscle pain, chills, tremors, loss of coordination, seizures, and coma may be seen. Gastrointestinal symptoms include nausea, vomiting, abdominal pain, and diarrhea. Renal (kidney) damage, hepatic (liver) damage, and jaundice may also occur.

Long Term Exposure: Chronic exposure to very low concentrations may result in anemia, bronchitis, gastrointestinal disturbances, and visual, speech, and motor disturbances. Chronic exposure may be more serious for children because of their potential longer latency period. Chronic poisoning may cause toothache, swelling of the jaw, spontaneous fractures of bones. May cause anemia. May damage the liver and kidneys. The effects are cumulative. Although most survivors of acute phosphine exposure show no permanent disabilities, damage due to insufficient blood supply to the heart and brain has been reported. Subacute poisoning resulting from exposure for a few days may cause reactive airways dysfunction syndrome (RADS) months later.

Points of Attack: Liver, kidney, and respiratory system.

Medical Surveillance: For those with frequent or potentially high exposure (half the TLV or greater), the following are recommended before beginning work and at regular times after that: Lung function tests. If symptoms develop or overexposure is suspected, the following may be useful: Consider chest x-ray after acute overexposure. Liver function tests. Typically, liver injury does not become evident until 48 to 72 hours after exposure. Findings may include jaundice, enlarged liver, elevated serum transaminases, and increased bilirubin in the blood. Analysis of blood gases may reveal combined respiratory and metabolic acidosis. Also, there have been reports of significant hypomagnesemia and hypermagnesemia associated with massive focal myocardial damage.

First Aid: There is no antidote for phosphine toxicidty. Brush all visible particles from clothes, skin, and hair. Remove and double-bag contaminated clothing and personal belongings. Thoroughly flush exposed skin and hair with water for 3 to 5 minutes, then wash with mild soap. Rinse thoroughly with water. Use caution to avoid hypothermia when decontaminating children or the elderly. Use blankets or similar warmers when appropriate. If phosphides have been ingested, *do not induce vomiting*. Phosphides will release phosphine in the stomach; therefore, watch for signs similar to those produced by phosphine inhalation. Administer a slurry of activated charcoal at 1 g/kg (adult). *Note to physician or authorized medical personnel: Advanced treatment;* In cases of respiratory compromise, secure airway and respiration via endotracheal intubation. If not possible, perform cricothyroidotomy if equipped and trained to do so. Treat patients who have bronchospasm with aerosolized bronchodilators. The use of bronchial sensitizing agents in situations of multiple chemical exposures may pose additional risks. Consider the health of the myocardium before choosing which type of bronchodilator should be administered. Cardiac sensitizing agents may be appropriate; however, the use of cardiac sensitizing agents after exposure to certain chemicals may pose enhanced risk of cardiac arrhythmias (especially in the elderly). Consider racemic epinephrine aerosol for children who develop stridor. Dose 0.25–0.75 mL of 2.25% racemic epinephrine solution in 2.5 cc water, repeat every 20 minutes as needed, cautioning for myocardial variability. Patients who are comatose, hypotensive, or having seizures or cardiac arrhythmias should be treated according to advanced life support protocols. If evidence of shock or hypotension is observed, begin fluid administration. For adults, bolus 1000 mL/hour intravenous saline or lactated Ringer's solution if blood pressure is under 80 mmHg; if systolic pressure is over 90 mmHg, an infusion rate of 150 to 200 mL/hour is sufficient. For children with compromised perfusion, administer a 20 mL/kg bolus of normal saline over 10 to 20 minutes, then infuse at 2 to 3 mL/kg/hour.

Decontamination: *This is very important*. The rapid physical removal of a chemical agent is essential. If you don't have the equipment and training, don't enter the hot or the warm zone to rescue and/or decontaminate victims. Medical personnel should wear the proper PPE. If the victim can't move, decontaminate without touching and without entering the hot or the warm zone. Metallic phosphides on clothes, skin, or hair can off-gas phosphine after contact with water or moisture, so a risk of secondary contamination may be present. Have the victim remove clothing; and seal contaminated clothes and personal belongings in a sealed double bag. For skin exposure to the metallic phosphides, scrape or brush all visible particles from the skin and hair. Use clean water from any source; if possible, use a hose (spray or fog to prevent injury to the victim) or other system to avoid touching the victim. Don't wait for soap or for the victim to remove clothing, begin washing immediately. Do not delay decontamination to obtain warm water; time is of the essence; use cold water instead. Immediately flush the eyes with water for at least 15 minutes. Use caution to avoid hypothermia in children and the elderly. Persons exposed only to phosphine gas do not pose substantial risks of secondary contamination. *Warning*: Highly toxic phosphine gas may evolve from vomitus and feces of victim. Rinse the eyes, mucous membranes, or open wounds with sterile saline or water and then move away from the hot zone in an upwind and up hill direction.

Personal Protective Methods: Reacts with the following absorbent materials: Mineral-Based and Clay-Based[88]. Wear full protective gloves and clothing to prevent any reasonable probability of dermal and/or eye contact. Safety equipment suppliers/manufacturers can provide recommendations on the most protective glove/clothing material for your operation. Here, for example, [with acknowledgement to CAMEO/NOAA & DuPont™] is a list of Normalized Breakthrough Times in minutes: Tychem® F =10 min or less; Tychem® ThermoPro =10 min or less; Tychem® BR= >480; Tychem® LV = >480; Tychem® Responder® CSM = >480; Tychem® TK = >480; Tychem® Reflector® = >480. All protective clothing (suits, gloves, footwear, headgear) should be clean, available each day, and put on before work. Contact lenses should not be worn when working with this chemical. Wear gas-proof chemical goggles and face shield unless full facepiece respiratory protection is worn. Employees should wash immediately with soap when skin is wet or contaminated. Provide emergency showers and eyewash.

Respirator Selection: SCBA >1 ppm. NIOSH: *Up to 3 ppm:* Sa (APF = 10) (any supplied-air respirator). *Up to 7.5 ppm:* Sa:Cf (APF = 25) (any supplied-air respirator operated in a continuous-flow mode). *Up to 15 ppm:*

GmFS (APF = 50) [any air-purifying, full facepiece respirator (gas mask) with a chin-style, front- or back-mounted canister providing protection against the compound of concern]; SCBAF (APF = 50) (any self-contained breathing apparatus with a full facepiece); or SaF (APF = 50) (any supplied-air respirator with a full facepiece). *Up to 50ppm:* Sa: Pd,Pp (APF = 1000) (any supplied-air respirator operated in a pressure-demand or other positive-pressure mode). *Emergency or planned entry into unknown concentrations or IDLH conditions:* SCBAF: Pd,Pp (APF = 10,000) (any self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode); or SaF: Pd,Pp: ASCBA (APF = 10,000) (any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary self-contained breathing apparatus operated in a pressure-demand or other positive-pressure mode). *Escape:* GmFS (APF = 50) [any air-purifying, full facepiece respirator (gas mask) with a chin-style, front- or back-mounted canister providing protection against the compound of concern]; or SCBAE (any appropriate escape-type, self-contained breathing apparatus).

Storage: Color Code-Red Stripe: Flammability Hazard: Store separately from all other flammable materials. Prior to working with this chemical you should be trained on its proper handling and storage. Before entering confined space where this chemical may be present, check to make sure that an explosive concentration is not a danger. Phosphine must be stored to avoid contact with oxidizers (such as perchlorates, peroxides, permanganates, chlorates and nitrates); strong acids (such as hydrochloric, sulfuric, and nitric); oxygen and halogenated hydrocarbons, since violent reactions occur. Store in tightly closed containers from physical damage. Use only non-sparking tools and equipment, especially when opening and closing containers of phosphine. Procedures for the handling, use and storage of cylinders should be in compliance with OSHA 1910.101 and 1910.169, as with the recommendations of the Compressed Gas Association. Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: Phosphine requires a shipping label of "POISON GAS, FLAMMABLE GAS." It usually falls in Hazard Class 2.3. It is a violation of transportation regulations to refill compressed gas cylinders without the express written permission of the owner. STN 49 201 60.

Spill Handling: Evacuate and restrict persons not wearing protective equipment from area of spill or leak until clean up is complete. Establish forced ventilation to keep levels below explosive limit. Stop the flow of gas if it can be done safely. If source of leak is a cylinder and the leak cannot be stopped in place, remove leaking cylinder to a safe place in the open air, and repair leak or allow cylinder to empty. Keep this chemical out of confined space, such as a sewer, because of the possibility of explosion, unless the sewer is designed to prevent the buildup of explosive concentrations. It may be necessary to contain and dispose of this chemical as a hazardous waste. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable.

Initial isolation and protective action distances

Distances shown are likely to be affected during the first 30 minutes after materials are spilled and could increase with time. If more than one tank car, cargo tank, portable tank, or large cylinder is involved in the incident is leaking, the protective action distance may need to be increased. You may need to seek emergency information from CHEMTREC at (800) 424-9300 or seek professional environmental engineering assistance from the U.S. EPA Environmental Response Team at (908) 548-8730 (24-hour response line).

Small spills (from a small package or a small leak from a large package)
First: isolate in all directions (feet/meters) 3000/1000
Then: Protect persons downwind (miles/kilometers)
Day 0.4/0.6
Night 1.5/2.4

Large spills (from a large package or from many small packages)
First: isolate in all directions (feet/meters) 2500/800
Then: Protect persons downwind (miles/kilometers)
Day 2.7/4.4
Night 5.6/8.9

Fire Extinguishing: Phosphene evolves hydrogen and ignites on contact with many materials. This chemical is a flammable gas. Hazardous decomposition includes oxides of phosphorus and phosphonic acid. Specially trained personnel may use fog lines to cool exposures and let the fire burn itself out. If material is on fire or involved in a fire, do not extinguish unless flow can be stopped; use water in flooding quantities as fog; cool all affected containers with flooding quantities of water; apply water from as far a distance as possible; solid streams of water may be ineffective; use "alcohol" foam, carbon dioxide or dry chemical. Wear full protective clothing including self-contained breathing apparatus; rubber gloves; boots, and bands around legs, arms, and waist. No skin surface should be exposed. For massive fires in cargo areas, use unmanned hose holders or monitor nozzles. Move containers from fire area. The gas is heavier than air and may travel along the ground to an ignition source. Container may explode in heat of fire. Vapors are heavier than air and will collect in low areas. Vapors are heavier than air and may travel long distances, to a source of ignition, and flash back. Closed containers may rupture violently when heated. Vapors in confined areas may explode when exposed to fire. Containers may explode in fire. Storage containers and parts of containers may rocket great distances, in many directions. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies. From a secure, explosion-proof location, use water spray to cool exposed containers. If cooling streams are ineffective (venting sound increases in volume and pitch, tank discolors, or shows any signs of deforming), withdraw immediately to a secure position. If cylinders are exposed to excessive heat from fire or flame contact, withdraw immediately to a secure location. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode.

Disposal Method Suggested: Consult with environmental regulatory agencies for guidance on acceptable disposal practices. Generators of waste containing this contaminant (≥100 kg/mo) must conform with EPA regulations governing storage, transportation, treatment, and waste disposal. In accordance with 40CFR165, follow recommendations for the disposal of pesticides and pesticide containers. Containers must be disposed of properly by following package label directions or by contacting your local or federal environmental control agency, or by contacting your regional EPA office. A potential candidate for rotary kiln incineration at a temperature range of 820 to 1,600 °C and residence times of seconds for liquids and gases, and hours for solids. A potential candidate for fluidized bed incineration at a temperature range of 450 to 980 °C and residence times of seconds for liquids and gases, and longer for solids[83]. *Warning:* Highly toxic gas, may be spontaneously flammable in air. Surplus gas or leaking cylinder can be vented slowly to air in a safe, open area or gas burnt off through a suitable burner in a fume cupboard. Recommendable methods: Evaporation & open burning. Not recommendable method: Landfill. Peer-review: Dilute with much air prior to evaporation[UN]. Once used, VAPORPH$_3$OS Phosphine fumigant cylinders are to be returned only to an authorized distributor or their designated point of return. This applies to all cylinders, regardless of the quantity of material remaining in the cylinder[83]. Controlled discharges of phosphine may be passed through 10% NAOH solution in a scrubbing tower. The product may be discharged to a sewer.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- USEPA, "Pesticide Fact Sheet, Phosphine," Washington DC, Office of Prevention, Pesticides and Toxic Substances, (December 1999). http://www.epa.gov/opprd001/factsheets/phosphine.pdf
- USEPA, Office of Pesticide Programs, Pesticide Residue Limits, "Phosphine," 40 CFR 180.225. http://www.epa.gov/pesticides/food/viewtols.htm
- New Jersey Department of Health, "Hazardous Substance Fact Sheet: Phosphine," Trenton, NJ (May 1997, rev. April 2004). http://www.state.nj.us/health/eoh/rtkweb/1514.pdf
- Sax, N. I., Ed., "Dangerous Properties of Industrial Materials Report," 6, No. 2, 103-107 (1986)

Picloram P:0710

Use Type: Herbicide

CAS Number: 1918-02-1

Formula: $C_6H_3Cl_3N_2O_2$

Synonyms: 4-Aminotrichloropicolinic acid; 4-Amino-3,5,6-trichloro-2-picolinic acid; 4-Amino-3,5,6-trichloropicolinic acid; 4-Amino-3,5,6-trichloro-2-pyridinecarboxylic acid; ATCP; NCI-C00237; NSC 233899; Picolinic acid, 4-amino-3,5,6-trichloro-; 2-Pyridine carboxylic acid, 4-amino-3,5,6-trichloro-; 3,5,6-Trichloro-4-aminopicolinic acid

Trade Names: ACCESS®; AMDON®; AMDON GRAZON®; BOROLIN®; GRAZON® Picloram; K-PIN®; PATHWAY®; TORDON®[C]; TORDON® 101 MIXTURE; TORDON® 10 K; TORDON® 22 K

Chemical class: Pyridinecarboxylic acid; Picolinic Acid; Pyridine Carboxylic acid; Pyridine; Pyralid

EPA/OPP PC Code: 005101

California DPR Chemical Code: 593

HSDB Number: 1151

UN/NA & ERG Number: Not listed

RTECS® Number: TJ7525000

EC Number: 217-636-1

Uses: Picloram is a systemic herbicide used for control of woody plants and a wide range of broad-leaved weeds along roads, power lines and long right-of-ways. Most grasses are resistant to picloram, so it is used in range management programs to control noxious weeds and brush. It is used to prepare sites for tree planting. Picloram is formulated either as an acid (technical product), a potassium or triisopropanolamine salt, or an isooctyl ester, and is available as either soluble concentrates, pellets, or granular formulations. During the Vietnam war, a herbicide named *Agent White* was used to control vegetation. It was a mixture of 2,4-D, triisopropanolamine salt and picloram. A U.S. EPA restricted Use Pesticide (RUP).

U.S. Maximum Allowable Residue Levels for Picloram [40 CFR 180.292 (a)]: Barley, grain 0.5 ppm; barley, pearled barley 3.0 ppm; barley, straw 1.0 ppm; cattle, fat 0.4 ppm; cattle, meat 0.4 ppm; cattle, meat byproducts 15 ppm; egg 0.05 ppm; goat, fat 0.4 ppm; goat, meat 0.4 ppm; goat, meat byproducts 15 ppm; grain, aspirated fractions 4.0 ppm; grass, forage 400 ppm; grass, hay 225 ppm; hog, fat 0.05 ppm; hog, meat 0.05 ppm; hog, meat byproducts 0.05 ppm; horse, fat 0.4 ppm; horse, meat 0.4 ppm; horse, meat byproducts 15 ppm; milk 0.25 ppm; oat, forage 1.0 ppm; oat, grain 0.5 ppm; oat, groats/rolled oats 3.0 ppm; oat, straw 1.0 ppm; poultry, fat 0.05 ppm; poultry, meat 0.05 ppm; poultry, meat byproducts 0.05 ppm; sheep, fat 0.4 ppm; sheep, meat 0.4 ppm; sheep, meat byproducts 15 ppm; wheat, bran 3.0 ppm; wheat, forage 1.0 ppm; wheat, germ 3.0 ppm; wheat, grain 0.5 ppm; wheat, middlings 3.0 ppm; wheat, shorts 3.0 ppm; wheat, straw 1.0 ppm.

Regulatory Authority and Advisory Information:

Carcinogenicity[83]: EPA Group E, evidence of non-carcinogenicity for humans; IARC, Group 3 not classifiable

as to its carcinogenicity in humans; ACGIH A4, not classified as a human carcinogen; NCI Carcinogen (positive, rat; negative, mouse)[9]
Acute Oral Category: 4, Caution, Not acutely toxic
Health Advisory: Mutagen, Developmental/Reproductive Toxin
Safe Drinking Water Act: MCL, 0.5 mg/L; MCLG, 0.5 mg/L; Regulated chemical (47 FR 9352) as pichloram
EPCRA Section 313 Form R *de minimis* concentration reporting level: 1.0%
European/International Regulations: Hazard Symbol: N; risk phrases: R51/53; safety phrases: S2; S60; S61 (see Appendix 1)

Description: Picloram is a fine beige crystalline solid or a white powder. Chlorine-like odor. It is probably combustible. Molecular weight = 241.46; Specific gravity (H_2O:1) = 1.083 @ 20 °C; Boiling point = (decomposes); Freezing/Melting point = (decomposes) 200–214 °C; Vapor pressure = 6.15×10^{-7} mmHg @ 35 °C. Very slight solubility in water; solubility = <0.1 mg/L @ 20 °C; 425 ppm @ 25 °C.

Incompatibilities: Picloram may be sensitive to prolonged exposure to light or UV. Aqueous solutions may be decomposed by light. Picloram is incompatible with strong oxidizing agents, strong acids, acid chlorides, and acid anhydrides. Reacts with hot concentrated alkali (hydrolyzes), strong bases. Attacks some metals in high temperatures, including mild steel.

Permissible Exposure Limits in Air: NIOSH NIOSH REL:15 mg/m^3 TWA, total dust; 5 mg/m^3 respirable fraction.
ACGIH TLV®[1]: 10 mg/m^3 TWA, 20 mg/m^3 STEL
NIOSH conducted a limited evaluation of the literature and concluded that the documentation cited by OSHA was inadequate to support the proposed PEL (as an 8-hour TWA) of 10 mg/m^3.

Determination in Air: Filter; none; Gravimetric; NIOSH IV, Particulates NOR: Method #0500 (total); Method #0600 (respirable).[18].

Permissible Concentration in Water: Federal Drinking Water Guidelines: 500 μg/L; State Drinking Water Guidelines: Arizona 49 μg/L; Minnesota 500 μg/L. Canadian Drinking Water Standards: IMAC 0.19 mg/L.

Determination in Water: Log K_{ow} = <1. Unlikely to bioaccumulate in marine organisms.

Routes of Entry: Inhalation, ingestion, skin and/or eye contact.

Harmful Effects and Symptoms

Short Term Exposure: Irritates the eyes, skin, and respiratory tract. Exposure can cause nausea. LD_{50} (oral, rat) = >8 g/kg; LD_{50} (dermal, rat) = >4 g/kg.

Long Term Exposure: Picloram should be handled as a carcinogen with extreme caution. It may damage the testes. May affect the kidneys and liver. In animals: liver, kidney changes.

Points of Attack: Eyes, skin, respiratory system, liver and kidneys. Cancer site in animals: liver, uterus, pituitary gland. May cause tumors.

Medical Surveillance: In addition to comprehensive initial medical and work histories emphasizing reproductive experience and menstrual history, patient should have physical examination and testing of genito-urinary tract, sperm count, motility and morphology. If required, other tests, such as serum testosterone, serum follicle stimulating hormone (FSH), and serum lutenizing hormone (LH), may be indicated. Preliminary medical exam to detect chronic diseases of central nervous system, liver, heart, kidneys, lung and skin, as well as endocrinological or immunological disturbances, should protect susceptible individuals. Periodical medical exams of internal organs, skin and eyes are important to avoid chronic occupational intoxications. They should include lab and patch tests when necessary[83]. Liver and kidney function test.

First Aid: If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least 15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately. If this chemical contacts the skin, remove contaminated clothing and wash immediately with soap and water. Seek medical attention immediately. If this chemical has been inhaled, remove from exposure, begin rescue breathing (using universal precautions) if breathing has stopped, and CPR if heart action has stopped. Transfer promptly to a medical facility. When this chemical has been swallowed, get medical attention. Give large quantities of water and induce vomiting. Do not make an unconscious person vomit.

Personal Protective Methods: Reacts with the following absorbent materials: Mineral-Based and Clay-Based[88]. Wear protective gloves and clothing to prevent any reasonable probability of dermal and/or eye contact. Safety equipment suppliers/manufacturers can provide recommendations on the most protective glove/clothing material for your operation. All protective clothing (suits, gloves, footwear, headgear) should be clean, available each day, and put on before work. Contact lenses should not be worn when working with this chemical. Wear dust-proof chemical goggles and face shield unless full facepiece respiratory protection is worn. Employees should wash immediately with soap when skin is wet or contaminated. Provide emergency showers and eyewash.

Respirator Selection: Wherever and whenever workplace conditions warrant respirator use, a respiratory protection program must be followed that meets one or more of the following government standards: OSHA's 29 CFR 1910.134, ANSI Z88.2, or European Standard EN 149.

Storage: Color Code-Blue: Health Hazard/Poison. Store in a tightly closed container in a dry, well-ventilated and secure poison location. Prior to working with this chemical you should be trained on its proper handling and storage. Where possible, automatically transfer material from other storage containers to process containers. Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: Dry material not listed.

Spill Handling: If a spill occurs, clean it up promptly. Don't wash it away. Instead, sprinkle the liquid spill with sawdust, vermiculite, or kitty litter. Sweep it into a plastic garbage bag, and dispose of it as directed on the pesticide product label. Wash all contaminated surfaces with a soap and water solution.

Fire Extinguishing: Hazardous decomposition includes oxides of nitrogen and carbon, hydrogen chloride and chlorine gases. As an immediate precautionary measure, isolate spill or leak area in all directions for at least 50 meters/150 feet for liquids and at least 25 meters/75 feet for solids. *Fire involving storage or vehicular tanks:* isolate for 800 meters/0.5 mile in all directions; also, consider initial evacuation for 800 meters/0.5 mile in all directions. *On a small fire:* use dry chemical, CO_2, water spray or regular foam. *On a large fire:* use water spray, fog or regular foam. Do not scatter spilled material with high-pressure streams of water. Move containers from fire area if you can do it without risk. Dike fire-control water for later disposal. *Fire involving tanks:* from a secure, explosion-proof location, use water spray to cool exposed containers. If cooling streams are ineffective (venting sound increases in volume and pitch, tank discolors, or shows any signs of deforming), withdraw immediately to a secure position. Always stay away from tanks engulfed in fire. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode.

Disposal Method Suggested: Containers must be disposed of properly by following package label directions or by contacting your local or federal environmental control agency, or by contacting your regional EPA office. Dissolve or mix the material with a combustible solvent and burn in a chemical incinerator equipped with an afterburner and scrubber. In accordance with 40CFR165, follow recommendations for the disposal of pesticides and pesticide containers.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- EXTOXNET, Extension Toxicology Network, "Pesticide Information Profile, Picloram," Oregon State University, Corvallis, OR (June 1996). http://extoxnet.orst.edu/pips/picloram.htm
- USEPA, Office of Pesticide Programs, Pesticide Residue Limits, "Picloram," 40 CFR 180.292. http://www.epa.gov/pesticides/food/viewtols.htm
- USEPA, "Health Advisory: Picloram," Washington DC, Office of Drinking Water (August 1987)
- New Jersey Department of Health, "Hazardous Substance Fact Sheet: Picloram," Trenton, NJ (May 2001). http://www.state.nj.us/health/eoh/rtkweb/1536.pdf

Piperonyl butoxide P:0775

Use Type: Insecticide synergist
CAS Number: 51-03-6
Formula: $C_{19}H_{30}O_5$
Synonyms: AI3-14250; 1,3-Benzodioxole, 5-[(2-(2-butoxyethoxy)ethoxy)methyl]-6-propyl-; Butoxide; butoxido de piperonilo (Spanish); α-[2-(2-*N*-Butoxyethoxy) ethoxy]-4,5-methylenedioxy-2-propyltoluene; α-[2-(2-Butoxyethoxy)ethoxy]-4,5-Methylenedioxy-2-propyltoluene; 5-[(2-(2-Butoxyethoxy)ethoxy)methyl]-6-propyl-1,3-benzodioxole; 2-(2-Butoxyethoxy)ethyl 6-propylpiperonyl ether; Butyl carbitol 6-propylpiperonyl ether; Butyl-carbityl (6-propylpiperonyl) ether; (Butylcarbityl)(6-propylpiperonyl) ether 80% and related compounds 20%; Caswell No. 670; ENT 14,250; (3, 4-Methylenedioxy-6-propylbenzyl) (butyl)diethylene glycol ether; 3,4-Methylenedioxy-6-propylbenzyl *N*-butyl diethyleneglycol ether; 4,5-Methylenedioxy-2-propylbenzyldiethylene glycol butyl ether; NCI-C02813; PB; Piperonyl butoxyde; 6-(Propylpiperonyl)-butyl carbityl ether; 6-Propylpiperonyl butyl diethylene glycol ether; Toluene, α-[2-(2-butoxyethoxy)ethoxy]-4,5-(methylenedioxy)-2-propyl-
Trade Names: The U.S. EPA lists 7,340 products containing this substance, 1,622 of which are active
Chemical class: Glycol ether; Cyclic aromatic
EPA/OPP PC Code: 067501
California DPR Chemical Code: 486
HSDB Number: 1755
UN/NA & ERG Number: UN2810/153
RTECS® Number: XS8050000
EC Number: 200-076-7
Uses: A U.S. EPA restricted Use Pesticide (RUP). Not listed for use in EU countries[115]. Piperonyl butoxide is a synergist, i.e., not a pesticide itself, but enhances the properties of other chemicals. It is used with other pesticides such as pyrethrins, pyrethroids, rotenone and carbamates in food and non-food agricultural products, home and garden products, termite and mosquito products, and veterinary pesticide products. It inhibits the insect's ability to break down an insecticide before it takes effect, thereby prolonging the action, and reduces the necessity for using a stronger formulation.

U.S. Maximum Allowable Residue Levels Piperonyl Butoxide [40 CFR 180.127 (a)(1)]: *Note:* 180.127 gives tolerance levels, but 180.905 says its exempt under certain circumstances. Almond, post-harvest 8 ppm; apple, post-harvest 8 ppm; barley, post-harvest 20 ppm; bean, post-harvest 8 ppm; birdseed, mixtures, post-harvest 20 ppm; blackberry, post-harvest 8 ppm; blueberry, post-harvest 8 ppm; boysenberry, post-harvest 8 ppm; buckwheat, post-harvest 20 ppm; cacao bean, post-harvest 8 ppm; cattle, fat 0.1 ppm; cattle, meat 0.1 ppm; cattle, meat byproducts 0.1 ppm; cherry, post-harvest 8 ppm; coconut, copra, post-harvest 8 ppm; corn, field, grain, post-harvest 20 ppm; corn, pop 20 ppm; cotton, undelinted seed, post-harvest 8 ppm; crabapple, post-harvest

8 ppm; currant, post-harvest 8 ppm; dewberry, post-harvest 8 ppm; egg 1 ppm; fig, post-harvest 8 ppm; flax, seed, post-harvest 8 ppm; goat, fat 0.1 ppm; goat, meat 0.1 ppm; goat, meat-by-products 0.1 ppm; gooseberry, post-harvest 8 ppm; grain, cereal, milled fractions, except flour 10 ppm; grape, post-harvest 8 ppm; guava, post-harvest 8 ppm; hog, fat 0.1 ppm; hog, meat 0.1 ppm; hog, meat byproducts 0.1 ppm; horse, fat 0.1 ppm; horse, meat 0.1 ppm; horse, meat byproducts 0.1 ppm; loganberry, post-harvest 8 ppm; mango, post-harvest 8 ppm; milk, fat 0.25 ppm; muskmelon, post-harvest 8 ppm; oat, post-harvest 8 ppm; orange, post-harvest 8 ppm; pea, post-harvest 8 ppm; peach, post-harvest 8 ppm; peanut, post-harvest 8 ppm; pear, post-harvest 8 ppm; pineapple, post-harvest 8 ppm; plum, fresh prune, post-harvest 8 ppm; potato, post-harvest 0.25 ppm; poultry, fat 3 ppm; poultry, meat 3 ppm; poultry, meat byproducts 3 ppm; processed food 10 ppm; raspberry, post-harvest 8 ppm; rice, post-harvest 20 ppm; rye, post-harvest 20 ppm; sheep, fat 0.1 ppm; sheep, meat 0.1 ppm; sheep, meat byproducts 0.1 ppm; sorghum, grain, post-harvest 8 ppm; stored feed, dried, 4% fat or less, from cotton bags 10 ppm; stored feed, dried, 4% fat or less, from paper bags 10 ppm; sweet potato, roots, post-harvest 0.25 ppm; tomato, post-harvest 8 ppm; walnut, post-harvest 8 ppm; wheat, post-harvest 20 ppm.

Regulatory Authority and Advisory Information:

Carcinogenicity[83]: EPA Group C, Possible carcinogen; IARC, Group 3 not classifiable as to its carcinogenicity in human

Health Advisory: Nerve toxin, Mutagen, Developmental/Reproductive Toxin, Endocrine disruptor (S)

Acute Oral Category: 4, Caution, Not acutely toxic

Potential Ground Water Pollutant [California FAC Section 13145(d)/12811, active]

EPCRA Section 313 Form R *de minimis* concentration reporting level: 1.0%

Clean Air Act: Hazardous Air Pollutants (Title I, Part A, Section 112) as glycol ethers

CAL Air Resources Board/AB 1807 Toxic Air Contaminants as glycol ethers

AB 2588-Air Toxics “Hot Spots” Chemicals (CAL) as glycol ethers

European/International Regulations: Hazard Symbol: T, N; risk phrases: R23; R24; R25 R40; R50/53; safety phrases: S2; S23; S26; R36; S37; S39; S45 (see Appendix 1)

Description: Light yellow to light brown liquid. Nearly odorless. Molecular weight = 338.45; Specific gravity (H_2O:1) = 1.06 @ 20 °C; Boiling point = 180 °C @ 1 mmHg. Flash point = 171 °C (oc); Specific gravity (H_2O:1) = 1.06 @ 25 °C. Henry's Law constant = 8.9×10^{-11} atm-m^3/mol @ 25 °C (est)[83]. Very slightly soluble in water.

Incompatibilities: Combustible solid. Contact with oxidizers (chlorates, nitrates, peroxides, permanganates, perchlorates, chlorine, bromine, fluorine, etc.) may cause fire and explosions. May react violently with aliphatic amines, alkalies, boranes, isocyanates, nitric acid, sulfuric acid.

Permissible Exposure Limits in Air: Protective Action Criteria (PAC) ver. 2

PAC-1: 1.2 mg/m^3
PAC-2: 13 mg/m^3
PAC-3: 1200 mg/m^3

Determination in Air:

Determination in Water: Log K_{ow} = >4.5. Values above 3.0 are likely to bioaccumulate in marine organisms.

Routes of Entry: Inhalation, ingestion, skin and/or eye contact. Absorbed through the skin.

Harmful Effects and Symptoms

Short Term Exposure: May affect you when breathed in and by passing through your skin. Contact can irritate the eyes and skin. Exposure can irritate the nose and throat. High levels of glycol ether vapor may cause central nervous system depression causing dizziness, lightheadedness, and unconsciousness. Very high levels of exposure may cause lung, liver, and kidney damage. LD_{50} (oral, rat) = >4 g/kg[83]; LD_{50} (dermal, rabbit) = >4 g/kg.

Long Term Exposure: May cause tumors. Causes skin dryness; dermatitis. May cause liver and kidney damage. May irritate the lungs; bronchitis may develop. A liver and nerve toxin.

Points of Attack: Eyes, skin, liver, respiratory system, central nervous system.

Medical Surveillance: If symptoms develop or overexposure is suspected, the following may be useful: Liver and kidney function tests. Lung function test.

First Aid: If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least 15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately. If this chemical contacts the skin, remove contaminated clothing and wash immediately with soap and water. Seek medical attention immediately. If this chemical has been inhaled, remove from exposure, begin rescue breathing (using universal precautions) if breathing has stopped, and CPR if heart action has stopped. Transfer promptly to a medical facility. When this chemical has been swallowed, get medical attention. Give large quantities of water and induce vomiting. Do not make an unconscious person vomit.

Personal Protective Methods: Applicators and other handlers must wear: Coveralls worn over long-sleeved shirt and long pants; Chemical-resistant gloves such as DuPont™ Tychem® suit fabrics, barrier laminate, or Viton®; Chemical-resistant footwear plus socks; Protective eye wear; Chemical-resistant headgear for overhead exposure; Chemical-resistant apron when cleaning equipment, mixing, or loading[83]. Agricultural Use/Engineering Controls: When handlers use closed systems, enclosed cabs, or aircraft in a manner that meets the requirements listed in the Worker Protection Standard (WPS) for agricultural pesticides, ***40 CFR 170.240(d)(4-6)***, the handler PPE requirements may be reduced or modified as specified in the Worker Protection Standard. Firefighters should wear NIOSH-approved self-contained breathing apparatus and full protective clothing.

Respirator Selection: SCBA >1.2 mg/m^3. Engineering controls should be used wherever feasible to maintain airborne concentrations of this chemical below the prescribed exposure limit. Respirators and protective equipment are less effective than engineering controls, and should be used only in non-routine or emergency situations which may result in exposure concentrations in excess of the TWA environmental limit. *Where there is no REL, at any detectable concentration:* SCBAF: Pd,Pp (APF = 10,000) (any NIOSH/MSHA- or European Standard EN 149-approved self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode); or SaF: Pd,Pp: ASCBA (APF = 10,000) (any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary, self-contained breathing apparatus operated in a pressure-demand or other positive-pressure mode). *Escape:* GmFOv100 (APF = 50) [any air-purifying, full facepiece respirator (gas mask) with a chin-style, front- or back-mounted organic vapor canister having an N100, R100, or P100 filter); or SCBAE (any appropriate escape-type, self-contained breathing apparatus).

Storage: Color Code-Blue: Health Hazard/Poison. Store in a secure poison location. Prior to working with this chemical you should be trained on its proper handling and storage. Before entering confined space where this chemical may be present, check to make sure that an explosive concentration does not exist. Piperonyl butoxide must be stored to avoid contact with strong oxidizers (such as chlorine, bromine and fluorine), chromic acid and calcium hypochlorite, since violent reactions occur. Store in tightly closed containers in a cool, well-ventilated area. If this material contains a flammable carrier, sources of ignition, such as smoking and open flames, are prohibited where it is used, handled, or stored in a manner that could create a potential fire or explosion hazard. Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: The required label is “poisonous materials.” Hazard Class is 6.1.

Spill Handling: First, remove all sources of ignition. Evacuate persons not wearing protective equipment from area of spill or leak until clean up is complete. Establish ventilation to keep levels below explosive limit. Collect powdered material in the most convenient and safe manner and deposit in sealed containers. Ventilate area after clean up is complete. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable.

Fire Extinguishing: This chemical is a combustible solid. Hazardous decomposition includes oxides of carbon. As an immediate precautionary measure, isolate spill or leak area in all directions for at least 50 meters/150 feet for liquids and at least 25 meters/75 feet for solids. *Fire involving storage or vehicular tanks:* isolate for 800 meters/0.5 mile in all directions; also, consider initial evacuation for 800 meters/0.5 mile in all directions. *On a small fire:* use dry chemical, CO_2, water spray or regular foam. *On a large fire:* use water spray, fog or regular foam. Do not scatter spilled material with high-pressure streams of water. Move containers from fire area if you can do it without risk. Dike fire-control water for later disposal. *Fire involving tanks:* from a secure, explosion-proof location, use water spray to cool exposed containers. If cooling streams are ineffective (venting sound increases in volume and pitch, tank discolors, or shows any signs of deforming), withdraw immediately to a secure position. Always stay away from tanks engulfed in fire. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode.

Disposal Method Suggested: Consult with environmental regulatory agencies for guidance on acceptable disposal practices. Incineration.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- National Pesticides Information Center (NPIC), “Fact Sheet, Piperonyl Butoxide,” Corvallis, OR (November 2000). http://npic.orst.edu/factsheets/pbogen.pdf
- USEPA, Office of Pesticide Programs, Pesticide Residue Limits, “Piperonyl Butoxide,” 40 CFR 180.127 and 40CFR 180.905. http://www.epa.gov/pesticides/food/viewtols.htm

Pirimicarb P:0785

Use Type: Insecticide

CAS Number: 23103-98-2

Formula: $C_{11}H_{18}N_4O_2$

Synonyms: Carbamic acid, dimethyl-, 2-(dimethylamino)-5,6-dimethyl-4-pyrimidinyl ester; 2-Dimethylamino-5,6-dimethyl-4-pyrimidinyl dimethylcarbamate; 2-(Dimethylamino)-5,6-dimethyl-4-pyrimidinyldimethylcarbamate; 2-Dimethylamino-5,6-dimethylpryimidin-4-yl *N,N*-dimethylcarbamate; Dimethylcarbamic acid 2-(dimethylamino)-5,6-dimethyl-4-pyrimidinyl ester; 5,6-Dimethyl-2-dimethylamino-4-pyrimidinyldimethylcarbamate; ENT 27,766

Trade Names: ABOL®; AFICIDA®; APHOX®; FERNOS®; PIRIMIKARB; PIRIMOR®; PP 062®; PYRIMOR®; RAPID®

Chemical class: Carbamate (N-methyl)

EPA/OPP PC Code: 106101

California DPR Chemical Code: 1875
HSDB Number: 7005
UN/NA & ERG Number: UN2757 (solid)/151; UN2811/154
RTECS® Number: EZ9100000
EC Number: 245-430-1[*Annex I Index No.:* 006-035-00-8]

Uses: Originally registered in the U.S. for non-food use on alfalfa grown for seed in selected. Elsewhere it is used on a wide range of cereals, potatoes, fruits, vegetables and other crop.

Regulatory Authority and Advisory Information:
Carcinogenicity[83]: EPA, Likely to be carcinogenic to humans
Health Advisory: Nerve Toxin (S!), Mutagen
Acute Oral Category: 2, WARNING
European/International Regulations: Hazard Symbol: T, N; risk phrases: R25 R50/53; safety phrases: S1/2; S22; S37; S45; S60; S61 (see Appendix 1)

Description: Colorless crystalline solid. Odorless. Commercial product may be available as a liquid. Molecular weight = 238.39; Specific gravity (H_2O:1) = 1.21 @ 20 °C; Boiling point = 370 °C; Freezing/Melting point = 90.5 °C. Vapor pressure = 9×10^{-6} mmHg @ 25 °C; Flash point = 180 °C. Soluble in water; solubility = 3 g/L. Physical and toxicological properties may be affected by carrier solvents in commercial formulations.

Incompatibilities: May react with strong oxidizers such as chlorates, peroxides, nitrates, etc. May form explosive materials with phosphorus pentachloride.

Determination in Water: FDA Method 232.4. Organophosphorus Residues General Methods for Nonfatty Foods Using Acetone Extraction and Isolation in Organic Phase. No detection limit. FDA Method 242.1. Organonitrogen Residues General Method for Nonfatty Foods Including Acetone Extraction and Isolation in Organic Phase. No detection limit. Log K_{ow} = <1.75. Unlikely to bioaccumulate in marine organisms.

Routes of Entry: Skin absorption, ingestion and inhalation.

Harmful Effects and Symptoms

Short Term Exposure: Eye pupils are small, blurred vision, eye watering, runny nose, cough, shortness of breath, salivation, nausea, stomach cramps, diarrhea, and vomiting, increased blood pressure, profuse sweating, hypermotility, hallucinations, agitation, tingling of the skin, slow heartbeat, convulsions, fluid in lungs, loss of consciousness, incontinence, breathing stops, death. Carbamates inhibit the acetylcholinesterase enzymes and alter the way in which nervous impulses are transmitted. However, within several hours carbamates spontaneously detach from the enzymes. LD_{50} (oral, rat) = 100–145 mg/kg; LD_{50} (dermal, rat) = >500[83].

Long Term Exposure: A potent acetylcholinesterase (AChE) inhibitor; cumulative effect is possible. Neurotoxic. This chemical may damage the nervous system with repeated exposure, resulting in convulsions, respiratory failure. May cause liver damage.

Points of Attack: Respiratory system, lungs, central nervous system, cardiovascular system, skin, eyes, plasma and red blood cell cholinesterase.

Medical Surveillance: Medical observation is recommended for 24 to 48 hours following breathing overexposure, as pulmonary edema may be delayed. Cigarette smoking may exacerbate pulmonary injury and should be discouraged for at least 72 hours following exposure. Routine biological monitoring of pesticide applicators and field workers includes testing of plasma and red blood cell acetylcholinesterase levels (for enzyme poisoned by this chemical). These tests are normally accurate only if done within about two hours of exposure. If exposure stops, plasma levels return to normal in 1–2 weeks while red blood cell levels may be reduced for 1–3 months. When acetylcholinesterase enzyme levels are reduced by 25% or more below preemployment levels, risk of poisoning is increased, even if results are in lower ranges of "normal." Reassignment to work not involving carbamate pesticides is recommended until enzyme levels recover. Do not drink any alcoholic beverages before or during use. Also consider complete blood count and chest x-ray following acute overexposure

First Aid: Speed in removing material from eyes and skin is of extreme importance. *Eyes:* Eye contact can cause dangerous amounts of these chemicals to be quickly absorbed through the mucous membrane into the bloodstream. Immediately and gently flush eyes with plenty of warm or cold water (NO hot water) for at least 15 minutes, occasionally lifting the upper and lower eyelids. Get medical aid immediately. *Skin:* Get medical aid. Dermal contact can cause dangerous amounts of these chemicals to be absorbed into the bloodstream. Wearing the appropriate PPE equipment and respirator for carbamate pesticides, immediately flush skin with plenty of soap and water for at least 15 minutes while removing contaminated clothing and shoes. Shampoo hair promptly if contaminated; protect eyes. *Ingestion:* Call poison control. Loosen all clothing. Never give anything by mouth to an unconscious person. Get medical aid. Do NOT induce vomiting. * If conscious, alert, and able to swallow, rinse mouth and have victim drink 4 to 8 ounces of water. Check to see if poison control instructs you to use ipecac syrup, otherwise administer slurry of activated charcoal (2 oz in 8 oz of water). If victim is *UNCONSCIOUS OR HAVING CONVULSIONS,* do nothing except keep victim warm. **In some cases you may be specifically instructed by poison control to induce vomiting by way of 2 tablespoons of syrup of ipecac (adult) washed down with a cup of water*. Do NOT give activated charcoal before or with ipecac syrup. Inhalation: Get medical aid. Do not contaminate yourself. Wearing the appropriate PPE equipment and respirator for carbamate pesticides, immediately remove the victim from the contaminated area to fresh air. If the victim is not breathing, administer artificial respiration. Do not use mouth-to-mouth method if victim ingested or inhaled the substance; give artificial respiration with the aid of a pocket mask equipped with a one-way valve or other proper respiratory medical device. If breathing is difficult, administer oxygen through bag/mask apparatus until medical help arrives. Do not leave victim unattended. *Note to physician or authorized medical personnel.* Administer atropine, 2 mg (1/30 gr) intramuscularly or intravenously as soon as any local or systemic signs or symptoms of an intoxication are noted; repeat the administration of atropine every 3 to 8 minutes until signs of atropinization (mydriasis, dry mouth, rapid pulse, hot and dry skin) occur; initiate treatment in children with 0.05 mg/kg of atropine; repeat at 5 to 10 minute intervals. Watch respiration, and remove bronchial secretions if they appear to be obstructing the airway; intubate if necessary. *Medical note:* 2-PAMCI may be contraindicated in the case of some carbamate poisoning. As first aid for pulmonary edema, a doctor or authorized paramedic might consider administering a corticosteroid spray.

Personal Protective Methods: Wear protective gloves and clothing to prevent any reasonable probability of dermal and/or eye contact. Safety equipment suppliers/manufacturers can provide recommendations on the most protective glove/clothing material for your operation. DuPont™ Tychem® suit fabrics[88]. All protective clothing (suits, gloves, footwear, headgear) should be clean, available each day, and put on before work. Contact lenses should not be worn when working with this chemical. Wear dust-proof chemical goggles and face shield unless full facepiece respiratory protection is worn. Employees should wash immediately with soap when skin is wet or contaminated. Provide emergency showers and eyewash.

Respirator Selection: SCBA >0.51 mg/m^3 NIOSH: *At concentrations above the NIOSH REL, or where there is no REL, at any detectable concentration:* SCBAF:Pd,Pp (APF = 10,000): (any self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode); or SaF:Pd,Pp:ASCBA (APF = 10,000) (any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary self-contained positive-pressure breathing apparatus). *Escape*: GmFOv100 (APF = 50) [any air-purifying, full facepiece respirator (gas mask) with a chin-style, front- or back-mounted organic vapor canister having an N100, R100, or P100 filter]; or SCBAE (any appropriate escape-type, self-contained breathing apparatus).

Storage: Color Code-Blue: Health Hazard/Poison. Store in a secure poison location. Prior to working with this chemical you should be trained on its proper handling and storage. Store in tightly closed containers in a cool, well-ventilated area away from strong alkalis (such as sodium hydroxide, sodium bicarbonate, etc.). Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: This is a liquid toxic carbamate and should be labeled "poisonous materials." It falls into Hazard Class 6.1.

Spill Handling: For liquids, isolate spill or leak area in all directions for at least 50 meters/150 feet. Increase, in the downwind direction, as necessary. Do not touch damaged containers or spilled material unless wearing appropriate protective clothing. Stop leak if you can do it without risk. Prevent entry into waterways, sewers, basements or confined areas. Cover with plastic sheet to prevent spreading. Absorb or cover with dry earth, sand or other non-combustible material and transfer to containers. Do not allow water to get inside containers.

Fire Extinguishing: Hazardous decomposition includes oxides of nitrogen and carbon. *On small fire:* use dry chemical powder, carbon dioxide, water spray, or foam. *On large fire:* use water spray, fog or alcohol -resistant foam. Do not scatter material using straight water jet streams. Dike fire-control water for later disposal; do not scatter the material. Move containers from fire area if you can do it without risk. *Fire involving storage or vehicular tanks:* isolate for 800 meters/0.5 mile in all directions; also, consider initial evacuation for 800 meters/0.5 mile in all directions. Fight fire from maximum distance or use unmanned hose holders or monitor nozzles. Do not allow water to get inside containers. Cool containers with flooding quantities of water until well after fire is out. Withdraw immediately in the case of rising sound from venting safety devices or discoloration of tank. *Always* stay away from tanks engulfed in fire. For massive fire, use unmanned hose holders or monitor nozzles; if this is impossible, withdraw from area and let fire burn. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies.

Disposal Method Suggested: Do not discharge into drains or sewers. Dispose of waste material as hazardous waste using a licensed disposal contractor to an approved landfill. Consult with environmental regulatory agencies for guidance on acceptable disposal practices. Incineration with effluent gas scrubbing is recommended. Containers must be disposed of properly by following package label directions or by contacting your local or federal environmental control agency, or by contacting your regional EPA office.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- USEPA, Office of Pesticide Programs, "Pesticide Fact Sheet, Pirimicarb." http://www.epa.gov/opprd001/factsheets/pirimicarb.pdf
- Pesticide Management Education Program, "Pirimicarb (Pirimor) Chemical Profile 4/85," Cornell University, Ithaca, NY (April 1985). http://pmep.cce.cornell.edu/profiles/insect-mite/mevinphos-propargite/pirimicarb/insect-prof-pirimicarb.html
- New Jersey Department of Health and Senior Services, "Hazardous Substance Fact Sheet, Pirimicarb," Trenton, NJ (March 1989, rev. January 2001). http://www.state.nj.us/health/eoh/rtkweb/1544.pdf

Pirimiphos-methyl P:0791

Use Type: Insecticide, Acaricide

CAS Number: 29232-93-7

Formula: $C_{11}H_{20}N_3O_3PS$

Synonyms: AI3-27699; Caswell No. 334B; *O*-[2-(Diethylamino]-6-methyl-4-pyrimidinyl) *O,O*-dimethyl phosphorothioate; *O*-(2-Diethylamino-6-methylpyrimidin-4-yl) *O,O*-dimethyl phosphorothioate; *O*-[2-(Diethylamino)-6-methyl-4-pyrimidinyl]-*O,O*-dimethyl phosphorothioate; 2-Diethylamino-6-methylpyrimidin-4-yl dimethyl phosphorothionate; *O,O*-Dimethyl-*O*-[2-(diethylamino)-6-methyl-4-pyrimidinyl]; *O,O*-Dimethyl *O*-[2-(diethylamino)-6-methyl-4-pyrimidinyl]phosphorothioate; ENT 27699GC; Methylpirimiphos; Methylpyrimiphos; Phosphorothioic acid, *O*-[2-(Diethylamino)-6-methyl-4-pyrimidinyl] *O,O*-dimethyl ester; 4-Pyrimidinol, 2-(diethylamino)-6-methyl-, *O*-ester with *O,O*-dimethyl phosphorothioate; Pyridimine phosphate

Trade Names: ACTELLIC®; ACTELLIFOG®; BLEX®; ENT 27699Gc®; DOMINATOR® EAR TAG; DOUBLE BARREL® EAR TAG; PLANT PROTECTION PP511®; PP511®; SILOSAN®; SYBOL®; TOMAHAWK®[C]

Chemical class: Organophosphate

EPA/OPP PC Code: 108102; (334300 old EPA code number)

California DPR Chemical Code: 2217

HSDB Number: 6984

UN/NA & ERG Number: UN2783 (solid)/152; UN3018 (liquid)/152

RTECS® Number: TF1410000

EC Number: 249-528-5 [*Annex I Index No.:*015-134-00-5]

Uses: Pirimiphos-methyl is a post-harvest insecticide used to control a variety of insects in stored grain products and seed such as corn, rice, wheat and sorghum. It is also incorporated into cattle ear tags, and used for the fogging treatment of iris bulbs and pre-harvest clean up of fruits and vegetables.

U.S. Maximum Allowable Residue Levels Pirimiphos-methyl [40 CFR 180.409(a)]: Cattle, fat 0.02 ppm; cattle, meat byproducts 0.02 ppm; corn, field, grain 8.0 ppm; corn, pop, grain 8.0 ppm; goat, fat 0.02 ppm; goat, meat byproducts 0.02 ppm; grain, aspirated fractions 20.0 ppm; hog, fat 0.02 ppm; hog, meat byproducts 0.02 ppm; horse, fat 0.02 ppm; horse, meat byproducts 0.02 ppm; poultry, fat 0.02 ppm; sheep, fat 0.02 ppm; sheep, meat byproducts 0.02 ppm; sorghum, grain, grain 8.0 ppm.

Regulatory Authority and Advisory Information:

Carcinogenicity[83]: EPA, Not yet determined

Acute Oral Category: 3, CAUTION.

Health Advisory: Nerve Toxin, Mutagen, Reproduction Hazard, Skin sensitizer

DOT Inhalation Hazard Chemicals as organophosphates

EPCRA Section 313 Form R *de minimis* concentration reporting level: 1.0%

European/International Regulations: Hazard Symbol: Xn, N; risk phrases: R22; R50/53; safety phrases: S2; S60; S61 (see Appendix 1)

WGK (German Aquatic Hazard Class): 3-Severe hazard to waters

Description: Light yellow, straw colored, or amber oily liquid. Odorless when pure. Molecular weight = 305.33; 274.4; Specific gravity (H_2O:1) = 1.17 @ 20 °C; Freezing/Melting point = 21 °C; Boiling point = (decomposes) 387 °C; Specific gravity (H_2O:1) = 1.157 @ 30 mmHg; Vapor pressure = 3.8×10^{-6} mmHg @ 25 °C; Flash point = 45 °C. Henry's Law constant = 6.0×10^{-7} atm-m^3/mol @ 25 °C (est)[83]. Slightly soluble in water; solubility = ~15 mg/L @ 25 °C.

Incompatibilities: May react violently with antimony(V) pentafluoride. Incompatible with strong acids and alkalies, lead diacetate, magnesium, silver nitrate. In the presence of strong reducing agents such as hydrides, organophosphates form highly toxic and flammable phosphine gas. Contact with oxidizers can cause the release of toxic oxides of phosphorus.

Determination in Air: OSHA versatile sampler-2; Toluene/Acetone; Gas chromatography/Flame ionization detection; NIOSH IV, Method #5600, Organophosphorus Pesticides.[18]

Determination in Water: Log K_{ow} = >4.0. Values above 3.0 are likely to bioaccumulate in marine organisms.

Routes of Entry: Inhalation, ingestion, through the skin.

Harmful Effects and Symptoms

Short Term Exposure: Eye pupils are small; blurred vision; eye watering; runny nose; cough; shortness of breath; salivation; dizziness; nausea, stomach cramps, diarrhea, and vomiting; increased blood pressure; profuse sweating; hypermotility, hallucinations; irritability; tingling of the skin; drowsiness; slow heartbeat; convulsions; fluid in lungs; loss of consciousness; incontinence; breathing stops; death. Organophosphates inhibit the action of acetylcholinesterase enzymes, and alter the way in which nervous impulses are transmitted. The effects can last for hours, days, or much longer. The action of the enzymes is reestablished after new enzymes are formed. LD_{50} (oral, rat) = 1200–1400 mg/kg; LD_{50} (dermal, rat) = >1900 mg/kg.

Long Term Exposure: Cholinesterase inhibitor; cumulative effect is possible. Organophosphates may damage the nervous system with repeated exposure, resulting in convulsions, respiratory failure. May cause liver damage. May cause contact dermatitis.

Points of Attack: Respiratory system, skin, central nervous system, cardiovascular system, blood cholinesterase. Evaluation by a qualified allergist, including exposure history and testing, may help diagnose allergy.

Medical Surveillance: Medical observation is recommended for 24 to 48 hours following breathing overexposure, as pulmonary edema may be delayed. As first aid for pulmonary edema, a doctor or authorized paramedic might consider administering a corticosteroid spray. Cigarette smoking may exacerbate pulmonary injury and should be discouraged for at least 72 hours following exposure. Routine biological monitoring of pesticide applicators and field workers includes testing of plasma and red blood cell acetylcholinesterase levels (for enzyme poisoned by this chemical). These tests are normally accurate only if done within about two hours of exposure. If exposure stops, plasma levels return to normal in 1–2 weeks while red blood cell levels may be reduced for 1–3 months. When acetylcholinesterase enzyme levels are reduced by 25% or more below preemployment levels, risk of poisoning is increased, even if results are in lower ranges of "normal." Reassignment to work not involving organophosphate pesticides is recommended until enzyme levels recover. Do not drink any alcoholic beverages before or during use as it promotes absorption of organophosphates. Evaluation by a qualified allergist, including exposure history and testing, may help diagnose allergy. In addition to comprehensive initial medical and work histories emphasizing reproductive experience and menstrual history, patient should have physical examination and testing of genito-urinary tract, sperm count, motility and morphology. If required, other tests, such as serum testosterone, serum follicle stimulating hormone (FSH), and serum lutenizing hormone (LH), may be indicated.

First Aid: Speed in removing material from eyes and skin is of extreme importance. Eye contact can cause dangerous amounts of these chemicals to be quickly absorbed through the mucous membrane into the bloodstream. Immediately and gently flush eyes with plenty of warm or cold water (NO hot water) for at least 15 minutes, occasionally lifting the upper and lower eyelids. Get medical aid immediately. *Skin:* Get medical aid. Dermal contact can cause dangerous amounts of these chemicals to be absorbed into the bloodstream. Wearing the appropriate PPE equipment and respirator for organophosphate pesticides, immediately flush skin with plenty of soap and water for at least 15 minutes while removing contaminated clothing and shoes. Shampoo hair promptly if contaminated. *Ingestion:* Call poison control. Loosen all clothing. Never give anything by mouth to an unconscious person. Get medical aid. Do NOT induce vomiting. * If conscious, alert, and able to swallow, rinse mouth and have victim drink 4 to 8 ounces of water do NOT induce vomiting but immediately administer slurry of activated charcoal (2 oz in 8 oz of water). If victim is *unconscious or having convulsions,* do nothing except keep victim warm. **In some cases you may be specifically instructed by poison control to induce vomiting by way of 2 tablespoons of syrup of ipecac (adult) washed down with a cup of water*. Do NOT give activated charcoal before or with ipecac syrup. *Inhalation:* Get medical aid. Do not contaminate yourself. Wearing the appropriate PPE equipment and respirator for organophosphate pesticides, immediately remove the victim from the contaminated area to fresh air. If the victim is not breathing, administer artificial respiration. Do not use mouth-to-mouth method if victim ingested or inhaled the substance; give artificial respiration with the aid of a pocket mask equipped with a one-way valve or other proper respiratory medical device. If breathing is difficult, administer oxygen through bag/mask apparatus until medical help arrives. Do not leave victim unattended. *Note to physician or authorized medical personnel.* Administer atropine, 2 mg (1/30 gr) intramuscularly or intravenously as soon as any local or systemic signs or symptoms of an intoxication are noted; repeat the administration of atropine every 3 to 8 minutes until signs of atropinization (mydriasis, dry mouth, rapid pulse, hot and dry skin) occur; initiate treatment in children with 0.05 mg/kg of atropine; repeat at 5 to 10 minute intervals. Watch respiration, and remove bronchial secretions if they appear to be obstructing the airway; intubate if necessary. *Notes to physician or authorized medical personnel*: *N*-methylpyridinium-2-aldoxime (2-PAMCI) when used in conjunction with atropine reacts with the phosphorylated cholinesterase, thereby restoring normal activity to by removing the phosphorylating group. The combination of these two chemicals is synergistic and must be administered within minutes to a few hours following exposure (depending on the specific agent) to be effective. Give 2-PAMCI (Pralidoxime; Protopam), 2.5 g in 100 ml of sterile water or in 5% dextrose and water, intravenously, slowly, in 15–30 minutes; if sufficient fluid is not available, give 1 g of 2-PAMCI in 3 ml of distilled water by deep intramuscular injection; repeat this every half hour if respiration weakens or if muscle fasciculation or convulsions recur. Also diazepam, an anticonvulsant, might be considered

Personal Protective Methods: Wear protective gloves and clothing to prevent any reasonable probability of dermal and/or eye contact. Safety equipment suppliers/manufacturers can provide recommendations on the most protective glove/clothing material for your operation. One recommendation is the use of DuPont™ Tychem® suit fabrics[88]. All protective clothing (suits, gloves, footwear, headgear) should be clean, available each day, and put on before work. Contact lenses should not be worn when working with this chemical. Wear splash-proof chemical goggles and face shield unless full facepiece respiratory protection is worn. Employees should wash immediately with soap when skin is wet or contaminated. Provide emergency showers and eyewash.

Respirator Selection: Engineering controls should be used wherever feasible to maintain airborne concentrations of this chemical below the prescribed exposure limit. Respirators and protective equipment are less effective than engineering controls, and should be used only in non-routine or emergency situations which may result in exposure concentrations in excess of the TWA environmental limit. *At any concentrations above the NIOSH REL, or where there is no REL, at any detectable concentration:* SCBAF: Pd,Pp (APF = 10,000) (any NIOSH/MSHA- or European Standard EN 149-approved self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode); or SaF: Pd,Pp: ASCBA (APF = 10,000) (any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary, self-contained breathing apparatus operated in a pressure-demand or other positive-pressure mode).

Storage: Color Code-Blue: Health Hazard/Poison. Store at 2–8 °C in a secure poison location. Prior to working with this chemical you should be trained on its proper handling and storage. Where possible, automatically transfer material from other storage containers to process containers. Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: Organophosphorus pesticides, solid or liquid (nonflammable), require a "poisonous materials" label. This chemical falls in Hazard Class 6.1.

Spill Handling: First remove all sources of ignition. Evacuate persons not wearing protective equipment from area of spill or leak until clean up is complete. Stay upwind; keep out of low areas. Ventilate area of spill or leak. Remove and isolate contaminated clothing at the site. Do not touch spilled material; stop leak if you can do so without risk. Use water spray to reduce vapors. *Small spills:* absorb with sand or other noncombustible absorbent material and place into containers for later disposal. *Large spills:* dike far ahead of spill for later disposal. Collect powdered material in the most convenient and safe manner and deposit in sealed containers. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable. Seek professional environmental engineering assistance from the U.S. EPA Environmental Response Team at (908) 548-8730 (24-hour response line).

Fire Extinguishing: Decomposes >120 °C. Hazardous decomposition includes oxides of phosphorus, sulfur, and nitrogen. May be fatal if inhaled, ingested or absorbed through skin. Inhalation or contact with some of these materials will irritate or burn skin and eyes. Vapors may cause dizziness or suffocation. *Small fires:* dry chemical, carbon dioxide; water spray; or foam. *Large fires:* water spray, fog, or foam. Stay upwind; keep out of low areas. Ventilate closed spaces before entering them. Firefighting gear (including SCBA) may not provide adequate protection. If exposure occurs, remove and isolate gear immediately and thoroughly decontaminate personnel. Wear positive-pressure breathing apparatus and special protective clothing. Remove and isolate contaminated clothing at the site. Move container from fire area if you can do so without risk. Fight fire from maximum distance. Dike fire-control water for later disposal; do not scatter the material. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies. From a secure, explosion-proof location, use water spray to cool exposed containers. If cooling streams are ineffective (venting sound increases in volume and pitch, tank discolors, or shows any signs of deforming), withdraw immediately to a secure position. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode.

Disposal Method Suggested: Destruction by alkali hydrolysis or incineration. Containers must be disposed of properly by following package label directions or by contacting your local or federal environmental control agency, or by contacting your regional EPA office.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- USEPA, Office of Pesticide Programs, Pesticide Residue Limits, "Pirimiphos-methyl," 40 CFR 180.409. http://www.epa.gov/pesticides/food/viewtols.htm
- International Programme on Chemical Safety (IPCS), "Data Sheets on Pesticides, Pirimiphos-methyl," Geneva, Switzerland (January 1983). http://www.inchem.org/documents/pds/pds/pest49_e.htm
- Pesticide Management Education Program, "Pirimiphos-methyl (Actellic) Chemical Fact Sheet 6/85," Cornell University, Ithaca, NY (June 1985). http://pmep.cce.cornell.edu/profiles/insect-mite/mevinphos-propargite/pirimiphos-methyl/insect-prof-actellic.html
- USEPA, "Interim Reregistration Eligibility Decision (IRED) Facts, Pirimiphos-Methyl," Office of Prevention, Pesticides and Toxic Substances, Washington DC (January 2003). http://www.epa.gov/REDs/factsheets/pirimiphosmethyl_ired_fs.htm

Primisulfuron-methyl P:1015

Use Type: Herbicide

CAS Number: 86209-51-0

Formula: $C_{15}H_{12}F_4N_4O_7S$

Synonyms: Benzoic acid, 2-[((((4,6-bis(difluoromethoxy)-2-pyrimidinyl)amino)carbonyl)amino) sulfonyl]-, methyl ester; 3-[4,6-Bis(difluoromethoxy)-pyrimidin-2-yl]-1-(methoxycarbonylphenylsulfonyl) urea; *N*-(2-Methoxycarbonylphenylsulfonyl)-*N*-[4,6-bis(difluoromethoxy)pyrimidin-2-yl]urea; Methyl-2-[((((4,6-bis(difluoromethoxy)-2-pyrimidinyl)amino) carbonyl)amino) sulfonyl]benzoate

Trade Names: BEACON®; CGA 136,872®; EXCEED®; NORTHSTAR®; RIFLE®[C]; SPIRIT®; TELL®

Chemical class: Sulfonylurea

EPA/OPP PC Code: 128973

California DPR Chemical Code: 5103

HSDB Number: 7062

UN/NA & ERG Number: UN3077 (solid)/171; UN3082 (liquid)/171

RTECS® Number: DG4436000

EC Number: Not assigned

Uses: A broad-spectrum herbicide. Actively registered for use in the U.S. Not approved for use in EU countries[115]. There are 14 global suppliers[97].

U.S. Maximum Allowable Residue Levels for Primisulfuron-methyl (40 CFR 180.452): corn, grain and milk: 0.02 ppm: cattle, fat; cattle, meat; cattle, meat-by-products; corn, forage; corn, stover; corn, sweet, kernel plus cob with husks removed; egg; goat, fat; goat, meat; goat, meat-by-products; hog, fat; hog, meat; hog, meat-by-products; horse, fat; horse, meat; horse, meat-by-products; poultry, fat; poultry, meat; poultry, meat-by-products; sheep, fat;sheep, meat; sheep, meat-by-products: 0.1 ppm

Regulatory Authority and Advisory Information:

Carcinogenicity[83]: EPA Group D, Not classifiable as a human carcinogen

Acute Oral Category: 4, Caution

Description: Colorless crystalline solid. Commercial products include wettable granules in water soluble packets. Molecular weight = 468.35; Specific gravity (H_2O:1) = 1.608 @ 20 °C; Freezing/Melting point = 195–203 °C; Vapor pressure = 4×10^{-7} mmHg @ 25 °C. Practically insoluble in water.

Determination in Water: . Log K_{ow} = <1.6. Unlikely to bioaccumulate in marine organisms.

Routes of Entry: Inhalation, dermal contact, ingestion.

Harmful Effects and Symptoms: Human health effects from the sulfonylurea herbicides at low environmental doses or at biomonitored levels from low environmental exposures are unknown. The sulfonylurea herbicides are generally of low toxicity in mammalian studies. Animal studies showed low acute toxicity and little chronic, reproductive, or developmental toxicity or teratogenic effects. Developmental or teratogenic effects tended only to occur at high or maternally toxic doses. At high sublethal, chronic oral doses, such nonspecific effects as weight loss and anemia were observed. Some chemical-specific effects were noted at high doses in animals[96].

Short Term Exposure: May cause skin and eye irritation. Moderately poisonous if ingested or inhaled. High levels may cause headache, nausea, vomiting, diarrhea; confusion; electrolyte depletion may occur in some cases. LD_{50} (oral, rat) = >5 g/kg; LD_{50} (dermal, rat) = >2 g/kg.

Long Term Exposure: Fluorides may cause bone disease (pain and tenderness of the bones); mottled teeth in children. May cause liver and kidney problems. Chronic exposure may cause weight loss, protein metabolism problems and moderate emphysema. May cause chronic nephritis, testicular atrophy, tooth and bone growth disorders[EXTOXNET, 1996; Kamrin, 1997].

Points of Attack: Bones, teeth, kidneys, testes.

Medical Surveillance: Preliminary medical exam to detect chronic diseases of central nervous system, liver, heart, kidneys, lung and skin, as well as endocrinological or immunological disturbances, should protect susceptible individuals. Periodical medical exams of internal organs, skin and eyes are important to avoid chronic occupational intoxications. They should include lab and patch tests when necessary[83]. Urinary levels of the sulfonylurea herbicides reflect recent exposure. There is very limited information on the biomonitoring of sulfonylurea herbicides or their metabolites. Detection of the metabolites may reflect exposure to more than one particular sulfonylurea herbicide or from exposure to environmental degradation products. The urinary metabolites dimethoxypyrimidine and dimethylpyrimidine can be used as nonspecific markers of exposure to the pyrimidinylsulfonylureas, a group that includes bensulfuron-methyl,[41] primisulfuron-methyl, and sulfosulfon. The urinary metabolite methoxymethyl triazine can be used as a nonspecific marker of exposure to the triazinylsulfonylureas, a group that includes chlorosulfuron, prosulfuron, and triasulfuron[96].

First Aid: If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least 15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately. If this chemical contacts the skin, remove contaminated clothing and wash immediately with soap and water. Seek medical attention immediately. If this chemical has been inhaled, remove from exposure, begin rescue breathing (using universal precautions) if breathing has stopped, and CPR if heart action has stopped. Transfer promptly to a medical facility. When this chemical has been swallowed, get medical attention. Give large quantities of water and induce vomiting. Do not make an unconscious person vomit.

Personal Protective Methods: Applicators and other handlers must wear: Coveralls worn over long-sleeved shirt and long pants; Chemical-resistant gloves such as DuPont™ Tychem® suit fabrics, barrier laminate, or Viton®; Chemical-resistant footwear plus socks; Protective eye wear; Chemical-resistant headgear for overhead exposure; Chemical-resistant apron when cleaning equipment, mixing, or loading[83]. Agricultural Use/Engineering Controls: When handlers use closed systems, enclosed cabs, or aircraft in a manner that meets the requirements listed in the Worker Protection Standard (WPS) for agricultural pesticides, ***40 CFR 170.240(d)(4-6)***, the handler PPE requirements may be reduced or modified as specified in the Worker Protection Standard. Firefighters should wear NIOSH-approved self-contained breathing apparatus and full protective clothing.

Respirator Selection: Wherever and whenever workplace conditions warrant respirator use, a respiratory protection program must be followed that meets one or more of the following government standards: OSHA's 29 CFR 1910.134, ANSI Z88.2, or European Standard EN 149.

Storage: Color Code-Blue: Health Hazard/Poison: Store in a tightly closed container in a dry, well-ventilated and secure poison location. Prior to working with this chemical you should be trained on its proper handling and storage. Where possible, automatically transfer material from other storage containers to process containers. Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: May be classified as Environmentally hazardous substances, solid, n.o.s. It usually falls in Hazard Class 9.

Spill Handling: Dampen the spilled material with water. Clean up with dampened absorbent paper and transfer material to a suitable trash container. Seal the absorbent paper and your clothing in a vapor-tight plastic bag for eventual disposal. Wash all contaminated surfaces with a soap and water solution. Do not reenter the contaminated area until and expert verifies that the area has been properly cleaned.

Fire Extinguishing: Hazardous decomposition includes oxides of nitrogen, sulfur, carbon and hydrogen fluoride gas. As an immediate precautionary measure, isolate spill or leak area in all directions for at least 50 meters/150 feet for liquids and at least 25 meters/75 feet for solids. *Fire involving storage or vehicular tanks:* isolate for 800 meters/0.5 mile in all directions; also, consider initial evacuation for 800 meters/0.5 mile in all directions. *On a small fire:* use dry chemical, CO_2, water spray or regular foam. *On a large fire:* use water spray, fog or regular foam. Do not scatter spilled material with high-pressure streams of water. Move containers from fire area if you can do it without risk. Dike fire-control water for later disposal. *Fire involving tanks:* from a secure, explosion-proof location, use water spray to cool exposed containers. If cooling streams are ineffective (venting sound increases in volume and pitch, tank discolors, or shows any signs of deforming), withdraw immediately to a secure position. Always stay away from tanks engulfed in fire. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode.

Disposal Method Suggested: Do not discharge into drains or sewers. Dispose of waste material as hazardous waste using a licensed disposal contractor to an approved landfill. Consult with environmental regulatory agencies for guidance on acceptable disposal practices. Incineration with effluent gas scrubbing is recommended. Containers must be disposed of properly by following package label directions or by contacting your local or federal environmental control agency, or by contacting your regional EPA office.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- USEPA, Office of Pesticide Programs, Pesticide Residue Limits, "Primisulfuron-methyl," 40 CFR 180. http://www.epa.gov/pesticides/food/viewtols.htm
- EXTOXNET, Extension Toxicology Network, "Pesticide Information Profile, Primisulfuron-methyl," Oregon State University, Corvallis, OR (June 1996). http://extoxnet.orst.edu/pips/primisul.htm
- USEPA, FQPA Tolerance Reassessment Progress and Interim Risk Management Decision (TRED) for Primisulfuron-methyl (July 2002). http://www.epa.gov/REDs/factsheets/primisulfuron_tred_fs.htm

Prochloraz P:1022

Use Type: Fungicide

CAS Number: 67747-09-5

Formula: $C_{15}H_{16}Cl_3N_3O_2$

Synonyms: *N*-Propyl-*N*-[2-(2,4,6-trichlorophenoxy) ethyl]imidazole-1-carboxamide; *N*-Propyl-*N*-(2,4,6-trichlorophenoxy)ethyl-imidazole-1-carboxamide; 1-(*N*-Propyl-*N*-[2-(2,4,6-trichlorophenoxy)ethyl]carbamoyl imidazole; *N*-Propyl-*N*-[2-(2,4,6-trichlorophenoxy) ethyl]-1 h-imidazole-1-carboxamid

Trade Names: ASCURIT®; BTS40542®; DIBAVIT®; EYETAK®; FORTAK®; FUNCHLORAZ®; GRAIL®; MASTER®; MIRAGE®; MIRAGE® 40 EC; PORAZ®; SPORGON®; SPORTAK®; SPORTAKALPHA®; SPORTAKDELTA®

Chemical class: Imidazole; Azole

EPA/OPP PC Code: 128851

California DPR Chemical Code: 6100

UN/NA&ERG Number: UN3077 (solid)/171; UN3082 (liquid)/171

RTECS® Number: NI4000400

EC Number: 266-994-5 [*Annex I Index No.:* 613-128-00-2]

Uses: Plocloraz is fungicide that has shown to be effective against cereal powdery mildew. Not approved for use in EU countries[115]. Not registered for use in the U.S. There are 26 global suppliers[97].

Regulatory Authority and Advisory Information:

Carcinogenicity: EPA Group C, Possible carcinogen; IARC: Group 2b, Possible human carcinogen

Acute Oral Category: 3, CAUTION

Hazard Symbols Xn; N; Risk Codes: R22; (Carcinogen Category 3) R40; R50/53; (Reproduction Category 3)R63; Safety Description S2; S60; S61

Description: Red crystalline solid. Commercial product is available as an emulsifiable concentrate. Molecular Weight = 376.67; Specific gravity (H_2O:1) = 1.4 @20 °C; Boiling point = (decomposes); Melting point = 46.5 °C; Vapor pressure = 4×10^{-10} mmHg @ 25 °C. Low solubility in water; solubility = 25 mg/L.

Incompatibilities: Oxidizers. Decomposition starts >200 °C.

Permissible Concentration in Water: Runoff from spills or fire control may cause water pollution.

Determination in Water: Log K_{ow} = >4.0.Values above 3.0 are likely to bioaccumulate in aquatic organisms.

Permissible Exposure Limits in Air:

Routes of Entry: Inhalation, ingestion, skin, eyes.

Harmful Effects and Symptoms

Short Term Exposure: May cause irritation to the skin, eyes, and respiratory tract. Harmful if ingested. LD_{50} (oral, rat) = <2000 mg/kg; LD_{50} (dermal, rat) = >5 g/kg.

Long Term Exposure: Possible liver toxin. Suspected reproductive toxin; may impair the reproductive capabilities in men and/or women.

Points of Attack: Liver, reproductive system.

Medical Surveillance: In addition to comprehensive initial medical and work histories emphasizing reproductive experience and menstrual history, patient should have physical examination and testing of genito-urinary tract, sperm count, motility and morphology. If required, other tests, such as serum testosterone, serum follicle stimulating hormone (FSH), and serum lutenizing hormone (LH), may be indicated. Liver function tests.

First Aid: If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least 15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately. If this chemical contacts the skin, remove contaminated clothing and wash immediately with soap and water. Seek medical attention immediately. If this chemical has been inhaled, remove from exposure, begin rescue breathing (using universal precautions) if breathing has stopped, and CPR if heart action has stopped. Transfer promptly to a medical facility. When this chemical has been swallowed, get medical attention. Give large quantities of water and induce vomiting. Do not make an unconscious person vomit. Do not induce vomiting when formulations containing petroleum solvents are ingested.

Personal Protective Methods: Wear protective gloves and clothing to prevent any reasonable probability of dermal and/or eye contact. Safety equipment suppliers/manufacturers can provide recommendations on the most protective glove/clothing material for your operation. All protective clothing (suits, gloves, footwear, headgear) should be clean, available each day, and put on before work. Contact lenses should not be worn when working with this chemical. Wear dust-proof chemical goggles and face shield unless full facepiece respiratory protection is worn. Employees should wash immediately with soap when skin is wet or contaminated. Provide emergency showers and eyewash. For emergency situations, wear a positive-pressure, pressure-demand, full facepiece self-contained breathing apparatus (SCBA); or pressure-demand supplied-air respirator with escape SCBA and a fully encapsulating, chemical resistant suit.

Respirator Selection: May react with mineral or clay based absorbents. Follow regulations in OSHA 29CFR1910.134 or European Standard EN149. Use a NIOSH/MSHA- or European Standard EN149-approved respirator; or use an approved supplied-air respirator with a full facepiece operated in the positive-pressure mode, or with a full facepiece, hood, or helmet in the continuous-flow mode; or use a NIOSH/MSHA- or European Standard EN149-approved self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive-pressure mode.

Storage: Color Code-Blue: Health Hazard/Poison: Store in a secure poison location. Prior to working with this chemical you should be trained on its proper handling and storage. Store in tightly closed containers in a cool, well- ventilated area. Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: Environmentally hazardous substances, solid or liquid, usually fall in Hazard Class 9.

Spill Handling: First remove all sources of ignition. Evacuate persons not wearing protective equipment from area of spill or leak until clean up is complete. Do not touch spilled material; stop leak if you can do so without risk. Use water spray to reduce vapors. *Small spills*: absorb with sand or other noncombustible absorbent material and place into containers for later disposal. *Small dry spills*: with clean shovel place material into clean, dry container and cover; move containers from spill area. *Large spills*: dike far ahead of spill for later disposal. Ventilate area after clean up is complete. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable.

Fire Extinguishing: When heated to decomposition, above 200 °C, this material releases toxic fumes of nitrogen oxides, carbon oxides, and hydrogen chloride gas. As an immediate precautionary measure, isolate spill or leak area in all directions for at least 50 meters/150 feet for liquids and at least 25 meters/75 feet for solids. *Fire involving storage or vehicular tanks:* isolate for 800 meters/0.5 mile in all directions; also, consider initial evacuation for 800 meters/0.5 mile in all directions. *On a small fire:* use dry chemical, CO_2, water spray or regular foam. *On a large fire:* use water spray, fog or regular foam. Do not scatter spilled material with high-pressure streams of water. Move containers from fire area if you can do it without risk. Dike fire-control water for later disposal. *Fire involving tanks:* from a secure, explosion-proof location, use water spray to cool exposed containers. If cooling streams are ineffective (venting sound increases in volume and pitch, tank discolors, or shows any signs of deforming), withdraw immediately to a secure position. Always stay away from tanks engulfed in fire. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode.

Disposal Method Suggested: In accordance with 40CFR 165 recommendations for the disposal of pesticides and pesticide containers. Containers must be disposed of properly by following package label directions or by contacting your local or federal environmental control agency, or by contacting your regional EPA office.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- United States Environmental Protection Agency, *Integrated Risk Information System (IRIS) Prochloraz*, Washington DC (FR 61(79):17960-18011, April 23, 1996) http://www.epa.gov/iris/subst/0378.htm

Profenofos P:1025

Use Type: Insecticide, Acaricide, Miticide

CAS Number: 41198-08-7

Formula: $C_{11}H_{15}BrClO_3PS$

Synonyms: A13-29236; *O*-(4-Bromo-2-chlorophenyl)-*O*-ethyl-*S*-propylphosphorothioate; Caswell No. 266AA; CGA 15,324; Phosphorothioic acid, *O*-(4-bromo-2-chlorophenyl)-*O*-ethyl-*S*-propyl ester

Trade Names: CGA-15324®; CURACRON®; POLYCRON®; SELECRON®

Chemical class: Organophosphate

EPA/OPP PC Code: 111401; (210700 old EPA code number)

California DPR Chemical Code: 2042

HSDB Number: 6992

UN/NA & ERG Number: UN2783 (solid)/152; UN3018 (liquid)/152

RTECS® Number: TE9675000

EC Number: 255-255-2 [*Annex I Index No.:* 015-135-00-0]

Uses: Profenofos is A U.S. EPA restricted Use Pesticide (RUP) used solely on cotton to control a number of pests including tobacco budworm, cotton aphid and bollworm, armyworm, fleahopper and whiteflies. It is not registered for residential use. Not approved for use in EU countries[115]. Registered for use in the U.S.

U.S. Maximum Allowable Residue Levels for Profenofos and its metabolites converted to 4-bromo-2-chlorophenyl and calculated as profenofos [40 CFR 180.404 (a)]: in or on the following food commodities cattle, fat 0.05 ppm; cattle, meat byproducts 0.05 ppm; cattle, meat 0.05 ppm; cottonseed 3.0 ppm; cottonseed hulls 6.0 ppm; eggs 0.05 ppm; goats, fat 0.05 ppm; goats, meat byproducts 0.05 ppm; goats, meat 0.05 ppm; hogs, fat 0.05 ppm; hogs, meat byproducts 0.05 ppm; hogs, meat 0.05 ppm; horses, fat 0.05 ppm; horses, meat byproducts 0.05 ppm; horses, meat 0.05 ppm; milk 0.01 ppm; poultry, fat 0.05 ppm; poultry, meat byproducts 0.05 ppm; poultry, meat 0.05 ppm; sheep, fat 0.05 ppm; sheep, meat byproducts 0.05 ppm; sheep, meat 0.05 ppm.

Human toxicity (long-term) ***[101]:*** 0.35 ppb, Health Advisory.

Fish toxicity (threshold)[101]: 3.0 ppb, MATC (Maximum Acceptable Toxicant Concentration).

Regulatory Authority and Advisory Information:

Carcinogenicity[83]: EPA Group E, evidence of non-carcinogenicity for humans

Health Advisory: Nerve Toxin, Mutagen, Developmental/Reproductive Toxin

Acute Oral Category: 2, WARNING

EPCRA Section 313 Form R *de minimis* concentration reporting level: 1.0%

DOT Inhalation Hazard Chemicals as organophosphates

European/International Regulations: Hazard Symbol: Xn, N; risk phrases: R20/21/22; R50/53; safety phrases: S2; S36/37; S60; S61 (see Appendix 1)

Description: Pale yellow liquid (technical profenofos). Garlic-like odor. Molecular weight = 373.65; Specific gravity (H_2O:1) = 1.47 @ 20 °C; Boiling point = 100 °C; Vapor pressure = 3×10^{-6} mmHg @ 20 °C; Flash point = 195 °C. Limited solubility in water.

Incompatibilities: May react violently with antimony(V) pentafluoride. Incompatible with lead diacetate, magnesium, silver nitrate. In the presence of strong reducing agents such as hydrides, organophosphates form highly toxic and flammable phosphine gas. Contact with oxidizers can cause the release of toxic oxides of phosphorus. Contact with flammable material may cause fire and explosions. Contact with combustible or oxidizable materials may form heat-, shock-, and friction-sensitive explosive mixtures. Static electricity may also cause explosions. Keep away from all acids, especially dibasic organic acids, ammonium compounds, antimony sulfide, arsenic trioxide, metal sulfides, powdered metals, calcium aluminum hydride, cyanides, manganese dioxide, phosphorus, selenium, sulfur, thiocyanates, zinc

Determination in Air: OSHA versatile sampler-2; Toluene/Acetone; Gas chromatography/Flame ionization detection; NIOSH IV, Method #5600, Organophosphorus Pesticides.[18].

Determination in Water: Log K_{ow} = >4.5. Values above 3.0 are likely to bioaccumulate in aquatic organisms.

Routes of Entry: Inhalation, ingestion, dermal contact.

Harmful Effects and Symptoms

Short Term Exposure: Eye pupils are small; blurred vision; eye watering; runny nose; cough; shortness of breath; salivation; dizziness; nausea, stomach cramps, diarrhea, and vomiting; increased blood pressure; profuse sweating; hypermotility, hallucinations; irritability; tingling of the skin; drowsiness; slow heartbeat; convulsions; fluid in lungs; loss of consciousness; incontinence; breathing stops; death. Organophosphates inhibit the action of acetylcholinesterase enzymes, and alter the way in which nervous impulses are transmitted. The effects can last for hours, days, or much longer. The action of the enzymes is reestablished after new enzymes are formed. LD_{50} (oral, rat) = <400 mg/kg; LD_{50} (dermal, rat) = <2 g/kg.

Long Term Exposure: Cholinesterase inhibitor; cumulative effect is possible. A nerve toxin; profenofos may damage the nervous system with repeated exposure, resulting in convulsions, respiratory failure. May cause liver damage. May cause reproductive and fetal effects.

Points of Attack: Respiratory system, central nervous system, cardiovascular system, blood cholinesterase. Reproductive cells.

Medical Surveillance: Medical observation is recommended for 24 to 48 hours following breathing overexposure, as pulmonary edema may be delayed. Cigarette smoking may exacerbate pulmonary injury and should be discouraged for at least 72 hours following exposure. Routine biological monitoring of pesticide applicators and field workers includes testing of plasma and red blood cell acetylcholinesterase levels (for enzyme poisoned by this chemical). These tests are normally accurate only if done within about two hours of exposure. If exposure stops, plasma levels return to normal in 1–2 weeks while red blood cell levels may be reduced for 1–3 months. When acetylcholinesterase enzyme levels are reduced by 25% or more below preemployment levels, risk of poisoning is increased, even if results are in lower ranges of "normal." Reassignment to work not involving organophosphate pesticides is recommended until enzyme levels recover. Do not drink any alcoholic beverages before or during use as it promotes absorption of organophosphates. In addition to comprehensive initial medical and work histories emphasizing reproductive experience and menstrual history, patient should have physical examination and testing of genito-urinary tract, sperm count, motility and morphology. If required, other tests, such as serum testosterone, serum follicle stimulating hormone (FSH), and serum lutenizing hormone (LH), may be indicated.

First Aid: Speed in removing material from eyes and skin is of extreme importance. *Eyes:* Eye contact can cause dangerous amounts of these chemicals to be quickly absorbed through the mucous membrane into the bloodstream. Immediately and gently flush eyes with plenty of warm or cold water (NO hot water) for at least 15 minutes, occasionally lifting the upper and lower eyelids. Get medical aid immediately. *Skin:* Get medical aid. Dermal contact can cause dangerous amounts of these chemicals to be absorbed into the bloodstream. Wearing the appropriate PPE equipment and respirator for organophosphate pesticides, immediately flush skin with plenty of soap and water for at least 15 minutes while removing contaminated clothing and shoes. Shampoo hair promptly if contaminated. *Ingestion:* Call poison control. Loosen all clothing. Never give anything by mouth to an unconscious person. Get medical aid. Do NOT induce vomiting. * If conscious, alert, and able to swallow, rinse mouth and have victim drink 4 to 8 ounces of water do NOT induce vomiting but immediately administer slurry of activated charcoal (2 oz in 8 oz of water). If victim is *unconscious or having convulsions,* do nothing except keep victim warm. **In some cases you may be specifically instructed by poison control to induce vomiting by way of 2 tablespoons of syrup of ipecac (adult) washed down with a cup of water*. Do NOT give activated charcoal before or with ipecac syrup. *Inhalation:* Get medical aid. Do not contaminate yourself. Wearing the appropriate PPE equipment and respirator for organophosphate pesticides, immediately remove the victim from the contaminated area to fresh air. If the victim is not breathing, administer artificial respiration. Do not use mouth-to-mouth method if victim ingested or inhaled the substance; give artificial respiration with the aid of a pocket mask equipped with a one-way valve or other proper respiratory medical device. If breathing is difficult, administer oxygen through bag/mask apparatus until medical help arrives. Do not leave victim unattended. *Note to physician or authorized medical personnel.* Administer atropine, 2 mg (1/30 gr) intramuscularly or intravenously as soon as any local or systemic signs or symptoms of an intoxication are noted; repeat the administration of atropine every 3 to 8 minutes until signs of atropinization (mydriasis, dry mouth, rapid pulse, hot and dry skin) occur; initiate treatment in children with 0.05 mg/kg of atropine; repeat at 5 to 10 minute intervals. Watch respiration, and remove bronchial secretions if they appear to be obstructing the airway; intubate if necessary. *Notes to physician or authorized medical personnel*: *N*-methylpyridinium-2-aldoxime (2-PAMCI) when used in conjunction with atropine reacts with the phosphorylated cholinesterase, thereby restoring normal activity to by removing the phosphorylating group. The combination of these two chemicals is synergistic and must be administered within minutes to a few hours following exposure (depending on the specific agent) to be effective. Give 2-PAMCI (Pralidoxime; Protopam), 2.5 g in 100 ml of sterile water or in 5% dextrose and water, intravenously, slowly, in 15–30 minutes; if sufficient fluid is not available, give 1 g of 2-PAMCI in 3 ml of distilled water by deep intramuscular injection; repeat this every half hour if respiration weakens or if muscle fasciculation or convulsions recur. Also diazepam, an anticonvulsant, might be considered. As first aid for pulmonary edema, a doctor or authorized paramedic might consider administering a corticosteroid spray.

Personal Protective Methods: Wear protective gloves and clothing to prevent any reasonable probability of dermal and/or eye contact. Safety equipment suppliers/manufacturers can provide recommendations on the most protective glove/clothing material for your operation. One recommendation is the use of DuPont™ Tychem® suit fabrics[88]. All protective clothing (suits, gloves, footwear, headgear) should be clean, available each day, and put on before work. Contact lenses should not be worn when working with this chemical. Wear splash-proof chemical goggles and face shield unless full facepiece respiratory protection is worn. Employees should wash immediately with soap when skin is wet or contaminated. Provide emergency showers and eyewash.

Respirator Selection: Engineering controls should be used wherever feasible to maintain airborne concentrations of this chemical below the prescribed exposure limit. Respirators and protective equipment are less effective than engineering controls, and should be used only in non-routine or emergency situations which may result in exposure concentrations in excess of the TWA environmental limit. *At any concentrations above the NIOSH REL, or where there is no REL, at any detectable concentration:* SCBAF: Pd,Pp (APF = 10,000) (any NIOSH/MSHA- or European Standard EN 149-approved self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode); or SaF: Pd,Pp: ASCBA (APF = 10,000) (any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary, self-contained breathing apparatus operated in a pressure-demand or other positive-pressure mode).

Storage: Color Code-Blue: Health Hazard/Poison. Store @ 2–8 °C in a secure poison location. Prior to working with this chemical you should be trained on its proper handling and storage. Where possible, automatically transfer material from other storage containers to process containers. Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: Organophosphorus pesticides, solid or liquid (nonflammable), require a "poisonous materials" label. This chemical falls in Hazard Class 6.1.

Spill Handling: First remove all sources of ignition. Evacuate persons not wearing protective equipment from area of spill or leak until clean up is complete. Stay upwind; keep out of low areas. Ventilate area of spill or leak. Remove and isolate contaminated clothing at the site. Do not touch spilled material; stop leak if you can do so without risk. Use water spray to reduce vapors. *Small spills:* absorb with sand or other noncombustible absorbent material and place into containers for later disposal. *Large spills:* dike far ahead of spill for later disposal. Collect powdered material in the most convenient and safe manner and deposit in sealed containers. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable. Seek professional environmental engineering assistance from the U.S. EPA Environmental Response Team at (908) 548-8730 (24-hour response line).

Fire Extinguishing: Hazardous decomposition includes hydrogen chloride, hydrogen bromide and oxides of phosphorus, sulfur, and nitrogen. May be fatal if inhaled, ingested or absorbed through skin. Inhalation or contact with some of these materials will irritate or burn skin and eyes. Vapors may cause dizziness or suffocation. *Small fires:* dry chemical, carbon dioxide; water spray; or foam. *Large fires:* water spray, fog, or foam. Stay upwind; keep out of low areas. Ventilate closed spaces before entering them. Firefighting gear (including SCBA) may not provide adequate protection. If exposure occurs, remove and isolate gear immediately and thoroughly decontaminate personnel. Wear positive-pressure breathing apparatus and special protective clothing. Remove and isolate contaminated clothing at the site. Move container from fire area if you can do so without risk. Fight fire from maximum distance. Dike fire-control water for later disposal; do not scatter the material. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies. From a secure, explosion-proof location, use water spray to cool exposed containers. If cooling streams are ineffective (venting sound increases in volume and pitch, tank discolors, or shows any signs of deforming), withdraw immediately to a secure position. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode.

Disposal Method Suggested: Destruction by alkali hydrolysis or incineration. Containers must be disposed of properly by following package label directions or by contacting your local or federal environmental control agency, or by contacting your regional EPA office.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- USEPA, Office of Pesticide Programs, Pesticide Residue Limits, "Profenofos," 40 CFR 180.404. http://www.epa.gov/pesticides/food/viewtols.htm
- USEPA, "Interim Reregistration Eligibility Decision (IRED), Profenofos," Office of Prevention, Pesticides and Toxic Substances, Washington DC (August 2000). http://www.epa.gov/REDs/2540ired.pdf

Prohexadione-calcium P:1028

Use Type: Plant growth regulator

CAS Number: 127277-53-6

Formula: $C_{10}H_{11}CaO_5$

Synonyms: Calcium 3-oxido-5-*oxo*-4-propionylcyclohex-3-enecarboxylate; Cyclohexanecarboxylic acid, 3,5-dioxo-4-(1-oxopropyl)-, ion$^{[1-]}$, calcium, calcium salt; 3,5-Dioxo-4-(1-oxopropyl)cyclohexanecarboxylic acid ion(1-) calcium salt

Trade Names: APOGEE® PLANT GROWTH REGULATOR; BASELINE® PLANT REGULATOR; BX 112®; K-I CHEMICAL; KIM-112®; KUH-833®; VIVIFUL®

Chemical class: Unclassified

EPA/OPP PC Code: 112600

California DPR Chemical Code: 5497

HSDB Number: 7252

RTECS® Number: GU8488500

Uses: Used to inhibit foliar growth on apples and pears, reduces maturation of fruit and foliar covering. Also used on turf grass.

U.S. Maximum Allowable Residue Levels for Prohexadione Calcium [40 CFR 180.547(a)]: cattle, kidney 0.10 ppm; cattle, meat byproducts, except kidney

0.05 ppm; cherry, sweet 0.40 ppm; fruit, pome, group 11, 3.0 ppm; goat, kidney 0.10 ppm; goat, meat byproducts, except kidney 0.05 ppm; grass, forage (registration is limited to grass grown for seed) 0.10 ppm; grass, hay (registration is limited to grass grown for seed) 0.10 ppm; grass, seed screenings (registration is limited to grass grown for seed) 3.5 ppm; grass, straw (registration is limited to grass grown for seed) 1.2 ppm; hog, kidney 0.10 ppm; hog, meat byproducts, except kidney 0.05 ppm; horse, kidney 0.10 ppm; horse, meat byproducts, except kidney 0.05 ppm; peanut 1.0 ppm; peanut, hay 0.60 ppm; sheep, kidney 0.10 ppm; sheep, meat byproducts, except kidney 0.05 ppm.

Regulatory Authority and Advisory Information:
Carcinogenicity[83]: EPA, Not likely to be carcinogenic to humans
Acute Oral Category: 4, Caution

Description: White solid when pure. Pale yellow-brown fine powder. Odorless. Commercial product is available as an emulsifiable concentrate or wettable powder. Molecular weight = 250.26[83]; Specific gravity (H_2O:1) = 1.46 @ 20 °C; Boiling point = (decomposes); Freezing/Melting point = >360 °C; Soluble in water. Physical and toxicological properties may be affected by carrier solvents in commercial formulations.

Incompatibilities: May react violently with strong oxidizers, bromine, 90% hydrogen peroxide, phosphorus trichloride, silver powders or dust. Incompatible with silver compounds. Mixture with some silver compounds form explosive salts of silver oxalate

Determination in Water: Log K_{ow} = –3. Unlikely to bioaccumulate in marine organisms.

Routes of Entry: Dermal contact.

Harmful Effects and Symptoms

Short Term Exposure: May cause irritation of the skin, eyes, and respiratory tract. LD_{50} (oral, rat) = >5 g/kg; LD_{50} (dermal, rat) = >2 g/kg.

Long Term Exposure: May cause kidney problems.

Points of Attack: Kidneys.

Medical Surveillance: Kidney function tests.

First Aid: If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least 15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately. If this chemical contacts the skin, remove contaminated clothing and wash immediately with soap and water. Seek medical attention immediately. If this chemical has been inhaled, remove from exposure, begin rescue breathing (using universal precautions) if breathing has stopped, and CPR if heart action has stopped. Transfer promptly to a medical facility. When this chemical has been swallowed, get medical attention. Give large quantities of water and induce vomiting. Do not make an unconscious person vomit. Do not induce vomiting when formulations containing petroleum solvents are ingested

Respirator Selection: Wherever and whenever workplace conditions warrant respirator use, a respiratory protection program must be followed that meets one or more of the following government standards: OSHA's 29 CFR 1910.134, ANSI Z88.2, or European Standard EN 149.

Spill Handling: Dampen the spilled material with water. Clean up with dampened absorbent paper and transfer material to a suitable trash container. Seal the absorbent paper and your clothing in a vapor-tight plastic bag for eventual disposal. Wash all contaminated surfaces with a soap and water solution. Do not reenter the contaminated area until and expert verifies that the area has been properly cleaned.

Fire Extinguishing: *On a small fire:* use dry chemical, carbon dioxide or water spray. *On a large fire:* use water spray, fog or regular foam. Move containers from fire area if you can do it without risk. Dike fire-control water for later disposal. Use water spray or fog; do not scatter material using straight water jet streams. *Fire involving storage or vehicular tanks:* isolate for 800 meters/0.5 mile in all directions; also, consider initial evacuation for 800 meters/0.5 mile in all directions. Fight fire from maximum distance or use unmanned hose holders or monitor nozzles. Do not get water inside containers. Cool containers with flooding quantities of water until well after fire is out. Withdraw immediately in the case of rising sound from venting safety devices or discoloration of tank. *Always* stay away from tanks engulfed in fire. For massive fire, use unmanned hose holders or monitor nozzles; if this is impossible, withdraw from area and let fire burn.

Disposal Method Suggested: It is the responsibility of chemical waste generators to determine if a discarded chemical is classified as a hazardous waste. See 40 CFR Parts 261.3 for U.S. EPA guidelines for the classification determination. Additionally, in order to ensure complete and accurate classification, waste generators must consult state and local hazardous waste regulations.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- USEPA, Office of Pesticide Programs, "Pesticide Fact Sheet, Prohexadione Calcium" (April 26, 2000). http://www.epa.gov/opprd001/factsheets/prohexadione.pdf
- USEPA, Office of Pesticide Programs, Pesticide Residue Limits, "Prohexadione Calcium," 40 CFR 180.547 http://www.setonresourcecenter.com/40CFR/Docs/wcd0004d/wcd04dd8.asp

Prometon P:1034

Use Type: Herbicide

CAS Number: 1610-18-0

Formula: $C_{10}H_{19}N_5O$

Synonyms: 2,4-Bis(isopropylamino)-6-methoxy-s-triazine; 2,6-Diisopropylamino-4-methoxytriazine; *N,N'*-Diisopropyl-6-methoxy-1,3,5-triazine-2,4-diyldiamine; *N,N'*-Diisopropyl-6-methoxy-1,3,5-triazine-2,4-diamine; 2-Methoxy-4,6-bis(isopropylamino)-*s*-triazine; 2-Methoxy-4,6-bis(isopropylamino)-1,3,5-triazine;

6-Methoxy-*N,N*'-bis(1-methylethyl)-1,3,5-triazine-2,4-diamine; Methoxypropazine; *s*-Triazine, 2,4-bis(isopropylamino)-6-methoxy-

Trade Names: ACME® Prometon; G-31435®; GESAFRAM® 50; GESAFRAM®; GESAGRAM®; GROUND ZERO®; KLEENWALK®; NIX®; NOXALL®; ONTRACK®; PRIMATOL® (prometon); PROMETONE®; WEED-GO®

Chemical class: Triazine

EPA/OPP PC Code: 080804

California DPR Chemical Code: 499

HSDB Number: 1519

UN/NA & ERG Number: UN2763/151

RTECS® Number: XY4200000

EC Number: 216-548-0

Uses: A non-selective pre-emergence and post-emergence herbicide. Use around buildings, storage areas, industrial sites, fences, recreational areas, rights-of-way, railroads, pipelines, lumberyards, tank farms, and similar areas. Controls broadleaf weeds and grasses over an extended period of time. Not listed for use in EU countries[115]. Registered for use in the U.S.

Regulatory Authority and Advisory Information:

Carcinogenicity[83]: EPA Group D, Not classifiable as a human carcinogen

Health Advisory: Mutagen, Skin irritant/sensitizer

Acute Oral Category: 3, CAUTION

Potential Ground Water Pollutant [California FAC Section 13149]

WGK (German Aquatic Hazard Class): 2-Hazard to waters

Description: Colorless crystalline solid or white powder. Odorless. Molecular weight 225.28; Specific gravity (H_2O:1) = 1.09 @ 20 °C; Boiling point = 324 °C; Freezing/Melting point = 91.5 °C; Vapor pressure = 7.7×10^{-6} mmHg @ 20 °C. Soluble in water; solubility = 750 mg/L @ 20 °C.

Incompatibilities: UV causes decomposition.

Permissible Concentration in Water: Federal Drinking Water Guidelines: 10 ppb[93]; EPA Health Advisory: 400 μg/L; State Drinking Water Guidelines: Florida 105 μg/L; Maine 100 μg/L; Minnesota 100 μg/L; Wisconsin 90 μg/L. Runoff from spills or fire control may cause water pollution.

Determination in Water: Log K_{ow} = >2.9. Values above 3.0 may bioaccumulate in marine organisms.

Routes of Entry: Inhalation, passing through the skin, ingestion.

Harmful Effects and Symptoms

Short Term Exposure: May cause skin and severe eye irritation. Moderately poisonous if ingested or inhaled. LD_{50} (oral, rat) = 1450 mg/kg–> 2 g/kg; (dermal, rat) = >2 g/kg.

Long Term Exposure: May cause lung irritation and damage. May cause skin allergy. Contact with some triazine compounds (such as atrazine) may increase risks of tumors known to be associated with hormonal factors. These have been observed in both animals and human beings, and are consistent with the known effects on the hypothalamic pituitary gonadal axis. Repeated exposure may cause weight loss and reduced red blood cell count. May cause reproductive and fetal effects.

Points of Attack: Liver, lungs, skin. Reproductive cells.

Medical Surveillance: Preliminary medical exam to detect chronic diseases of central nervous system, liver, heart, kidneys, lung and skin, as well as endocrinological or immunological disturbances, should protect susceptible individuals. Periodical medical exams of internal organs, skin and eyes are important to avoid chronic occupational intoxications. They should include lab and patch tests when necessary[83]. Before beginning employment and at regular times after that, for those with frequent or potentially high exposures, the following is recommended: Lung function tests. Consider chest x-ray following acute overexposure. Evaluation by a qualified allergist. Examination of the nervous system. In addition to comprehensive initial medical and work histories emphasizing reproductive experience and menstrual history, patient should have physical examination and testing of genito-urinary tract, sperm count, motility and morphology. If required, other tests, such as serum testosterone, serum follicle stimulating hormone (FSH), and serum lutenizing hormone (LH), may be indicated.

First Aid: If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least 15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately. If this chemical contacts the skin, remove contaminated clothing and wash immediately with soap and water. Seek medical attention immediately. If this chemical has been inhaled, remove from exposure, begin rescue breathing (using universal precautions) if breathing has stopped, and CPR if heart action has stopped. Transfer promptly to a medical facility. When this chemical has been swallowed, get medical attention. Give large quantities of water or milk and induce vomiting. Do not make an unconscious person vomit.

Personal Protective Methods: Applicators and other handlers must wear: Coveralls worn over long-sleeved shirt and long pants; Chemical-resistant gloves such as DuPont™ Tychem® suit fabrics, barrier laminate, or Viton®; Chemical-resistant footwear plus socks; Protective eye wear; Chemical-resistant headgear for overhead exposure; Chemical-resistant apron when cleaning equipment, mixing, or loading[83]. Agricultural Use/Engineering Controls: When handlers use closed systems, enclosed cabs, or aircraft in a manner that meets the requirements listed in the Worker Protection Standard (WPS) for agricultural pesticides, ***40 CFR 170.240(d)(4-6)***, the handler PPE requirements may be reduced or modified as specified in the Worker Protection Standard. Firefighters should wear NIOSH-approved self-contained breathing apparatus and full protective clothing.

Respirator Selection: Engineering control must be effective to ensure that exposure to prometon does not occur. Where there is potential exists for exposures to prometon use a NIOSH/MSHA- or European Standard EN149-approved full facepiece respirator with a pesticide cartridge. Increased protection is obtained from full facepiece air-purifying respirators. *Where potential for high exposures exists*, use a NIOSH/MSHA- or European Standard EN149-approved supplied-air-respirator with a full facepiece operated in the positive-pressure mode, or with a full facepiece, hood, or helmet in the continuous-flow mode; or use a NIOSH/MSHA- or European Standard EN149-approved self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive-pressure mode.

Storage: Color Code-Blue: Health Hazard/Poison. Store in a secure poison location. Prior to working with cyanazine you should be trained on its proper handling and storage. Store in tightly closed containers in a cool, well-ventilated area. Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: Triazine pesticides, solid, toxic, n. o. s. require a shipping label of "poisonous materials." This material falls in DOT/UN Hazard Class 6.1.

Spill Handling: First remove all sources of ignition. Evacuate persons not wearing protective equipment from area of spill or leak until clean up is complete. If appropriate, moisten to prevent dust. Collect powdered material in the most convenient and safe manner and deposit in sealed containers. Ventilate area after clean up is complete. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable.

Fire Extinguishing: Hazardous decomposition includes oxides of nitrogen. *On a small fire:* use dry chemical, CO_2 or water spray. *On a large fire:* use water spray, fog or regular foam. Move containers from fire area if you can do it without risk. Dike fire-control water for later disposal; do not scatter the material. Use water spray or fog; do not use straight streams. *Fire involving tanks or car/trailer loads*: isolate for 800 meters/0.5 mile in all directions; also, consider initial evacuation for 800 meters/0.5 mile in all directions. Fight fire from maximum distance or use unmanned hose holders or monitor nozzles. Do not get water inside containers. Cool containers with flooding quantities of water until well after fire is out. Withdraw immediately in the case of rising sound from venting safety devices or discoloration of tank. ALWAYS stay away from tanks engulfed in fire. For massive fire, use unmanned hose holders or monitor nozzles; if this is impossible, withdraw from area and let fire burn. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies.

Disposal Method Suggested: Dissolve or mix the material with a combustible solvent and burn in a chemical incinerator equipped with an afterburner and scrubber. All federal, state, and local environmental regulations must be observed. In accordance with 40CFR165, follow recommendations for the disposal of pesticides and pesticide containers. Containers must be disposed of properly by following package label directions or by contacting your local or federal environmental control agency, or by contacting your regional EPA office.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- Pesticide Management Education Program, "Prometon (Pramitol) Herbicide Profile 2/85," Cornell University, Ithaca, NY (February 1985). http://pmep.cce.cornell.edu/profiles/herb-growthreg/naa-rimsulfuron/prometon/herb-prof-prometon.html

Prometryn P:1036

Use Type: Herbicide

CAS Number: 7287-19-6

Formula: $C_{10}H_{19}N_5S$

Synonyms: A13-60366; 2,4-Bis(isopropylamino)-6-(methylmercapto)-*S*-triazine; 2,4-Bis(isopropylamino)-6-(methylthio)-*S*-triazine; 2,4-Bis(isopropylamino)-6-(methylthio)-1,3,5-triazine; *N,N'*-Bis(1-methylethyl)-6-methylthio-1,3,5-triazine-2,4-diamine; *N,N'*-Bis(1-methylethyl)-6-(methylthio)-1,3,5-triazine-2,4-diamine; Caswell No. 097; *N,N'*-Di-isopropyl-6-methylthio-1,3,5-triazine-2,4-diamine;*N,N'*-Di-isopropyl-6-methylthio-1,3,5-triazine-2,4-diyldiamine; 2-(Methylmercapto)-4,6-bis(isopropylamino)-*S*-Triazine; 2-(Methylthio)-4,6-bis(isopropylamino)-*S*-Triazine; NSC 163049; Prometrin; Prometrene; *S*-Triazine,4,6-bis(isopropylamino)-2-(methylmercapto)-; *S*-Triazine, 2,4-bis(isopropylamino)-6-(methylthio)-; 1,3,5-Triazine-2,4-diamine, *N,N'*-bis(1-methylethyl)-6-(methylthio)-

Trade Names: A-1114®; CAPAROL®; COTTON PRO®; G 34161®; GESAGARD®; MERCASIN®; MERCAZIN®; MERKAZIN®; POLISIN®; PRIMAPIN®; PRIMATOL-Q®; PROMET®; PROMETREX®; SELECTIN®; SELECTIN-50®; SELEKTIN®; SESAGARD®; SUPREND®; UVON®

Chemical class: Triazine

EPA/OPP PC Code: 080805

California DPR Chemical Code: 502

HSDB Number: 4060

UN/NA & ERG Number: UN2763/151

RTECS® Number: XY4390000

EC Number: 230-771-3

Uses: Prometryn is used to control several annual grasses and broadleaf weeds in terrestrial food and feed crops. Its major uses are on cotton and celery, and is often used on dill and pigeon peas. Not approved for use in EU countries[115]. Registered for use in the U.S.

U.S. Maximum Allowable Residue Levels for Prometryn [40 CFR 180.222(a)]: celery 0.5 ppm; corn, grain 0.25 ppm; cotton, undelinted seed 0.25 ppm; pea, pigeon seed 0.25 ppm. ***Regional registration, as defined in section 180.1(n) [40 CFR 180.222(c)]:*** dill 0.3 ppm; parsley, leaves 0.1 ppm.

Regulatory Authority and Advisory Information:

Carcinogenicity[83]: EPA Group E, evidence of non-carcinogenicity for humans

Health Advisory: Mutagen, Developmental/Reproductive Toxin, Skin irritant/sensitizer, Developmental toxin (TRI)

Acute Oral Category: 3, CAUTION

Potential Ground Water Pollutant [California FAC Section 13145(d)/12811, active]

EPCRA Section 313 Form R *de minimis* concentration reporting level: 1.0%

Description: Colorless crystalline solid. Molecular weight = 241.385; Specific gravity (H_2O:1) = 1.16 @ 20 °C; Boiling point = 295 °C; Freezing/Melting point = 119 °C; Vapor pressure = 1.24×10^{-6} mmHg @ 20 °C. Slightly soluble in water; solubility = 48 ppm @ 20 °C.

Determination in Air: Filter; none; Gravimetric; NIOSH IV [Particulates NOR; #0500 (total), #0600 (respirable)].[18].

Permissible Concentration in Water: Federal Drinking Water Guidelines: 30 ppb[93]. State Drinking Water Guidelines: Florida 28 μg/L. Runoff from spills or fire control may cause water pollution.

Determination in Water: Log K_{ow} = >3.0. Values >3.0 may bioaccumulate in marine organisms.

Routes of Entry: Inhalation, passing through the skin, ingestion.

Harmful Effects and Symptoms

Short Term Exposure: May cause skin and severe eye irritation. Moderately poisonous if ingested or inhaled. LD_{50} (oral, rat) = <2 g/kg[83]; LD_{50} (dermal, rat) = >3 g/kg[83].

Long Term Exposure: May cause lung irritation and damage. May cause skin allergy. Contact with some triazine compounds (such as atrazine) may increase risks of tumors known to be associated with hormonal factors. These have been observed in both animals and human beings, and are consistent with the known effects on the hypothalamic pituitary gonadal axis. Repeated exposure may cause weight loss and reduced red blood cell count. May be mutagenic. May be a liver, kidney and blood toxin.

Points of Attack: Kidney, liver, blood, lungs, skin.

Medical Surveillance: Preliminary medical exam to detect chronic diseases of central nervous system, liver, heart, kidneys, lung and skin, as well as endocrinological or immunological disturbances, should protect susceptible individuals. Periodical medical exams of internal organs, skin and eyes are important to avoid chronic occupational intoxications. They should include lab and patch tests when necessary[83]. Before beginning employment and at regular times after that, for those with frequent or potentially high exposures, the following is recommended: Lung function tests. Consider chest x-ray following acute overexposure. Evaluation by a qualified allergist. Examination of the nervous system. Live and kidney function tests. Complete blood count.

First Aid: If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least 15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately. If this chemical contacts the skin, remove contaminated clothing and wash immediately with soap and water. Seek medical attention immediately. If this chemical has been inhaled, remove from exposure, begin rescue breathing (using universal precautions) if breathing has stopped, and CPR if heart action has stopped. Transfer promptly to a medical facility. When this chemical has been swallowed, get medical attention. Give large quantities of water or milk and induce vomiting. Do not make an unconscious person vomit.

Personal Protective Methods: Applicators and other handlers must wear: Coveralls worn over long-sleeved shirt and long pants; Chemical-resistant gloves such as DuPont™ Tychem® suit fabrics, barrier laminate, or Viton®; Chemical-resistant footwear plus socks; Protective eye wear; Chemical-resistant headgear for overhead exposure; Chemical-resistant apron when cleaning equipment, mixing, or loading[83]. Agricultural Use/Engineering Controls: When handlers use closed systems, enclosed cabs, or aircraft in a manner that meets the requirements listed in the Worker Protection Standard (WPS) for agricultural pesticides, ***40 CFR 170.240(d)(4-6)***, the handler PPE requirements may be reduced or modified as specified in the Worker Protection Standard. Firefighters should wear NIOSH-approved self-contained breathing apparatus and full protective clothing.

Respirator Selection: Engineering control must be effective to ensure that exposure to cyanazine does not occur. Where potential exists for exposures to prometryn use a NIOSH/MSHA- or European Standard EN149-approved full facepiece respirator with a pesticide cartridge. Increased protection is obtained from full facepiece air-purifying respirators. *Where potential for high exposures exists*, use a NIOSH/MSHA- or European Standard EN149-approved supplied-air-respirator with a full facepiece operated in the positive-pressure mode, or with a full facepiece, hood, or helmet in the continuous-flow mode; or use a NIOSH/MSHA- or European Standard EN149-approved self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive-pressure mode.

Storage: Color Code-Blue: Health Hazard/Poison. Store in a secure poison location. Prior to working with cyanazine you should be trained on its proper handling and storage. Store in tightly closed containers in a cool, well-ventilated area. Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid.

Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: Triazine pesticides, solid, toxic, n. o. s. require a shipping label of "poisonous materials." This material falls in DOT/UN Hazard Class 6.1.

Spill Handling: First remove all sources of ignition. Evacuate persons not wearing protective equipment from area of spill or leak until clean up is complete. If appropriate, moisten to prevent dust. Collect powdered material in the most convenient and safe manner and deposit in sealed containers. Ventilate area after clean up is complete. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable.

Fire Extinguishing: Hazardous decomposition includes toxic oxides of nitrogen. *On a small fire:* use dry chemical, CO_2 or water spray. *On a large fire:* use water spray, fog or regular foam. Move containers from fire area if you can do it without risk. Dike fire-control water for later disposal; do not scatter the material. Use water spray or fog; do not use straight streams. *Fire involving storage or vehicular tanks:* isolate for 800 meters/0.5 mile in all directions; also, consider initial evacuation for 800 meters/0.5 mile in all directions. Fight fire from maximum distance or use unmanned hose holders or monitor nozzles. Do not get water inside containers. Cool containers with flooding quantities of water until well after fire is out. Withdraw immediately in the case of rising sound from venting safety devices or discoloration of tank. ALWAYS stay away from tanks engulfed in fire. For massive fire, use unmanned hose holders or monitor nozzles; if this is impossible, withdraw from area and let fire burn. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies.

Disposal Method Suggested: Dissolve or mix the material with a combustible solvent and burn in a chemical incinerator equipped with an afterburner and scrubber. All federal, state, and local environmental regulations must be observed. In accordance with 40CFR165, follow recommendations for the disposal of pesticides and pesticide containers. Containers must be disposed of properly by following package label directions or by contacting your local or federal environmental control agency, or by contacting your regional EPA office.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- USEPA, "Reregistration Eligibility Decision (RED), Prometryn," Office of Prevention, Pesticides and Toxic Substances, Washington DC (February 1996). http://www.epa.gov/REDs/0467.pdf
- EXTOXNET, Extension Toxicology Network, "Pesticide Information Profile, Prometryn," Oregon State University, Corvallis, OR (June 1996). http://extoxnet.orst.edu/pips/prometry.htm
- USEPA, Office of Pesticide Programs, Pesticide Residue Limits, "Prometryn," 40 CFR 180.222. http://www.setonresourcecenter.com/40CFR/Docs/wcd0004c/wcd04cd7.asp

Pronamide P:1040

Use Type: Herbicide

CAS Number: 23950-58-5

Formula: $C_{12}H_{11}Cl_2NO$

Synonyms: Benzamide, 3,5-dichloro-*N*-(1,1-dimethyl-2-propynyl); Caswell No. 306A; 3,5-Dichloro-*N*-(1,1-dimethyl-2-propynyl)benzamide; 3,5-Dichloro-*N*-(1,1-dimethylpropynyl)benzamide; 3,5-Dichloro-*N*-(1,1-dimethylprop-2-ynyl)benzamide; *N*-(1,1-Dimethylpropynyl)-3,5-dichlorobenzamide; Propyzamide

Trade Names: BENZAMIDE®; CAMPBELL'S RAPIER®; CLANEX®; KERB®; KERB 50W®; KERB® PROPYZAMIDE 50; RH-315 RAPIER®; RONAMID®

Chemical class: Amide Herbicide

EPA/OPP PC Code: 101701

California DPR Chemical Code: 694

HSDB Number: 5118

UN/NA & ERG Number: UN3077(solid)/171

RTECS® Number: CV3460000

EC Number: 245-951-4 [*Annex I Index No.:* 616-055-00-4]

Uses: Pronamide is a selective herbicide used either before weeds emerge (pre-emergence), and/or after weeds come up (post-emergence). It controls a wide range of annual and perennial grasses, as well as certain annual broadleaf weeds. It is used primarily on lettuce and alfalfa crops, as well as on blueberries, ornamentals, fruit trees, forage legumes, and on pastures and rangelands. Pronamide is usually incorporated into the soil by cultivation, irrigation, or rain immediately following application. It is available in wettable powder and granular formulations. Registered for use in the U.S. and EU countries. A U.S. EPA restricted Use Pesticide (RUP).

Regulatory Authority and Advisory Information:

Carcinogenicity[83]: EPA Group B2, Probable human carcinogen; EU GHS Category 2: Suspected human carcinogen as propyzamide.

California Proposition 65 Chemical: Cancer (5/1/1996).
Health Advisory: Tumorigen, Liver cancer in animals
Health Advisory: Endocrine disruptor (S!)
Acute Oral Category: 3, CAUTION
Potential Ground Water Pollutant [California FAC Section 13145(d)/12811, active] as propyzamide
EPA Hazardous Waste Number (RCRA No.): U192
RCRA 40CFR268.48; 61FR15654, Universal Treatment Standards: Wastewater (mg/L), 0.093; Non-wastewater (mg/kg), 1.5
RCRA 40CFR264, Appendix 9; TSD Facilities Ground Water Monitoring List. Suggested test method(s) (PQL μg/L): 8270(10)
EPCRA Section 313 Form R *de minimus* concentration reporting level: 1.0%
Hazard Symbols: Xn, N, risk phrases: R40; R50/53, safety phrases: S2; S36/37; S60; S61 (see Appendix 1)

Description: Pronamide is a colorless crystalline solid or powder. Molecular weight = 256.14; Freezing/Melting point = 155–156 °C; Vapor pressure = 8.3×10^{-5} mmHg @ 25 °C; Flash point = 160 °C. Practically insoluble in water; solubility = 15 ppm @ 25 °C.

Permissible Concentration in Water: Federal Drinking Water Guidelines: 10 ppb[14]; EPA Health Advisory: 50 μg/L; State Drinking Water Guidelines: Florida 53 μg/L; Maine 23 μg/L; Arizona 52 μg/L.

Determination in Water: Extraction with Methylene chloride, separation by capillary-column gas chromatography, then measurement using a nitrogen-phosphorus detector.

Routes of Entry: Inhalation, ingestion, skin and/or eye contact.

Harmful Effects and Symptoms

Short Term Exposure: Eye contact can cause irritation. Inhalation can cause irritation of the respiratory tract with cough, phlegm, and/or chest tightness. LD_{50} (oral, rat) = >5 g/kg; LD_{50} (dermal, rat) = >3 g/kg.

Long Term Exposure: May cause cancer. There is limited animal evidence of liver cancer. May be a skin sensitizer.

Points of Attack: Cancer site in animals: liver. Skin.

Medical Surveillance: Preliminary medical exam to detect chronic diseases of central nervous system, liver, heart, kidneys, lung and skin, as well as endocrinological or immunological disturbances, should protect susceptible individuals. Periodical medical exams of internal organs, skin and eyes are important to avoid chronic occupational intoxications. They should include lab and patch tests when necessary[83]. This chemical is a suspected or known human carcinogen. Exposed persons should contact a physician for advice regarding the possible long term health effects and advice for medical monitoring. Evaluation by a qualified allergist, including exposure history and testing, may help diagnose allergy.

First Aid: If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least 15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately. If this chemical contacts the skin, remove contaminated clothing and wash immediately with soap and water. Seek medical attention immediately. If this chemical has been inhaled, remove from exposure, begin rescue breathing (using universal precautions) if breathing has stopped, and CPR if heart action has stopped. Transfer promptly to a medical facility. When this chemical has been swallowed, get medical attention. Give large quantities of water and induce vomiting. Do not make an unconscious person vomit.

Personal Protective Methods: Wear protective gloves and clothing to prevent any reasonable probability of dermal and/or eye contact. Safety equipment suppliers/manufacturers can provide recommendations on the most protective glove/clothing material for your operation. All protective clothing (suits, gloves, footwear, headgear) should be clean, available each day, and put on before work. Contact lenses should not be worn when working with this chemical. Wear dust-proof chemical goggles and face shield unless full facepiece respiratory protection is worn. Employees should wash immediately with soap when skin is wet or contaminated. Provide emergency showers and eyewash.

Respirator Selection: *At any detectable concentration:* SCBAF: Pd,Pp (APF = 10,000) (any NIOSH/MSHA- or European Standard EN 149-approved self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode); or SaF: Pd,Pp: ASCBA (APF = 10,000) (any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary, self-contained breathing apparatus operated in a pressure-demand or other positive-pressure mode). *Escape:* 100 F (APF = 50) (any air-purifying, full facepiece respirator with an N100, R100, or P100 filter k-mounted organic vapor canister having a high-efficiency particulate filter); or SCBAE (any appropriate escape-type, self-contained breathing apparatus).

Storage: Color Code-Green: General storage may be used. Prior to working with this chemical you should be trained on its proper handling and storage. Store in tightly closed containers in a cool, well-ventilated area away from strong oxidizers. Where possible, automatically transfer material from drums or other storage containers to process containers. A regulated, marked area should be established where this chemical is handled, used, or stored in compliance with OSHA Standard 1910.1045. Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: Environmentally hazardous substances, solid or liquid, usually fall in Hazard Class 9.

Spill Handling: Evacuate persons not wearing protective equipment from area of spill or leak until clean up is complete. Use HEPA vacuum or wet method to reduce dust during clean up. Do not dry sweep. Collect powdered material in the most convenient and safe manner and deposit in sealed containers. Ventilate area after clean up is complete. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable. Soil Adsorption Index (K_{oc}) = 200.

Fire Extinguishing: Hazardous decomposition includes hydrogen chloride and oxides of nitrogen. This chemical is a combustible solid. As an immediate precautionary measure, isolate spill or leak area in all directions for at least 50 meters/150 feet for liquids and at least 25 meters/75 feet for solids. *Fire involving storage or vehicular tanks:* isolate for 800 meters/0.5 mile in all directions; also, consider initial evacuation for 800 meters/0.5 mile in all directions. *On a small fire:* use dry chemical, CO_2, water spray or regular foam. *On a large fire:* use water spray, fog or regular foam. Do not scatter spilled material with high-pressure streams of water. Move containers from fire area if you can do it without risk. Dike fire-control water for later disposal. *Fire involving tanks:* from a secure, explosion-proof location, use water spray to cool exposed containers. If cooling streams are ineffective (venting sound increases in volume and pitch, tank discolors, or shows any signs of deforming), withdraw immediately to a secure position. Always stay away from tanks engulfed in fire. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode.

Disposal Method Suggested: Generators of waste containing this contaminant (≥100 kg/mo) must conform with EPA regulations governing storage, transportation, treatment, and waste disposal. Consult with environmental regulatory agencies for guidance on acceptable disposal practices. In accordance with 40CFR165, follow recommendations for the disposal of pesticides and pesticide containers. Containers must be disposed of properly by following package label directions or by contacting your local or federal environmental control agency, or by contacting your regional EPA office.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- EXTOXNET, Extension Toxicology Network, "Pesticide Information Profile, Pronamide," Oregon State University, Corvallis, OR (June 1996). http://extoxnet.orst.edu/pips/pronamid.htm
- USEPA, "Health Advisory: Pronamide," Washington DC, Office of Drinking Water (August 1987)
- New Jersey Department of Health and Senior Services, "Hazardous Substance Fact Sheet, Pronamide," Trenton, NJ (May 1998). http://www.state.nj.us/health/eoh/rtkweb/1592.pdf

Propachlor P:1045

Use Type: Herbicide

CAS Number: 1918-16-7

Formula: $C_{11}H_{14}ClNO$; $(ClCH_2CO)N(C_6H_5)CH(CH_3)_2$

Synonyms: Acetamide, 2-chloro-*N*-(1-methylethyl)-*N*-phenyl-; Acetamide, 2-chloro-*N*-isopropyl-; α-Chloro-*N*-isopropylacetanilide; α-Chloro-*N*-isopropylacetanilide; 2-Chloro-*N*-isopropylacetanilide; 2-Chloro-*N*-isopropyl-*N*-phenylacetamide;2-Chloro-*N*-(1-methylethyl)-*N*-phenylacetamide; *N*-Isopropyl-α-chloroacetanilide; *N*-Isopropyl-2-chloroacetanilide; Propachlore; Propacloro (Spanish)

Trade Names: AATRAM®[C]; ACLID®; AI3-51503®; ALBRASS®; BEXTON®[C]; CIPA®; CP 31393®; KARTEX A®; NITICID®; RAMROD®; RAMROD® 65; SATECID®; WALLOP®[C]

Chemical class: Chloroacetanilide; Chloroacetamide

EPA/OPP PC Code: 019101

California DPR Chemical Code: 511

HSDB Number: 1200

UN/NA & ERG Number: UN2588 (Pesticide, solid, poisonous, n.o.s.)/151; UN2902 (Pesticide, liquid, poisonous, n.o.s.)/151

RTECS® Number: AE1575000

EC Number: 217-638-2 [*Annex I Index No.:* 616-008-00-8]

Uses: A pre-emergence herbicide used to combat annual grasses and broad-leaved weeds in corn, sorghum, soybeans, cotton, sugar cane, sugar beets, vegetable crops, forage crops, pasture land and range land. Also used to control weeds in groundnuts, leeks, onions, peas, maize, roses and ornamental trees and shrubs. Not approved for use in EU countries[115]. Not registered for use in the U.S. except California.

U.S. Maximum Allowable Residue Levels for Propachlor [40 CFR 180.211(a)]: cattle, fat 0.02 (negligible); cattle, meat byproducts 0.02 (negligible); cattle, meat 0.02 (negligible); corn, forage 1.5 ppm; corn, grain 0.1 (negligible); egg 0.02 (negligible); goat, fat 0.02 (negligible); goat, meat byproducts 0.02 (negligible); goat, meat 0.02 (negligible); hog, fat 0.02 (negligible); hog, meat byproducts 0.02 (negligible); hog, meat 0.02 (negligible); horse, fat 0.02 (negligible); horse, meat byproducts 0.02 (negligible); horse, meat 0.02 (negligible); milk 0.02 (negligible); Poultry, fat 0.02 (negligible); poultry, meat byproducts 0.02 (negligible); poultry, meat 0.02 (negligible); sheep, fat 0.02 (negligible); sheep, meat byproducts 0.02 (negligible); sheep, meat 0.02 (negligible); sorghum, forage 5.0 ppm; sorghum, grain 0.25 ppm; sorghum, grain, stover 5.0 ppm.

Regulatory Authority and Advisory Information: Carcinogenicity[83]: EPA, Likely to be a human carcinogen

California Proposition 65 Chemical: Carcinogen (2/27/2001).
Health Advisory: Mutagen, Reproductive/developmental toxin (TRI)
Acute Oral Category: 3, CAUTION
EPCRA Section 313 Form R *de minimis* concentration reporting level: 1.0%
MARINE POLLUTANT (49CFR, Subchapter 172.101, Appendix B)
European/International Regulations: Hazard Symbol: Xi; Xn, N; risk phrases: R22; R36; R43; R50/53; safety phrases: S2; S22; S36; S46; S60 (see Appendix 1)

Description: Propachlor is a light tan solid. Commercial product can be a soluble concentrate that may be mixed with water and used as a spray. Molecular weight = 211.71; Specific gravity (H_2O:1) = 1.13 @ 20 °C; Boiling point = 110 °C @ 0.03 mm; Freezing/Melting point = 73–76 °C; Vapor pressure = 1.9×10^{-3} mmHg @ 25 °C. Flash point = about 150 °C. Soluble in water. Physical and toxicological properties may be affected by carrier solvents in commercial formulations.

Incompatibilities: Incompatible with alkaline materials, strong acids, strong oxidizers. Attacks carbon steel.

Permissible Exposure Limits in Air: Russia[35][43] set a MAC in work-place air of 0.5 mg/m^3.

Determination in Air: Gas chromatography/electron-capture detection.

Permissible Concentration in Water: Federal Drinking Water Guidelines: EPA 90 μg/L; State Drinking Water Guidelines: Florida 91 μg/L; Minnesota 90 μg/L.

Determination in Water: Log K_{ow} = <2.5. Unlikely to bioaccumulate in marine organisms.

Routes of Entry: Inhalation, ingestion, skin and/or eye contact.

Harmful Effects and Symptoms

Short Term Exposure: Causes severe irritation to the skin and eyes. May be corrosive to the eyes. May cause irritation of the respiratory tract. Harmful if swallowed. The maximal tolerated dosage of propachlor without adverse effect is reported as 133.3 mg/kg/day in both rats and dogs. Other workers reported slight organ pathology in rats, mice, and rabbits at 100 mg/kg/day or higher; this agrees approximately with the former data. LD_{50} (oral, rat) = 500–700 mg/kg; LD_{50} (dermal, rat) = >2 g/kg.

Long Term Exposure: Apparently, no long-term toxicity studies have been completed of propachlor's degradation products, which include aniline derivatives. Based on animal studies, it may be mutagenic. May cause contact dermatitis.

Medical Surveillance: Preliminary medical exam to detect chronic diseases of central nervous system, liver, heart, kidneys, lung and skin, as well as endocrinological or immunological disturbances, should protect susceptible individuals. Periodical medical exams of internal organs, skin and eyes are important to avoid chronic occupational intoxications. They should include lab and patch tests when necessary[83]. This chemical is a suspected or known human carcinogen. Exposed persons should contact a physician for advice regarding the possible long term health effects and advice for medical monitoring. Evaluation by a qualified allergist, including exposure history and testing, may help diagnose allergy.

First Aid: If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least 15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately. Give artificial respiration if victim is not breathing. *Do not* use mouth-to-mouth method if victim ingested or inhaled the substance; give artificial respiration with the aid of a pocket mask equipped with a one-way valve or other proper respiratory medical device. Administer oxygen if breathing is difficult. Remove and isolate contaminated clothing and shoes. In cases of contact with substance, immediately flush skin or eyes with running water for at least 20 minutes. For minor skin contact, avoid spreading material on unaffected skin. Keep victim warm and quiet. Effects of exposure (inhalation, ingestion or skin contact) to substance may be delayed. Ensure that medical personnel are aware of the material(s) involved and take precautions to protect themselves.

Personal Protective Methods: Applicators and other handlers must wear: Coveralls worn over long-sleeved shirt and long pants; Chemical-resistant gloves such as DuPont™ Tychem® suit fabrics, barrier laminate, or Viton®; Chemical-resistant footwear plus socks; Protective eye wear; Chemical-resistant headgear for overhead exposure; Chemical-resistant apron when cleaning equipment, mixing, or loading[83]. Agricultural Use/Engineering Controls: When handlers use closed systems, enclosed cabs, or aircraft in a manner that meets the requirements listed in the Worker Protection Standard (WPS) for agricultural pesticides, ***40 CFR 170.240(d)(4-6)***, the handler PPE requirements may be reduced or modified as specified in the Worker Protection Standard. Firefighters should wear NIOSH-approved self-contained breathing apparatus and full protective clothing.

Respirator Selection: *At any detectable concentration:* SCBAF: Pd,Pp (APF = 10,000) (any NIOSH/MSHA- or European Standard EN 149-approved self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode); or SaF: Pd,Pp: ASCBA (APF = 10,000) (any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary, self-contained breathing apparatus operated in a pressure-demand or other positive-pressure mode). *Escape:* 100 F (APF = 50) (any air-purifying, full facepiece respirator with an N100, R100, or P100 filter k-mounted organic vapor canister having a high-efficiency particulate filter); or SCBAE (any appropriate escape-type, self-contained breathing apparatus).

Storage: Color Code-Blue: Health Hazard/Poison: Store in a secure poison location. Prior to working with this chemical you should be trained on its proper handling and storage. Store in tightly closed containers in a cool, well-ventilated area away from strong oxidizers. Where possible, automatically transfer material from drums or other storage containers to process containers. If this material contains a flammable carrier, sources of ignition, such as smoking and open flames, are prohibited where this chemical is handled, used, or stored. Metal containers involving the transfer of this chemical should be grounded and bonded. Wherever this chemical is used, handled, manufactured, or stored, use explosion-proof electrical equipment and fittings. Color Code-White: Corrosive or Contact Hazard; Store separately in a corrosion resistant location. Prior to working with this chemical you should be trained on its proper handling and storage. Store in tightly closed containers in a cool, well-ventilated area.

Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: Pesticides, solid, toxic/poisonous, n.o.s require a shipping label of "poisonous materials" and fall in Hazard Class 6.1. Technical name required.

Spill Handling: Evacuate persons not wearing protective equipment from area of spill or leak until clean up is complete. Collect powdered material in the most convenient and safe manner and deposit in sealed containers. Ventilate area after clean up is complete. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable. Soil Adsorption Index (K_{oc}) = 80.

Fire Extinguishing: Hazardous decomposition includes nitrogen oxides and hydrogen chloride. This chemical is a combustible solid. As an immediate precautionary measure, isolate spill or leak area in all directions for at least 50 meters/150 feet for liquids and at least 25 meters/75 feet for solids. *Fire involving storage or vehicular tanks:* isolate for 800 meters/0.5 mile in all directions; also, consider initial evacuation for 800 meters/0.5 mile in all directions. *On a small fire:* use dry chemical, CO_2, water spray or regular foam. *On a large fire:* use water spray, fog or regular foam. Do not scatter spilled material with high-pressure streams of water. Move containers from fire area if you can do it without risk. Dike fire-control water for later disposal. *Fire involving tanks:* from a secure, explosion-proof location, use water spray to cool exposed containers. If cooling streams are ineffective (venting sound increases in volume and pitch, tank discolors, or shows any signs of deforming), withdraw immediately to a secure position. Always stay away from tanks engulfed in fire. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode.

Disposal Method Suggested: Alkaline hydrolysis would yield *N*-isopropylaniline. However, incineration @ 850 °C together with flue gas scrubbing is the preferred disposal method.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- EXTOXNET, Extension Toxicology Network, "Pesticide Information Profile," Oregon State University, Corvallis, OR
- USEPA, Office of Pesticide Programs, Pesticide Residue Limits, "Propachlor," 40 CFR 180.211. http://www.epa.gov/pesticides/food/viewtols.htm
- USEPA, "Health Advisory: Propachlor," Washington DC, Office of Drinking Water (August 1987)

Propamocarb hydrochloride

P:1055

Use Type: Fungicide

CAS Number: 25606-41-1

Formula: $C_9H_{21}ClN_2O_2$

Synonyms: Carbamic acid, [3-(dimethylamino)propyl]-, propyl ester, monohydrochloride; *N*-(γ-Dimethylaminopropyl) carbamic acid propyl ester, monohydrochloride; Propyl [3-(dimethylamino)propyl]carbamate monohydrochloride

Trade Names: BANOL®; PREVEX®; PREVICUR N®; SH-66752®; TATTOO®

Chemical class: Carbamate

EPA/OPP PC Code: 119302

California DPR Chemical Code: 4022

UN/NA & ERG Number: UN2757 (solid)/151

RTECS® Number: EZ8860000

EC Number: 247-1245-9

Uses: Propamocarb hydrochloride is used for the plant disease called damping-off and has fungicidal activity against *Pythium* spp. and *Phytophthora* spp. It is used on non-food sites such as ornamental lawns and turf, sod farms, plants, vines and woody plants. Registered for use in EU countries[115]. Registered for use in the U.S.

U.S. Maximum Allowable Residue Levels for Propamocarb Hydrochloride (40 CFR 180.499): tomato 2.0 ppm; tomato, paste 5.0 ppm; tomato, puree 1.0 ppm.

Regulatory Authority and Advisory Information:

Carcinogenicity[83]: EPA, Not likely to be carcinogenic to humans

Acute Oral Category: 3, CAUTION

Description: Colorless to yellow granules. Commercial product can be a soluble concentrate that may be mixed with water and used as a spray. Odorless to faint aromatic odor. Molecular weight = 224.73; Specific gravity (H_2O:1) = 1.16 @ 20 °C; Boiling point = (decomposes)

100 °C (liquid); Freezing/Melting point = 64 °C. Highly soluble in water. Physical and toxicological properties may be affected by carrier solvents in commercial formulations.

Incompatibilities: Carbamates are incompatible with reducing agents, strong acids, oxidizing acids, peroxides, and bases. Contact with active metals or nitrides causes the release of flammable, and potentially explosive, hydrogen gas. May form explosive materials with phosphorus pentachloride. When heated to decomposition or on contact with acids or acid fumes, it may produce highly toxic chloride fumes; deadly phosgene gas may be formed. May cause pitting of some metals.

Determination in Water: Log K_{ow} = <–1.0. Unlikely to bioaccumulate in marine organisms.

Routes of Entry: Skin absorption, ingestion, inhalation.

Harmful Effects and Symptoms

Short Term Exposure: Eye pupils are small; blurred vision; eye watering; runny nose; cough; shortness of breath; salivation; nausea, stomach cramps, diarrhea, and vomiting; increased blood pressure; profuse sweating; hypermotility, hallucinations; agitation; tingling of the skin; slow heartbeat; convulsions; fluid in lungs; loss of consciousness; incontinence; breathing stops; death. Carbamates inhibit the acetylcholinesterase enzymes and alter the way in which nervous impulses are transmitted. However, within several hours carbamates spontaneously detach from the enzymes. May cause skin sensitization. LD_{50} (oral, rat) = >2 g/kg; LD_{50} (dermal, rat) = >3 g/kg.

Long Term Exposure: A potent acetylcholinesterase (AChE) inhibitor; cumulative effect is possible. This chemical may damage the nervous system with repeated exposure, resulting in convulsions, respiratory failure. May cause liver damage.

Points of Attack: Respiratory system, lungs, central nervous system, cardiovascular system, skin, eyes, plasma and red blood cell cholinesterase. May cause skin allergy.

Medical Surveillance: Evaluation by a qualified allergist. Medical observation is recommended for 24 to 48 hours following breathing overexposure, as pulmonary edema may be delayed. Cigarette smoking may exacerbate pulmonary injury and should be discouraged for at least 72 hours following exposure. Before employment and at regular times after that, the following are recommended: Plasma and red blood cell cholinesterase levels (tests for the enzyme poisoned by this chemical). If exposure stops, plasma levels return to normal in 1–2 weeks while red blood cell levels may be reduced for 1–3 months. When acetylcholinesterase enzyme levels are reduced by 25% or more below preemployment levels, risk of poisoning is increased, even if results are in lower ranges of "normal." Reassignment to work not involving carbamate pesticides is recommended until enzyme levels recover. If symptoms develop or overexposure occurs, repeat the above tests as soon as possible and get an exam of the nervous system. Also consider complete blood count and chest x-ray following acute overexposure

First Aid: Speed in removing material from eyes and skin is of extreme importance. *Eyes:* Eye contact can cause dangerous amounts of these chemicals to be quickly absorbed through the mucous membrane into the bloodstream. Immediately and gently flush eyes with plenty of warm or cold water (NO hot water) for at least 15 minutes, occasionally lifting the upper and lower eyelids. Get medical aid immediately. *Skin:* Get medical aid. Dermal contact can cause dangerous amounts of these chemicals to be absorbed into the bloodstream. Wearing the appropriate PPE equipment and respirator for carbamate pesticides, immediately flush skin with plenty of soap and water for at least 15 minutes while removing contaminated clothing and shoes. Shampoo hair promptly if contaminated; protect eyes. *Ingestion:* Call poison control. Loosen all clothing. Never give anything by mouth to an unconscious person. Get medical aid. *Do NOT induce vomiting.* * If conscious, alert, and able to swallow, rinse mouth and have victim drink 4 to 8 ounces of water. Check to see if poison control instructs you to use ipecac syrup, otherwise administer slurry of activated charcoal (2 oz in 8 oz of water). If victim is *unconscious or having convulsions,* do nothing except keep victim warm. **In some cases you may be specifically instructed by poison control to induce vomiting by way of 2 tablespoons of syrup of ipecac (adult) washed down with a cup of water*. Do NOT give activated charcoal before or with ipecac syrup. *Inhalation*: Get medical aid. Do not contaminate yourself. Wearing the appropriate PPE equipment and respirator for carbamate pesticides, immediately remove the victim from the contaminated area to fresh air. If the victim is not breathing, administer artificial respiration. Do not use mouth-to-mouth method if victim ingested or inhaled the substance; give artificial respiration with the aid of a pocket mask equipped with a one-way valve or other proper respiratory medical device. If breathing is difficult, administer oxygen through bag/mask apparatus until medical help arrives. Do not leave victim unattended. *Note to physician or authorized medical personnel.* Administer atropine, 2 mg (1/30 gr) intramuscularly or intravenously as soon as any local or systemic signs or symptoms of an intoxication are noted; repeat the administration of atropine every 3 to 8 minutes until signs of atropinization (mydriasis, dry mouth, rapid pulse, hot and dry skin) occur; initiate treatment in children with 0.05 mg/kg of atropine; repeat at 5 to 10 minute intervals. Watch respiration, and remove bronchial secretions if they appear to be obstructing the airway; intubate if necessary. *Medical note:* 2-PAMCI may be contraindicated in the case of some carbamate poisonings. As first aid for pulmonary edema, a doctor or authorized paramedic might consider administering a corticosteroid spray.

Personal Protective Methods: Wear protective gloves and clothing to prevent any reasonable probability of dermal and/or eye contact. Safety equipment suppliers/manufacturers can provide recommendations on the most protective glove/clothing material for your operation. DuPont™ Tychem® suit fabrics[88]. All protective clothing (suits, gloves, footwear, headgear) should be clean, available each day, and put on before work. Contact lenses should not be worn when working with this chemical. Wear dust-proof chemical goggles and face shield unless full facepiece respiratory protection is worn. Employees should wash immediately with soap when skin is wet or contaminated. Provide emergency showers and eyewash.

Respirator Selection: *At concentrations above the NIOSH REL, or where there is no REL, at any detectable concentration:* SCBAF:Pd,Pp (APF = 10,000): (any self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode); or SaF:Pd,Pp:ASCBA (APF = 10,000) (any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary self-contained positive-pressure breathing apparatus). *Escape*: GmFOv100 (APF = 50) [any air-purifying, full facepiece respirator (gas mask) with a chin-style, front- or back-mounted organic vapor canister having an N100, R100, or P100 filter]; or SCBAE (any appropriate escape-type, self-contained breathing apparatus).

Storage: Color Code-Blue: Health Hazard/Poison. Store in a secure poison location. Prior to working with this chemical you should be trained on its proper handling and storage. Store in tightly closed containers in a cool, well-ventilated area away from strong alkalis (such as sodium hydroxide, sodium bicarbonate, etc.). Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: Solid toxic carbamate must be labeled "poisonous materials." It falls into Hazard Class 6.1.

Spill Handling: For solids, isolate spill or leak area in all directions for at least 25 meters/75 feet; for liquids, isolate spill or leak area in all directions for at least 50 meters/150 feet. Increase, in the downwind direction, as necessary. Do not touch damaged containers or spilled material unless wearing appropriate protective clothing. Stop leak if you can do it without risk. Prevent entry into waterways, sewers, basements or confined areas. Cover with plastic sheet to prevent spreading. Absorb or cover with dry earth, sand or other non-combustible material and transfer to containers. Do not allow water to get inside containers.

Fire Extinguishing: Begins to decompose >150 °C. Hazardous decomposition includes oxides of nitrogen and carbon and hydrogen chloride gas. *On small fire:* use dry chemical powder, carbon dioxide, water spray, or foam. *On large fire:* use water spray, fog or alcohol-resistant foam. Do not scatter material using straight water jet streams. Dike fire control water for later disposal; do not scatter the material. Move containers from fire area if you can do it without risk. *Fire involving storage or vehicular tanks:* isolate for 800 meters/0.5 mile in all directions; also, consider initial evacuation for 800 meters/0.5 mile in all directions. Fight fire from maximum distance or use unmanned hose holders or monitor nozzles. Do not allow water to get inside containers. Cool containers with flooding quantities of water until well after fire is out. Withdraw immediately in the case of rising sound from venting safety devices or discoloration of tank. *Always* stay away from tanks engulfed in fire. For massive fire, use unmanned hose holders or monitor nozzles; if this is impossible, withdraw from area and let fire burn.

Disposal Method Suggested: Do not discharge into drains or sewers. Dispose of waste material as hazardous waste using a licensed disposal contractor to an approved landfill. Consult with environmental regulatory agencies for guidance on acceptable disposal practices. Incineration with effluent gas scrubbing is recommended. Containers must be disposed of properly by following package label directions or by contacting your local or federal environmental control agency, or by contacting your regional EPA office.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- USEPA, Office of Pesticide Programs, Pesticide Residue Limits, "Propamocarb Hydrochloride," 40 CFR 180.499, http://www.epa.gov/pesticides/food/viewtols.htm
- USEPA, "Reregistration Eligibility Decision (RED), Propamocarb Hydrochloride," Office of Prevention, Pesticides and Toxic Substances, Washington DC. http://www.epa.gov/REDs/3124red.pdf

Propanil P:1080

Use Type: Herbicide

CAS Number: 709-98-8

Formula: $C_9H_9Cl_2NO$

Synonyms: Cekupropanil; DCPA; *N*-(3,4-Dichlorophenyl) propanamide; 3',4'-Dichlorophenyl propionanilide; 3,4-Dichloropropionanilide; 3',4'-Dichloropropionanilide; Dichloropropionanilide; Dipram; DPA; NSC 31312; Propanamide, *N*-(3,4-Dichlorophenyl)-; Propanide; Propionanilide, 3',4'-Dichloro-; Propionic acid, 3,4-dichloroanilide

Trade Names: AI3-31382®; ARROSOLO®; ATLAS®; BAY® 30130; CHEM RICE®[C]; CRYSTAL PROPANIL-4®[C]; DREXEL PROP-JOB®; DROPAVEN®; DUET®; ERBAN®; FARMCO PROPANIL®; FW-734®; HERBANIL 368®; HERBAX TECHNICAL®; IDA PROP-A-NEL®; KENSOLO®; LONDAX PRO-PACK BNB®; MONTROSE PROPANIL®[C]; PANTOX®; PROPANEX®[C]; PROP-JOB®; PROPANIL MILENIA®; RISELECT®; ROGUE®[C]; ROSANIL®; RICECO TOUCHE®; S-10165®; SETRA PROWL®; STAM®; STAM® F-34; STAM® LV 10; STAMPEDE® 3E; STAM SUPERNOX®; STREL®; SURCOPUR®; SURPUR®; SUPERNOX®; SYNPRAN N®; TURF! EZ®; VERTAC®; WHAM! EZ®

Chemical class: Anilide; Acetanilide

EPA/OPP PC Code: 028201

California DPR Chemical Code: 503

HSDB Number: 1226

UN/NA & ERG Number: UN3077(solid)/171

RTECS® Number: UE4900000

EC Number: 211-914-6 [*Annex I Index No.:* 616-009-00-3]

Uses: Propanil is a post-emergence herbicide with no residual effect. It is used against numerous grasses and broad-leaved weeds in rice, potatoes, and wheat. Mixing with carbamates or organophosphorus compounds is not recommended. It is also used on wheat in a mixture with MCPA. With carbaryl, it is used in citrus crops grown in sod culture. Not approved for use in EU countries (re-submitted)[115]. Registered for use in the U.S.

U.S. Maximum Allowable Residue Levels for Propanil [40 CFR 180.274(a)]: cattle, fat 0.10 ppm; cattle, meat 0.05 ppm; cattle, meat byproducts 1.0 ppm; crayfish 0.05 ppm; egg 0.30 ppm; goat, fat 0.10 ppm; goat, meat 0.05 ppm; goat, meat byproducts 1.0 ppm; hog, fat 0.10 ppm; hog, meat 0.05 ppm; hog, meat byproducts 1.0 ppm; horse, fat 0.10 ppm; horse, meat 0.05 ppm; horse, meat byproducts 1.0 ppm; milk 0.05 ppm; poultry, fat 0.05 ppm; poultry, meat 0.10 ppm; poultry, meat byproducts 0.50 ppm; rice, bran 40 ppm; rice, grain 10 ppm; rice, hulls 30 ppm; rice, straw 75 ppm; sheep, fat 0.10 ppm; sheep, meat 0.05 ppm; sheep, meat byproducts 1.0 ppm.

Human toxicity (long-term)[101]: Intermediate–35.00 ppb, Health Advisory

Fish toxicity (threshold)[101]: Extra high–0.48990 ppb, MATC (Maximum Acceptable Toxicant Concentration)

Regulatory Authority and Advisory Information:

Carcinogenicity[83]: EPA Suggestive evidence of carcinogenicity, but not sufficient to assess human potential

Health Advisory: Mutagen

Acute Oral Category: 2, WARNING

Potential Ground Water Pollutant [California FAC Section 13145(d)/12811, active]

Safe Drinking Water Act: Priority List (55 FR 1470) as DCPA (and its acid metabolites)

EPCRA Section 313 Form R *de minimis* concentration reporting level: 1.0%

European/International Regulations: Hazard Symbol: Xn, N; risk phrases: R22; R50; safety phrases: S2; S22; S61 (see Appendix 1)

WGK (German Aquatic Hazard Class): 3-Severe hazard to waters

Description: Propanil is a colorless solid. The technical product is a brown crystalline solid. Commercial products used for field application may contain hydrocarbon solvents. Molecular weight = 218.09; Specific gravity (H_2O:1) = 1.22 @ 25 °C; Boiling point = 350 °C[83]; Freezing/Melting point (pure) = 89–92 °C (pure); 85–89 °C (technical grade); Vapor pressure = 2.6×10^{-7} mmHg @ 30 °C. Henry's Law constant = 1.71×10^{-9} atm-m^3/mol @ 25 °C (est)[83]. Hazard Identification (based on NFPA-704 M Rating System): Health 2, Flammability 0, Reactivity 0. Soluble in water; solubility = 125 ppm @ 22 °C; 152 mg/L @ 25 °C[83,USDA]. Commercial formulations use carrier solvents that may change the physical properties shown.

Permissible Exposure Limits in Air: Russia[43] set a MAC in work-place air of 0.1 mg/m^3 and has set MAC values for ambient air in residential areas of 0.005 mg/m^3 on a once-daily basis and 0.001 mg/m^3 on a daily average basis.

Permissible Concentration in Water: Federal Drinking Water Guidelines: 40 ppb[93] State Drinking Water Guidelines: Maine 35 μg/L.

Determination in Water: Log K_{ow} = >3.0. Values >3.0. May bioaccumulate in marine organisms.

Routes of Entry: Inhalation, ingestion, skin and/or eye contact.

Harmful Effects and Symptoms

Short Term Exposure: Causes blue lips or fingernails, blue skin, headaches and dizziness. Propanil is well tolerated by experimental animals on a chronic basis, and there is little or no indication of mutagenic or oncogenic properties of the compound. The highest no-adverse-effect concentration of propanil based on reproduction in the rat and acute, subchronic, and chronic studies in rats and dogs is 400 pm in the diet. Based on this data, ADI was calculated at 0.02 mg/kg/day. LD_{50} (oral, rat) = 300–4000 mg/kg; LD_{50} (dermal, rat) = >2; >5 g/kg.

Long Term Exposure: Possible liver, kidney, spleen, and testes toxin. The solvents in commercial products may cause a form of acne.

Points of Attack: Digestive system, skin, nails, central nervous system, liver, kidney, spleen, and testes.

Medical Surveillance: This chemical may be a human carcinogen. Exposed persons should contact a physician for advice regarding the possible long term health effects and advice for medical monitoring. In addition to comprehensive initial medical and work histories emphasizing reproductive experience and menstrual history, patient should have physical examination and testing of genito-urinary tract, sperm count, motility and morphology. If required, other tests, such as serum testosterone, serum follicle stimulating hormone (FSH), and serum lutenizing hormone (LH), may be indicated. Evaluation by a qualified allergist, including exposure history and testing, may help diagnose allergy. Any employee developing the above-listed conditions should be referred for further medical examination.

First Aid: If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least 15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately. If this chemical contacts the skin, remove contaminated clothing and wash immediately with soap and water. Seek medical attention immediately. If this chemical has been inhaled, remove from exposure, begin rescue breathing (using universal precautions) if breathing has stopped, and CPR if heart action has stopped. Transfer promptly to a medical facility. When this chemical has been swallowed, get medical attention. Give large quantities of water and induce vomiting. Do not make an unconscious person vomit.

Personal Protective Methods: Applicators and other handlers must wear: Coveralls worn over long-sleeved shirt and

long pants; Chemical-resistant gloves such as DuPont™ Tychem® suit fabrics, barrier laminate, or Viton®; Chemical-resistant footwear plus socks; Protective eye wear; Chemical-resistant headgear for overhead exposure; Chemical-resistant apron when cleaning equipment, mixing, or loading[83]. Agricultural Use/Engineering Controls: When handlers use closed systems, enclosed cabs, or aircraft in a manner that meets the requirements listed in the Worker Protection Standard (WPS) for agricultural pesticides, ***40 CFR 170.240(d)(4-6)***, the handler PPE requirements may be reduced or modified as specified in the Worker Protection Standard. Firefighters should wear NIOSH-approved self-contained breathing apparatus and full protective clothing.

Respirator Selection: *At any detectable concentration:* SCBAF: Pd,Pp (APF = 10,000) (any NIOSH/MSHA- or European Standard EN 149-approved self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode); or SaF: Pd,Pp: ASCBA (APF = 10,000) (any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary, self-contained breathing apparatus operated in a pressure-demand or other positive-pressure mode). *Escape:* 100 F (APF = 50) (any air-purifying, full facepiece respirator with an N100, R100, or P100 filter k-mounted organic vapor canister having a high-efficiency particulate filter); or SCBAE (any appropriate escape-type, self-contained breathing apparatus).

Storage: Color Code-Green: General storage may be used. Prior to working with this chemical you should be trained on its proper handling and storage. Store in tightly closed containers in a cool, well-ventilated area. Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: Environmentally hazardous substances, solid or liquid, usually fall in Hazard Class 9.

Spill Handling: Evacuate persons not wearing protective equipment from area of spill or leak until clean up is complete. Collect powdered material in the most convenient and safe manner and deposit in sealed containers. Ventilate area after clean up is complete. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable. Soil Adsorption Index (K_{oc}) = 149

Fire Extinguishing: This chemical is a combustible solid. Hazardous decomposition includes hydrogen chloride and oxides of nitrogen and carbon. As an immediate precautionary measure, isolate spill or leak area in all directions for at least 50 meters/150 feet for liquids and at least 25 meters/75 feet for solids. *Fire involving storage or vehicular tanks:* isolate for 800 meters/0.5 mile in all directions; also, consider initial evacuation for 800 meters/0.5 mile in all directions. *On a small fire:* use dry chemical, CO_2, water spray or regular foam. *On a large fire:* use water spray, fog or regular foam. Do not scatter spilled material with high-pressure streams of water. Move containers from fire area if you can do it without risk. Dike fire-control water for later disposal. *Fire involving tanks:* from a secure, explosion-proof location, use water spray to cool exposed containers. If cooling streams are ineffective (venting sound increases in volume and pitch, tank discolors, or shows any signs of deforming), withdraw immediately to a secure position. Always stay away from tanks engulfed in fire. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode.

Disposal Method Suggested: Do not discharge into drains or sewers. Dispose of waste material as hazardous waste using a licensed disposal contractor to an approved landfill. Consult with environmental regulatory agencies for guidance on acceptable disposal practices. Incineration with effluent gas scrubbing is recommended[22]. In accordance with 40CFR165, follow recommendations for the disposal of pesticides and pesticide containers. Noncombustible containers should be compacted and buried under more than 16 inches/40 cm of soil[83]. Must be disposed properly by following package label directions or by contacting your local or federal environmental control agency, or by contacting your regional EPA office.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- EXTOXNET, Extension Toxicology Network, "Pesticide Information Profile, Propanil," Oregon State University, Corvallis, OR (June 1986)
- USEPA, Office of Pesticide Programs, Pesticide Residue Limits, "Propanil," 40 CFR 180.274. http://www.epa.gov/pesticides/food/viewtols.htm

Propargite P:1085

Use Type: Miticide and acaricide

CAS Number: 2312-35-8

Formula: $C_{19}H_{26}O_4S$

Synonyms: AI3-27226; BPPS; 2-(*p-tert*-Butylphenoxy)cyclohexyl propargyl sulfite; Caswell No. 130I; Cyclosulfyne; 2-[4-(1,1-dimethylethyl)phenoxy]cyclohexyl 2-propynyl sulfite; 2-[4-(1,1-Dimethylethyl)phenoxy]cyclohexyl 2-propynyl sulfurous acid; ENT 27,226; Propargil;

Propargita (Spanish); Sulfurous acid, 2-[4-(1,1-dimethylethyl)phenoxy]cyclohexyl 2-propynyl ester; Sulfurous acid, 2-(*p-tert*-butylphenoxy)cyclohexyl-2-propynyl ester; 2-(*p-tert*-Butylphenoxy)cyclohexyl 2-propynyl sulfite; 2-(*p-tert*-Butylphenoxy)cyclohexyl propargyl sulfite; 2-(4-*tert*-Butylphenoxy)cyclohexyl prop-2-ynyl sulfite

Trade Names: COMITE II®; COMITE® AGRICULTURAL MITICIDE; D-014®; DIBROM OMITE®; DICTATOR®; NAUGATUCK® D-014; OMAIT®; OMITE®; OMITE® 570EW; RED-TOP®[C]; UNIROYAL® D-014; U.S. RUBBER D-014®

Chemical class: Organosulfite; Sulfite ester

EPA/OPP PC Code: 097601

California DPR Chemical Code: 445

HSDB Number: 1528

UN/NA & ERG Number: UN2810/153

RTECS® Number: WT2900000

EC Number: 219-006-1 [*Annex I Index No.:* 607-151-00-7]

Uses: Pending for use in EU countries[115]. A U.S. EPA restricted Use Pesticide (RUP). Used on a variety of bearing and non-bearing food crops and non-food sites. Grapes, walnuts, almonds, nectarines and mint are the most treated crops. Other crops include alfalfa, avocados, beans, boysenberries, carrots, cherries, citrus, corn, currants, dates, filberts, grapefruit, jojoba, grapes, hops, peanuts, sugar beets, cotton and ornamentals.

U.S. Maximum Allowable Residue Levels for Propargite [40 CFR 180.259(a)]: Almond 0.1 ppm; almond, hulls 55 bean, dry, seed 0.2 ppm; cattle, fat 0.1 ppm; cattle, meat byproducts 0.1 ppm; cattle, meat 0.1 ppm; citrus, dried pulp 40 ppm; corn, forage 10 ppm; corn, grain 0.1 ppm; corn, stover 10 ppm; cotton, undelinted seed 0.1 ppm; egg 0.1 ppm; goat, fat 0.1 ppm; goat, meat byproducts 0.1 ppm; goat, meat 0.1 ppm; grapefruit 5 grape 10 ppm; hog, fat 0.1 ppm; hog, meat byproducts 0.1 ppm; hog, meat 0.1 ppm; hop 15 ppm; hop, dried cones 30 ppm; horse, fat 0.1 ppm; horse, meat byproducts 0.1 ppm; horse, meat 0.1 ppm; lemon 5 ppm; milk, fat (0.08 ppm in milk) 2 ppm; mint 50 ppm; nectarine 4 ppm; orange, sweet 5 ppm; peanut 0.1 ppm; peanut, hay 10 ppm; peanut, hulls 10 ppm; poultry, fat 0.1 ppm; poultry, meat byproducts 0.1 ppm; poultry, meat 0.1 ppm; potato 0.1 ppm; sheep, fat 0.1 ppm; sheep, meat byproducts 0.1 ppm; sheep, meat 0.1 ppm; sorghum, forage 10 ppm; sorghum, grain 10 ppm; sorghum, grain, stover 10 ppm; tea, dried 10 ppm; walnut 0.1 ppm. *Tolerances with regional registration, as defined in section 180(n)* ***[40 CFR 180.259(c)]:*** in or on the following raw agricultural commodities: corn, sweet, kernel plus cob with husks removed 0.1 ppm.

Regulatory Authority and Advisory Information:

Carcinogenicity[83]: EPA Group B2, Probable human carcinogen; EU GHS Category 2: Suspected human carcinogen.

California Proposition 65 Chemical: Carcinogen (10/1 1994) and developmental toxin (6/15/1999)

U.S. TRI: Developmental toxin

Acute Oral Category: 3, CAUTION

Clean Water Act: Section 311 Hazardous Substances/RQ (same as CERCLA)

EPCRA Section 304 RQ: CERCLA, 10 lb (4.54 kg)

EPCRA Section 313 Form R *de minimis* concentration reporting level: 1.0%

European/International Regulations Hazard Symbol: T, Xi, N; risk phrases: R23; R40; R38; R41; R50/53; safety phrases: S1/2; S26; S28; S36/37/39; S45; S60; 61 (see Appendix 1)

Description: Flammable, dark amber or brown-yellow viscous liquid. Faint solvent odor. A strong odor of sulfur dioxide may indicate that partial decomposition has occurred. Commercial product is available as a wettable powder or as an emulsifiable concentrate. Molecular weight = 350.47; Specific gravity (H_2O:1) = 1.085 to 1.115 @ 20 °C[86]; Boiling point = (decomposes) ~200 °C; Freezing/Melting point = 70 °C; Vapor pressure = 3×10^{-3} mmHg @ 20 °C. Flash point = 27.8 °C (oc)[86]. Hazard Identification (based on NFPA-704 M Rating System): Health 2, Flammability 2, Reactivity 0. Practically insoluble in water; sinks slowly in water; solubility 10.5 mg/L. Physical and toxicological properties may be affected by carrier solvents in commercial formulations.

Incompatibilities: Incompatible with oxidizers, chlorates, nitrates, peroxides, sulfuric acid, caustics, ammonia, aliphatic amines, alkanolamines, isocyanates, alkylene oxides, epichlorohydrin. May react with water, steam, or acids, forming corrosive acid solution and sulfur oxide fumes. Incompatible with lead diacetate, mercury(I) chloride. Esters hydrolyze to form sulfur dioxide and alcohols; reaction is more rapid under basic conditions. Strong oxidizing acids may cause a vigorous reaction that is sufficiently exothermic to ignite the reaction products. Heat is also generated by the interaction of esters with caustic solutions. Flammable hydrogen is generated by mixing esters with alkali metals and hydrides.

Permissible Concentration in Water: State Drinking Water Guidelines: Arizona 160 μg/L. Runoff from spills or fire control may cause water pollution.

Determination in Water: Log K_{ow} = >4.5. Values above 3.0 are likely to bioaccumulate in aquatic organisms.

Routes of Entry: Inhalation, ingestion, dermal contact.

Harmful Effects and Symptoms

Short Term Exposure: Contact may burn eyes, skin, and respiratory tract. Toxic if ingested. If spilled on clothing and allowed to remain may cause smarting and reddening of skin. May cause skin sensitization and allergy. LD_{50} (oral, rat) = 1500 mg/kg; LD_{50} (dermal, rat) = 250 mg/kg[83].

Long Term Exposure: Skin sensitizer.

Points of Attack: Ingestion, dermal and/or eye contact.

Medical Surveillance: This chemical is a suspected or known human carcinogen. Exposed persons should contact a physician for advice regarding the possible long term health effects and advice for medical monitoring. Consult a physician if poisoning is suspected or if redness, itching, or burning of the eyes or skin develops. Evaluation by a qualified allergist, including exposure history and testing, may help diagnose allergy.

First Aid: If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least

15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately. If this chemical contacts the skin, remove contaminated clothing and wash immediately with soap and water. Seek medical attention immediately. If this chemical has been inhaled, remove from exposure, begin rescue breathing (using universal precautions) if breathing has stopped, and CPR if heart action has stopped. Transfer promptly to a medical facility. When this chemical has been swallowed, get medical attention. *Do not induce vomiting when formulations containing petroleum solvents are ingested*. Otherwise, give large quantities of water and induce vomiting. Do not make an unconscious person vomit.

Personal Protective Methods: Applicators and other handlers must wear: Coveralls worn over long-sleeved shirt and long pants; Chemical-resistant gloves such as DuPont™ Tychem® suit fabrics, barrier laminate, or Viton®; Chemical-resistant footwear plus socks; Protective eye wear; Chemical-resistant headgear for overhead exposure; Chemical-resistant apron when cleaning equipment, mixing, or loading[83]. Agricultural Use/Engineering Controls: When handlers use closed systems, enclosed cabs, or aircraft in a manner that meets the requirements listed in the Worker Protection Standard (WPS) for agricultural pesticides, ***40 CFR 170.240(d)(4-6)***, the handler PPE requirements may be reduced or modified as specified in the Worker Protection Standard. Firefighters should wear NIOSH-approved self-contained breathing apparatus and full protective clothing.

Respirator Selection: *At any detectable concentration:* SCBAF: Pd,Pp (APF = 10,000) (any NIOSH/MSHA- or European Standard EN 149-approved self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode); or SaF: Pd,Pp: ASCBA (APF = 10,000) (any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary, self-contained breathing apparatus operated in a pressure-demand or other positive-pressure mode). *Escape:* 100F (APF = 50) (any air-purifying, full facepiece respirator with an N100, R100, or P100 filter k-mounted organic vapor canister having a high-efficiency particulate filter); or SCBAE (any appropriate escape-type, self-contained breathing apparatus).

Spill Handling: *For liquids*, isolate spill or leak area in all directions for at least 50 meters /150 feet. Increase, in the downwind direction, as necessary. Do not touch damaged containers or spilled material unless wearing appropriate protective clothing. Stop leak if you can do it without risk. Prevent entry into waterways, sewers, basements or confined areas. Cover with plastic sheet to prevent spreading. Absorb or cover with dry earth, sand or other non-combustible material and transfer to containers. Do not get water inside containers. *For solids*, isolate spill or leak area in all directions for at least 25 meters/75 feet. Increase, in the downwind direction, as necessary. Do not touch damaged containers or spilled material unless wearing appropriate protective clothing. Stop leak if you can do it without risk. Prevent entry into waterways, sewers, basements or confined areas. Cover with plastic sheet to prevent spreading. Absorb or cover with dry earth, sand or other non-combustible material and transfer to containers. Do not get water inside container.

Fire Extinguishing: *On a small fire*: use dry chemical powder, carbon dioxide or water spray. *On a large fire:* use water spray, fog or alcohol-resistant foam. Move containers from fire area if you can do it without risk. Dike fire-control water for later disposal. Use water spray or fog; do not scatter material using straight water jet streams. *Fire involving storage or vehicular tanks:* isolate for 800 meters/0.5 mile in all directions; also, consider initial evacuation for 800 meters/0.5 mile in all directions. Fight fire from maximum distance or use unmanned hose holders or monitor nozzles. Do not get water inside containers. Cool containers with flooding quantities of water until well after fire is out. Withdraw immediately in the case of rising sound from venting safety devices or discoloration of tank. *Always* stay away from tanks engulfed in fire. For massive fire, use unmanned hose holders or monitor nozzles; if this is impossible, withdraw from area and let fire burn.

Disposal Method Suggested: Do not discharge into drains or sewers. Dispose of waste material as hazardous waste using a licensed disposal contractor to an approved landfill. Consult with environmental regulatory agencies for guidance on acceptable disposal practices. If allowed, incineration with effluent gas scrubbing is recommended. Containers must be disposed of properly by following package label directions or by contacting your local or federal environmental control agency, or by contacting your regional EPA office.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- USEPA, "Reregistration Eligibility Decision (RED), Propargite, Case No. 0243," Office of Prevention, Pesticides and Toxic Substances, Washington DC. http://www.epa.gov/REDs/propargite_red.pdf
- New Jersey Department of Health and Senior Services, "Hazardous Substance Fact Sheet, Propargite," Trenton, NJ (January 2002). http://www.state.nj.us/health/eoh/rtkweb/1596.pdf
- International Programme on Chemical Safety (IPCS), "Propargite," Geneva, Switzerland (1978). http://www.inchem.org/documents/jmpr/jmpmono/v078pr26.htm

Propazine P:1110

Use Type: Herbicide

CAS Number: 139-40-2

Formula: $C_9H_{16}ClN_5$

Synonyms: 2,4-Bis(isopropylamino)-6-chloro-*s*-triazine; 2-Chloro-4,6-bis(isopropylamino)-*s*-triazine; Propasin

Trade Names: GEIGY® 30,028; GESAMIL®; MAXX-90®; MILOCEP®; MILOGARD®[C]; MILO-PRO®; PLANTULIN®; PRIMATOL P®; PROPAZIN®; PROPINEX®; PROZINEX®

Chemical class: Triazine
EPA/OPP PC Code: 080808
California DPR Chemical Code: 504
HSDB Number: 1400
UN/NA & ERG Number: UN2753/151
RTECS® Number: XY5300000
EC Number: 205-359-9 [*Annex I Index No.:* 613-067-00-1]

Uses: Atrazine, simazine, and propazine and their common chlorinated degradates have a common mechanism of toxicity. They have similar applications. Propazine is used for control of broadleaf weeds and annual grasses in sweet sorghum. It is applied as a spray at the time of planting or immediately following planting, but prior to weed or sorghum emergence. It is also used as a post-emergence selective herbicide on carrots, celery and fennel. Not approved for use in EU countries[115]. Some formulations are U.S. EPA restricted Use Pesticides (RUPs).

U.S. Maximum Allowable Residue Levels for Propazine (40 CFR 180.243): sorghum, forage 0.25 ppm; sorghum, grain 0.25 ppm; sorghum, grain, stover 0.25 ppm; sorghum, sweet 0.25 ppm.

Regulatory Authority and Advisory Information:
Carcinogenicity[83]: EPA, Not likely to be carcinogenic to humans. *Note:* Reclassified from Group C in 2000; EU GHS Category 2: Suspected human carcinogen
Acute Oral Category: 3, Caution
Health Advisory: Tumorigen
European/International Regulations: Hazard Symbol: Xn, N; risk phrases: R40; R50/53; safety phrases: S2; S36/37; S60; S61 (see Appendix 1)

Description: Propazine is a colorless crystalline solid or powder. Molecular weight = 229.71; Specific gravity (H_2O:1) = 1.16 @ 20 °C; Boiling point = 318.5°C; Freezing/Melting point = 213.5 °C; Vapor pressure = 1.3×10^{-7} mmHg @ 20 °C. Slightly soluble in water; solubility = 9.0 ppm @ 20 °C; 4.5×10^{-4} g/100 mL @ 20 °C.

Permissible Exposure Limits in Air: Russia[43] set a MAC in work-place air of 5.0 mg/m^3 and a MAC in ambient air in residential areas of 0.04 mg/m^3 both on a momentary and an average daily basis.

Permissible Concentration in Water: Federal Drinking Water Guidelines: EPA 10 μg/L; State Drinking Water Guidelines: Maine 14 μg/L; Florida 10 μg/L.

Determination in Water: Log K_{ow} = >3.5. Values above 3.0 are likely to bioaccumulate in aquatic organisms.

Determination in Water: Analysis of propazine is by a gas chromatographic (GC) method applicable to the determination of certain nitrogen-phosphorus-containing pesticides in water samples. In this method, approximately 1 liter of sample is extracted with Methylene chloride. The extract is concentrated and the compounds are separated using capillary column GC. Measurement is made using a nitrogen-phosphorus detector. The method detection limit has not been determined for propazine, but it is estimated that the detection limits for analytes included in this method are in the range of 0.1 to 2 μg/L. Log K_{ow} = ~3.0. Values at or above 3.0 are likely to bioaccumulate in marine organisms.

Routes of Entry: Inhalation, ingestion, skin and/or eye contact. May be absorbed by the skin.

Harmful Effects and Symptoms

Short Term Exposure: May cause eye irritation. Skin irritant/sensitizer was reported among workers involved in propazine manufacturing. LD_{50} (oral, rat) = 3000–4000 mg/kg; LD_{50} (dermal, rat) = >3000 mg/kg.

Long Term Exposure: May cause skin allergy, development of tumors. May cause reproductive and fetal effects.

Points of Attack: Skin. Reproductive cells.

Medical Surveillance: Examination by a qualified allergist. A suspected tumorigen. Exposed persons should contact a physician for advice regarding the possible long term health effects and advice for medical monitoring. In addition to comprehensive initial medical and work histories emphasizing reproductive experience and menstrual history, patient should have physical examination and testing of genito-urinary tract, sperm count, motility and morphology. If required, other tests, such as serum testosterone, serum follicle stimulating hormone (FSH), and serum lutenizing hormone (LH), may be indicated.

First Aid: If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least 15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately. If this chemical contacts the skin, remove contaminated clothing and wash immediately with soap and water. Seek medical attention immediately. If this chemical has been inhaled, remove from exposure, begin rescue breathing (using universal precautions) if breathing has stopped, and CPR if heart action has stopped. Transfer promptly to a medical facility. When this chemical has been swallowed, get medical attention. Give large quantities of water and induce vomiting. Do not make an unconscious person vomit.

Personal Protective Methods: Wear protective gloves and clothing to prevent any reasonable probability of dermal and/or eye contact. Safety equipment suppliers/manufacturers can provide recommendations on the most protective glove/clothing material for your operation. All protective clothing (suits, gloves, footwear, headgear) should be clean, available each day, and put on before work. Contact lenses should not be worn when working with this chemical. Wear dust-proof chemical goggles and face shield unless full facepiece respiratory protection is worn. Employees should wash immediately with soap when skin is wet or contaminated. Provide emergency showers and eyewash.

Respirator Selection: Follow regulations in OSHA 29CFR1910.134 or European Standard EN149. Use a NIOSH/MSHA- or European Standard EN149-approved respirator; or use an approved supplied-air respirator with a full facepiece operated in the positive-pressure mode, or with a full facepiece, hood, or helmet in the continuous-flow mode; or use a NIOSH/MSHA- or European Standard EN149-approved self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive-pressure mode.

Storage: Color Code-Blue: Health Hazard/Poison: Store in a secure poison location. Prior to working with this chemical you should be trained on its proper handling and storage. Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: Triazine pesticides, solid, toxic, require a shipping label of "poisonous materials." Hazard Class 6.1.

Spill Handling: Evacuate persons not wearing protective equipment from area of spill or leak until clean up is complete. Collect powdered material in the most convenient and safe manner and deposit in sealed containers. Ventilate area after clean up is complete. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable. Soil Adsorption Index (K_{oc}) = 154.

Fire Extinguishing: Hazardous decomposition includes nitrogen oxides and chlorine. This chemical is a combustible solid. Use dry chemical, carbon dioxide; water spray; or alcohol foam extinguishers. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies. From a secure, explosion-proof location, use water spray to cool exposed containers. If cooling streams are ineffective (venting sound increases in volume and pitch, tank discolors, or shows any signs of deforming), withdraw immediately to a secure position. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode.

Disposal Method Suggested: It is the responsibility of chemical waste generators to determine if a discarded chemical is classified as a hazardous waste. See 40 CFR Parts 261.3 for U.S. EPA guidelines for the classification determination. Additionally, in order to ensure complete and accurate classification, waste generators must consult state and local hazardous waste regulations. Do not discharge into drains or sewers. Dispose of waste material as hazardous waste using a licensed disposal contractor to an approved landfill. Consult with environmental regulatory agencies for guidance on acceptable disposal practices. If allowed, incineration with effluent gas scrubbing is recommended. Containers must be disposed of properly by following package label directions or by contacting your local or federal environmental control agency, or by contacting your regional EPA office.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- EXTOXNET, Extension Toxicology Network, "Pesticide Information Profile, Propazine," Oregon State University, Corvallis, OR (June 1996). http://extoxnet.orst.edu/pips/propazin.htm
- USEPA, Office of Pesticide Programs, Pesticide Residue Limits, "Propazine," 40 CFR 180.243. http://www.epa.gov/pesticides/food/viewtols.htm
- USEPA, "Pesticide Fact Sheet: Propazine," Washington DC, Office of Prevention, Pesticides and Toxic Substances (September 1998). http://www.epa.gov/opprd001/factsheets/propazinepdf

Propetamphos P:1115

Use Type: Fungicide, Insecticide

CAS Number: 31218-83-4

Formula: $C_{10}H_{20}NO_4PS$

Synonyms: 2-Butenoic acid, 3-[((ethylamino) methoxyphosphinothioyl)oxy]-, isopropylester, *(E)*-; 2-Butenoic acid, 3-[((ethylamino) methoxyphosphinothioyl) oxy]-,1-methylethyl ester, *(E)*-; Caswell No. 706A; Crotonic acid, 3-hydroxy-, isopropyl ester, O-ester with O-methyl ethylphosphoramidothioate, *(E)*-; ENT 27989; 3-[((Ethylamino) methoxyphosphinothioyl)oxy]-2-butenoic acid, 1-methylethyl ester; *(E)*-O-2-Isopropoxycarbonyl-1-methylvinyl O-methylethylphosphoramidothioate; O-(1-Isopropoxycarbonyl-1-propen-2-yl)-O-methyl-ethyl-phosphoramidothionate; Isopropyl 3-[((ethylamino)methoxyphosphinothioyl)oxy]crotonate; Isopropyl 3-(ethylamino(methoxy)phosphinothioyloxy) isocrotonate; 1-Methylethyl*(E)*-3-[((ethylamino) methoxyphosphinothioyl)oxy]-2-butenoate; *(E)*-1-Methylethyl 3-[((ethylamino)methoxy phosphinothioyl)oxy]-2-butenoate; Z-O-2-iso-Propoxycarbonyl-1-methylvinyl O-methyl ethyl phosphoramidothioate; Phosphoramidothioic acid, *N*-ethyl-, *(E)*-O-(2-isopropoxycarbonyl-1-methylvinyl) O-methyl ester

Trade Names: BLOTIC®; OVIDIP®; SAFROTIN®[C]; SAN-52139®; SANDOZ®- 52139; SERAPHOS®; TSAR®; VEL-4283®; ZOECON®

Chemical class: Organophosphate

EPA/OPP PC Code: 113601; (216800 old EPA code number)

California DPR Chemical Code: 2122

HSDB Number: 6985

UN/NA & ERG Number: UN3018 (liquid)/152

RTECS® Number: GQ4750000

EC Number: 250-517-2 [*Annex I Index No.:* 015-136-00-6]

Uses: Propetamphos is used indoors for the control of structural insects, e. g., ants, cockroaches, fleas, and termites. It is applied in indoor residential, medical, commercial, and industrial buildings, and in food service establishments where there is no contact with food, and where no processing, packing, or warehousing of food occurs. It is also used in veterinary practice to control ticks, lice, mites and other parasites in livestock. Not listed for use in EU countries[115]. Some formulations may be U.S. EPA restricted Use Pesticides (RUPs).

Regulatory Authority and Advisory Information: U.S.

EPA Carcinogens: Unlikely carcinogen

Acute Oral Category: 1, DANGER–POISON.

Health Advisory: Nerve Toxin

EPCRA Section 313 Form R *de minimis* concentration reporting level: 1.0%

DOT Inhalation Hazard Chemicals

Description: Yellowish, oily liquid at room temperature. Commercial product is available as an emulsifiable concentrate. Molecular weight = 281.30; Specific gravity (H_2O:1) = 1.1294 @ 20 °C[88]; Boiling point = 88 °C @ 0.005 mmHg; Vapor pressure = 3×10^{-4} mmHg @ 25 °C. Soluble in water; solubility – 1000 mg/L @ 25 °C. Physical and toxicological properties may be affected by carrier solvents in commercial formulations.

Incompatibilities: May react violently with antimony(V) pentafluoride. Incompatible with lead diacetate, magnesium, silver nitrate. In the presence of strong reducing agents such as hydrides, organophosphates form highly toxic and flammable phosphine gas. Contact with oxidizers can cause the release of toxic oxides of phosphorus.

Determination in Air: OSHA versatile sampler-2; Toluene/Acetone; Gas chromatography/Flame ionization detection; NIOSH IV, Method #5600, Organophosphorus Pesticides.[18].

Determination in Water: Log K_{ow} = >3.5. Values above 3.0 are likely to bioaccumulate in aquatic organisms.

Harmful Effects and Symptoms

Short Term Exposure: Organophosphates can cause cholinesterase inhibition in humans, resulting in overstimulation of the nervous system, nausea, dizziness, confusion; and, at very high exposures, such as accidents or major spills, respiratory paralysis and death[83]. Eye pupils are small; blurred vision; eye watering; runny nose; cough; shortness of breath; salivation; dizziness; nausea, stomach cramps, diarrhea, and vomiting; increased blood pressure; profuse sweating; hypermotility, hallucinations; irritability; tingling of the skin; drowsiness; slow heartbeat; convulsions; fluid in lungs; loss of consciousness; incontinence; breathing stops; death. Organophosphates inhibit the action of acetylcholinesterase enzymes, and alter the way in which nervous impulses are transmitted. The effects can last for hours, days, or much longer. The action of the enzymes is reestablished after new enzymes are formed. LD_{50} (oral, rat) = 75–150 mg/kg; LD_{50} (dermal, rat) = 2200–2300 mg/kg.

Long Term Exposure: Cholinesterase inhibitor; cumulative effect is possible. Neurotoxic. Organophosphates may damage the nervous system with repeated exposure, resulting in convulsions, respiratory failure. May cause liver damage.

Points of Attack: Respiratory system, central nervous system, cardiovascular system, blood cholinesterase.

Medical Surveillance: Medical observation is recommended for 24 to 48 hours following breathing overexposure, as pulmonary edema may be delayed. Cigarette smoking may exacerbate pulmonary injury and should be discouraged for at least 72 hours following exposure. Routine biological monitoring of pesticide applicators and field workers includes testing of plasma and red blood cell acetylcholinesterase levels (for enzyme poisoned by this chemical). These tests are normally accurate only if done within about two hours of exposure. If exposure stops, plasma levels return to normal in 1–2 weeks while red blood cell levels may be reduced for 1–3 months. When acetylcholinesterase enzyme levels are reduced by 25% or more below preemployment levels, risk of poisoning is increased, even if results are in lower ranges of “normal.” Reassignment to work not involving organophosphate pesticides is recommended until enzyme levels recover. Do not drink any alcoholic beverages before or during use as it promotes absorption of organophosphates.

First Aid: Speed in removing material from eyes and skin is of extreme importance. *Eyes:* Eye contact can cause dangerous amounts of these chemicals to be quickly absorbed through the mucous membrane into the bloodstream. Immediately and gently flush eyes with plenty of warm or cold water (NO hot water) for at least 15 minutes, occasionally lifting the upper and lower eyelids. Get medical aid immediately. *Skin:* Get medical aid. Dermal contact can cause dangerous amounts of these chemicals to be absorbed into the bloodstream. Wearing the appropriate PPE equipment and respirator for organophosphate pesticides, immediately flush skin with plenty of soap and water for at least 15 minutes while removing contaminated clothing and shoes. Shampoo hair promptly if contaminated. *Ingestion:* Call poison control. Loosen all clothing. Never give anything by mouth to an unconscious person. Get medical aid. Do NOT induce vomiting. * If conscious, alert, and able to swallow, rinse mouth and have victim drink 4 to 8 ounces of water do NOT induce vomiting but immediately administer slurry of activated charcoal (2 oz in 8 oz of water). If victim is *unconscious or having convulsions,* do nothing except keep victim warm. **In some cases you may be specifically instructed by poison control to induce vomiting by way of 2 tablespoons of syrup of ipecac (adult) washed down with a cup of water*. Do NOT give activated charcoal before or with ipecac syrup. *Inhalation:* Get medical aid. Do not contaminate yourself. Wearing the appropriate PPE equipment and respirator for organophosphate pesticides, immediately remove the victim from the contaminated area to fresh air. If the victim is not breathing, administer artificial respiration. Do not use mouth-to-mouth method if victim ingested or inhaled the substance; give artificial respiration with the aid of a pocket mask equipped with a one-way valve or other proper respiratory medical device. If breathing is difficult, administer oxygen through bag/mask apparatus until medical help arrives. Do not leave victim unattended. *Note* *to physician or authorized medical personnel.* Administer atropine, 2 mg (1/30 gr) intramuscularly or intravenously as soon as any local or systemic signs or symptoms of an intoxication are noted; repeat the administration of atropine every 3 to 8 minutes until signs of atropinization (mydriasis, dry mouth, rapid pulse, hot and dry skin) occur; initiate treatment in children with 0.05 mg/kg of atropine; repeat at 5 to 10 minute intervals. Watch respiration, and remove bronchial secretions if they appear to be obstructing the airway; intubate if necessary. *Notes to physician or authorized medical personnel*: *N*-methylpyridinium-2-aldoxime (2-PAMCI) when used in conjunction with atropine reacts with the phosphorylated cholinesterase, thereby restoring normal activity to by removing the phosphorylating group. The combination of these two chemicals is synergistic and must be administered within minutes to a few hours following exposure (depending on the specific agent) to be effective. Give 2-PAMCI (Pralidoxime; Protopam), 2.5 g in 100 ml of sterile water or in 5% dextrose and water, intravenously, slowly, in 15–30 minutes; if sufficient fluid is not available, give 1 g of 2-PAMCI in 3 ml of distilled water by deep intramuscular injection; repeat this every half hour if respiration weakens or if muscle fasciculation or convulsions recur. Also diazepam, an anticonvulsant, might be considered. As first aid for pulmonary edema, a doctor or authorized paramedic might consider administering a corticosteroid spray.

Personal Protective Methods: Wear protective gloves and clothing to prevent any reasonable probability of dermal and/or eye contact. Safety equipment suppliers/manufacturers can provide recommendations on the most protective glove/clothing material for your operation. One recommendation is the use of DuPont™ Tychem® suit fabrics[88]. All protective clothing (suits, gloves, footwear, headgear) should be clean, available each day, and put on before work. Contact lenses should not be worn when working with this chemical. Wear splash-proof chemical goggles and face shield unless full facepiece respiratory protection is worn. Employees should wash immediately with soap when skin is wet or contaminated. Provide emergency showers and eyewash.

Respirator Selection: Engineering controls should be used wherever feasible to maintain airborne concentrations of this chemical below the prescribed exposure limit. Respirators and protective equipment are less effective than engineering controls, and should be used only in non-routine or emergency situations which may result in exposure concentrations in excess of the TWA environmental limit. *At any concentrations above the NIOSH REL, or where there is no REL, at any detectable concentration:* SCBAF: Pd,Pp (APF = 10,000) (any NIOSH/MSHA- or European Standard EN 149-approved self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode); or SaF: Pd,Pp: ASCBA (APF = 10,000) (any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary, self-contained breathing apparatus operated in a pressure-demand or other positive-pressure mode).

Storage: Color Code-Blue: Health Hazard/Poison. Store in a secure poison location. Prior to working with this chemical you should be trained on its proper handling and storage. Where possible, automatically transfer material from other storage containers to process containers. Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: Organophosphorus pesticides, solid or liquid (nonflammable), require a "poisonous materials" label. This chemical falls in Hazard Class 6.1.

Spill Handling: First remove all sources of ignition. Evacuate persons not wearing protective equipment from area of spill or leak until clean up is complete. Stay upwind; keep out of low areas. Ventilate area of spill or leak. Remove and isolate contaminated clothing at the site. Do not touch spilled material; stop leak if you can do so without risk. Use water spray to reduce vapors. *Small spills:* absorb with sand or other noncombustible absorbent material and place into containers for later disposal. *Large spills:* dike far ahead of spill for later disposal. Collect powdered material in the most convenient and safe manner and deposit in sealed containers. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable. Seek professional environmental engineering assistance from the U.S. EPA Environmental Response Team at (908) 548-8730 (24-hour response line).

Fire Extinguishing: Hazardous decomposition includes oxides of phosphorus, sulfur, and nitrogen. May be fatal if inhaled, ingested or absorbed through skin. Inhalation or contact with some of these materials will irritate or burn skin and eyes. Vapors may cause dizziness or suffocation. *Small fires:* dry chemical, carbon dioxide; water spray; or foam. *Large fires:* water spray, fog, or foam. Stay upwind; keep out of low areas. Ventilate closed spaces before entering them. Firefighting gear (including SCBA) may not provide adequate protection. If exposure occurs, remove and isolate gear immediately and thoroughly decontaminate personnel. Wear positive-pressure breathing apparatus and special protective clothing. Remove and isolate contaminated clothing at the site. Move container from fire area if you can do so without risk. Fight fire from maximum distance. Dike fire-control water for later disposal; do not scatter the material. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies.

From a secure, explosion-proof location, use water spray to cool exposed containers. If cooling streams are ineffective (venting sound increases in volume and pitch, tank discolors, or shows any signs of deforming), withdraw immediately to a secure position. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode.

Disposal Method Suggested: Destruction by alkali hydrolysis or incineration. Containers must be disposed of properly by following package label directions or by contacting your local or federal environmental control agency, or by contacting your regional EPA office.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- USEPA, "Interim Reregistration Eligibility Decision (IRED), Propetamphos," Office of Prevention, Pesticides and Toxic Substances, Washington DC (October 2000). http://www.epa.gov/REDs/2550ired.pdf
- EXTOXNET, Extension Toxicology Network, "Pesticide Information Profile, Propetamphos," Oregon State University, Corvallis, OR (June 1996). http://extoxnet.orst.edu/pips/propetam.htm

Propiconazole P:1125

Use Type: Fungicide

CAS Number: 60207-90-1; 75881-82-2

Formula: $C_{15}H_{17}Cl_2N_3O_2$

Synonyms: Caswell No. 323EE; Desmel; (±)-1-[2-(2,4-Dichlorophenyl)-4-propyl-1,3-dioxolan-2-ylmethyl]-1*H*-1,2,4-triazole; 1-[(2-(2,4-Dichlorophenyl)-4-propyl-1,3-dioxolan-2-yl)methyl]-1*H*-1,2,4-triazole; 1-[2-(2,4-Dichlorophenyl)-4-propyl-1,3-dioxolan-2-yl]-methyl-1*H*-1,2,4,-triazole; Proconazole; 1*H*-1,2,4-Triazole, 1-[(2-(2,4-dichlorophenyl)-4-propyl-1,3-dioxolan-2-yl) methyl]-

Trade Names: ALAMO®; BANNER®; BENIT®; BREAK®; BUMPER®; CGA-64250®; CGA-92710F®; DESMEL®; FIDIS®; JUNO®; MANTI® S; MAXX®; NOVEL®; ORBIT®; PRACTIS®; PROPIMAX®; RADAR®; RESTORE®; SPIRE®; STRATEGO® (trifloxystrobin+propiconazole); TASPA®; TILT®; WOCOSIN®

Chemical class: Azole; Triazole

EPA/OPP PC Code: 122101

California DPR Chemical Code: 2276

HSDB Number: 6731

UN/NA & ERG Number: UN3082 (liquid)/171

RTECS® Number: XZ4620000

EC Number: 262-104-4 [*Annex I Index No.:* 613-205-00-0]

Uses: Used to control fungi on a broad range of crops and turf. Used on ornamentals, range land and rights-of-way to prevent and control powdery mildew and fungi on hardwoods and conifers.

U.S. Maximum Allowable Residue Levels for Propiconazole [40 CFR 180.434(a)]: banana 0.2 ppm; barley, grain 0.1 ppm; barley, straw 1.5 ppm; cattle, fat 0.1 ppm; cattle, kidney 2.0 ppm; cattle, liver 2.0 ppm; cattle, meat byproducts, except kidney and liver 0.1 ppm; cattle, meat 0.1 ppm; celery 5.0 ppm; fruit, stone, group 12 1.0 ppm; goat, fat 0.1 ppm; goat, kidney 2.0 ppm; goat, liver 2.0 ppm; goat, meat byproducts, except kidney and liver 0.1 ppm; goat, meat 0.1 ppm; grass, forage 0.5 ppm; grass, hay 40 ppm; grass, straw 40 ppm; hog, fat 0.1 ppm; hog, kidney 2.0 ppm; hog, liver 2.0 ppm; hog, meat byproducts, except kidney and liver 0.1 ppm; hog, meat 0.1 ppm; horse, fat 0.1 ppm; horse, kidney 2.0 ppm; horse, liver 2.0 ppm; horse, meat byproducts, except kidney and liver 0.1 ppm; horse, meat 0.1 ppm; milk 0.05 ppm; mushroom 0.1 ppm; oat, forage 10.0 ppm; oat, grain 0.1 ppm; oat, hay 30.0 ppm; oat, straw 1.0 ppm; peanut 0.2 ppm; 11/30/08 peanut, pecans 0.1 ppm; pineapple, fodder 0.1 ppm; 11/30/08 plum, prune, fresh 1.0 ppm; rice, grain 0.1 ppm; rice, straw 3.0 ppm; rye, grain 0.1 ppm; rye, straw 1.5 ppm; sheep, fat 0.1 ppm; sheep, kidney 2.0 ppm; sheep, liver 2.0 ppm; sheep, meat byproducts, except kidney and liver 0.1 ppm; sheep, meat 0.1 ppm; wheat, grain 0.1 ppm; wheat, straw 1.5 ppm. *Regional registration, as defined in section 180.1(n)* ***[40 CFR 180.434(c)]:*** mint, tops (leaves and stems) 0.3 ppm; wild rice 0.5 ppm.

Regulatory Authority and Advisory Information:

Carcinogenicity[83]: EPA Group C, Possible human carcinogen

Health Advisory: Developmental & Reproductive Toxin, Endocrine disruptor (S!)

Poison (oral) Category: 3, CAUTION

EPCRA Section 313 Form R *de minimis* concentration reporting level: 1.0%

Regulations: Hazard Symbol: T, Xn, Xi, N; risk phrases: R22; R43; R50/53; safety phrases: S1/2; S36/37; S46; S60; S61 (see Appendix 1).

WGK (German Aquatic Hazard Class): 3-Severe hazard to waters

Description: Colorless solid or a yellow thick liquid. Odorless. Commercial product is available as an emulsifiable concentrate. Physical and toxicological properties may be affected by carrier solvents in commercial formulations. Molecular weight = 342.22; Specific gravity (H_2O:1) = 1.33 @ 20 °C; Boiling point = (decomposes); Freezing/Melting point = –25 °C; Vapor pressure = 4.2×10^{-7} mmHg @ 20 °C; Flash point = 244 °C. Hazard Identification (based on NFPA-704 M Rating System): Health 3, Flammability 0, Reactivity 0. Soluble in water; solubility = 112 ppm.

Incompatibilities: The triazoles are sensitive to heat, friction, and impact. Sensitivity varies with the type of substitution to the triazole ring. Metal chelated and halogen substitution of the triazol ring make for a particularly heat- sensitive material. Azido and nitro derivatives have been employed as high explosives. No matter the derivative these materials should be treated as explosives[88].

Permissible Concentration in Water: Federal Drinking Water Guidelines: 9 ppb[93] State Drinking Water Guidelines: Maine 9 μg/L. Runoff from spills or fire control may cause water pollution.

Determination in Water: Log K_{ow} = >3.5. Values above 3.0 are likely to bioaccumulate in aquatic organisms.

Routes of Entry: Inhalation, passing through the skin and ingestion.

Harmful Effects and Symptoms

Short Term Exposure: Irritates the skin, eyes, and respiratory tract. Eye contact may cause irritation, burning sensation, and damage. Harmful if ingested, inhaled or absorbed through the skin. Inhalation should be avoided; use NIOSH- or CEN (UK)-approved air-purifying respirators for pesticides. May be harmful if swallowed. LD_{50} (oral, rat) = >1000 mg/kg; LD_{50} (dermal, rat) = >4 g/kg.

Medical Surveillance: This chemical is a suspected or known human carcinogen. Exposed persons should contact a physician for advice regarding the possible long term health effects and advice for medical monitoring. Consult a physician if poisoning is suspected or if redness, itching, or burning of the eyes or skin develops. Skin sensitizer.

First Aid: If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least 15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately. If this chemical contacts the skin, remove contaminated clothing and wash immediately with soap and water. Seek medical attention immediately. If this chemical has been inhaled, remove from exposure, begin rescue breathing (using universal precautions) if breathing has stopped, and CPR if heart action has stopped. Transfer promptly to a medical facility. When this chemical has been swallowed, get medical attention. Give large quantities of water and induce vomiting. Do not make an unconscious person vomit. Do not induce vomiting when formulations containing petroleum solvents are ingested. Evaluation by a qualified allergist, including exposure history and testing, may help diagnose allergy.

Personal Protective Methods: Wear positive-pressure self-contained breathing apparatus (SCBA). Wear chemical protective clothing that is specifically recommended by the manufacturer. DuPont™ Tychem® Suit Fabrics is recommended by one government source[88]. It may provide little or no thermal protection. Structural firefighters' protective clothing provides limited protection in fire situations ONLY; it is not effective in spill situations where direct contact with the substance is possible.

Respirator Selection: Where the neat (undiluted) test chemical is weighed and diluted, wear a NIOSH-approved half-face respirator equipped with a combination filter cartridge, i.e. organic vapor/acid gas/HEPA (specific for organic vapors, HCl, acid gas, SO_2 and a high-efficiency particulate filter)[88]. Wherever and whenever workplace conditions warrant respirator use, a respiratory protection program must be followed that meets one or more of the following government standards: OSHA's 29 CFR 1910.134, ANSI Z88.2, or European Standard EN 149.

Storage: Color Code-Blue: Health Hazard/Poison. Store in a secure poison location. Refrigerate. Prior to working with this chemical you should be trained on its proper handling and storage. Store in tightly closed containers in a cool, well-ventilated area. If this material contains a flammable carrier, sources of ignition, such as smoking and open flames, are prohibited where this chemical is used, handled, or stored in a manner that could create a potential fire or explosion hazard. Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: Environmentally hazardous substances, solid or liquid, usually fall in Hazard Class 9.

Spill Handling: For solids, isolate spill or leak area in all directions for at least 25 meters/75 feet. Increase, in the downwind direction, as necessary. First remove all sources of ignition. Evacuate persons not wearing protective equipment from area of spill or leak until clean up is complete. Do not touch damaged containers or spilled material unless wearing appropriate protective clothing. Stop leak if you can do it without risk. Prevent entry into waterways, sewers, basements or confined areas. Cover with plastic sheet to prevent spreading. Absorb or cover with dry earth, sand or other non-combustible material and transfer to containers. If you spill this chemical, you should dampen the solid spill material with water, then transfer the dampened material to a suitable container. Use absorbent paper dampened with water to pick up any remaining material. Seal your contaminated clothing and the absorbent paper in a vapor-tight plastic bag for eventual disposal. Wash all contaminated surfaces with a soap and water solution. Do not reenter the contaminated area until the Safety Officer (or other responsible person) has verified that the area has been properly cleaned. Do not allow water to get inside containers. Ventilate area after clean up is complete. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable.

Fire Extinguishing: Hazardous decomposition includes toxic oxides of nitrogen and hydrogen chloride gas. See "Incompatibilities" section. As an immediate precautionary measure, isolate spill or leak area in all directions for at least 50 meters/150 feet for liquids and at least 25 meters/75 feet for solids. *Fire involving storage or vehicular tanks:* isolate for 800 meters/0.5 mile in all directions; also, consider initial evacuation for 800 meters/0.5 mile in all directions. *On a small fire:* use dry chemical, CO_2, water spray or regular foam. *On a large fire:* use water spray, fog or regular foam. Do not scatter spilled material with high-pressure streams of water. Move containers from fire area if you can do it without risk. Dike fire-control water for later disposal. *Fire involving tanks:* from a secure, explosion-proof location, use water spray to cool exposed containers. If cooling streams are ineffective (venting sound increases in volume and pitch, tank discolors, or shows any signs of deforming), withdraw immediately to a secure position. Always stay away from tanks engulfed in fire. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode.

Disposal Method Suggested: Consult with environmental regulatory agencies for guidance on acceptable disposal practices. Contact a licensed disposal facility about surplus and non-recyclable solutions. Burn in a chemical incinerator equipped with an afterburner and scrubber. Extra care must be exercised as the material in an organic solvent is highly flammable. In accordance with 40CFR165, follow recommendations for the disposal of pesticides and pesticide containers. Containers must be disposed of properly by following package label directions or by contacting your local or federal environmental control agency, or by contacting your regional EPA office. Incineration or permanganate oxidation.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- USEPA, Office of Pesticide Programs, Pesticide Residue Limits, "Propiconazole," 40 CFR 180.434. http://www.epa.gov/pesticides/food/viewtols.htm
- EXTOXNET, Extension Toxicology Network, "Pesticide Information Profile, Propiconazole," Oregon State University, Corvallis, OR (October 1997). http://pmep.cce.cornell.edu/profiles/extoxnet/metiram-propoxur/propiconazole-ext.html

Propineb P:1128

Use Type: Fungicide

CAS Number: 12071-83-9

Formula: $C_5H_8N_2S_4Zn$

Synonyms: [(1-Methyl-1,2-ethanediyl)bis (carbamodithioato)](2-)zinc homopolymer; Methyl zineb; Zinc, (1-methyl-1,2-ethanediyl)bis(carbamodithioato)(2-)-; Propylenebis(dithiocarbamato)zinc; Zinc-1,2-propylenebisdithiocarbamate; Zinc propylenebis(dithiocarbamate); Zinc [*N,N'*-propylene-1,2-bis(dithiocarbamate)]

Trade Names: AIRONE®; ANTRACOL®; BAY®-46131; BAYER®-46131; LH 3012®; LH 30/Z®; MEZINEB®; PROPINEBE®; ZIPROMAT®

Chemical class: Dithiocarbamate

EPA/OPP PC Code: 522200

California DPR Chemical Code:

HSDB Number: 6912 as zinc compounds

UN/NA & ERG Number: UN3077(solid)/171; UN2771 (solid)/151

RTECS® Number: ZH4950000

EC Number: 235-134-0

Uses: Used to control downy mildew, black rot, brown rot and other fungi on vines, apples, pears, citrus, berry fruit, stone fruit, tomatoes, potatoes, tobacco, vegetables, rice, ornamentals and tea. Not currently registered in the U.S. Used in more than a dozen European countries. There are more than 15 global suppliers[97].

Regulatory Authority and Advisory Information:

EPA Genetox program 1988, Positive: *S cerevisiae* gene conversion.

Health Advisory: Mutagen, Developmental & Reproductive Toxin

Acute Oral Category: 3, CAUTION

Clean Water Act: Section 307 Toxic Pollutants as zinc and compounds

Safe Drinking Water Act: SMCL, 5 mg/L; Priority List (55 FR 1470) as zinc

AB 2588-Air Toxics "Hot Spots" Chemicals (CAL) as zinc compounds

The "Director's List" (CAL/OSHA) as zinc compounds

EPCRA Section 313: Form R *de minimis* concentration reporting level: 1.0% as zinc compounds.

WGK (German Aquatic Hazard Class): 2-Hazard to waters

Description: Yellowish to white crystalline solid or powder. Slight characteristic odor. Molecular weight = 289.79; Specific gravity (H_2O:1) = 1.79 @ 20°C; Boiling point = (decomposes); Freezing/Melting point = (decomposes). Insoluble in water.

Incompatibilities: Combustible material. Dust may form explosive mixture in air. Water, acid, oxidizing materials. Heat, or contact with moisture or acids causes rapid decomposition and the generation of toxic and flammable hydrogen sulfide and carbon disulfide. Flammable gases are generated by reaction with aldehydes, nitrides, and hydrides. Incompatible with oxidizers including peroxides, acids, acid halides, mercury[88]. Decomposition products in fire include oxides of nitrogen and sulfur. Corrosive to iron, copper brass and zinc metals, especially in the presence of moisture. Heat alkalies (lime), moisture can cause decomposition. Decomposes on prolonged storage. Degradation produces ethylene thiourea.

Permissible Concentration in Water: Federal Drinking Water Guidelines: EPA 5000 μg[Zn]/L; EPA Lifetime Health Advisory 2000 μg[Zn]/L. State Drinking Water Guidelines: Arizona 5000 μg[Zn]/L; Minnesota 2000 μg[Zn]/L. Canadian Drinking Water Standards: AO $\leq$ 5.0 mg[Zn]/L. Runoff from spills or fire control may cause water pollution.

Determination in Water: EPA EMSLC Method 630. The Determination of Dithiocarbamate Pesticides in Municipal and Industrial Wastewater by UV-VIS Spectrophotometry.

Log K_{ow} = negative. Unlikely to bioaccumulate in marine organisms. EPA EMSLC Method 630. The Determination of Dithiocarbamate Pesticides in Municipal and Industrial Wastewater by UV-VIS Spectrophotometry.

Harmful Effects and Symptoms

Short Term Exposure: Low levels of toxicity. Concentrated solutions are slightly corrosive to eyes and mucous membranes. Dust inhalation can cause irritation of the respiratory system with sneezing. Eye contact can cause irritation, watering, pain, and inflammation of the eyelids. Dermal contact can cause irritation and minor ulceration. Ingestion can cause nausea, vomiting, fever, muscle twitching, seizure, rapid respiration, slow heart beat. Severe exposure may result in death. Unlike carbamates the dithiocarbamates are not cholinesterase inhibitors, but some of them may react with recently ingested alcohol or alcohol-containing products including wine, medications, and cold remedies such as cough-syrups. LD_{50} (oral, rat) = >5 g/kg; LD_{50} (dermal, rat) = 1–3 g/kg.

Long Term Exposure: May cause respiratory tract and lung problems.

Points of Attack: Respiratory system, lungs, thyroid, central nervous system, cardiovascular system, skin, eyes, muscular system.

Medical Surveillance: There are tests available to measure zinc in your blood, urine, hair, saliva, and feces. High levels of zinc in the feces can mean high recent zinc exposure. High levels of zinc in the blood can mean high zinc consumption and/or high exposure. Tests to measure zinc in hair may provide information on long-term zinc exposure; however, the relationship between levels in your hair and the amount of zinc you were exposed to is not clear. Medical observation is recommended for 24 to 48 hours following breathing overexposure, as pulmonary edema may be delayed. Cigarette smoking may exacerbate pulmonary injury and should be discouraged for at least 72 hours following exposure. Before employment and at regular times after that, the following are recommended: If symptoms develop or overexposure occurs, repeat the above tests as soon as possible and get an exam of the nervous system. Also consider complete blood count and chest x-ray following acute overexposure

First Aid: If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least 15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately. If this chemical contacts the skin, remove contaminated clothing and wash immediately with soap and water. Seek medical attention immediately. If this chemical has been inhaled, remove from exposure, begin rescue breathing (using universal precautions) if breathing has stopped, and CPR if heart action has stopped. Transfer promptly to a medical facility. When this chemical has been swallowed, get medical attention. If victim is conscious and able to swallow, have victim drink 4 to 8 ounces of water. Do not induce vomiting. *Note to physician or authorized medical personnel*: Medical observation is recommended for 24 to 48 hours following breathing overexposure, as pulmonary edema may be delayed. As first aid for pulmonary edema, a doctor or authorized paramedic might consider administering a corticosteroid spray. Cigarette smoking may exacerbate pulmonary injury and should be discouraged for at least 72 hours following exposure.

Personal Protective Methods: Reacts with the following absorbent materials: Cellulose-Based; Mineral- and Clay-Based; Dirt/Earth[88]. Wear protective gloves and clothing to prevent any reasonable probability of dermal and/or eye contact. Safety equipment suppliers/manufacturers can provide recommendations on the most protective glove/clothing material for your operation. All protective clothing (suits, gloves, footwear, headgear) should be clean, available each day, and put on before work. Contact lenses should not be worn when working with this chemical. Wear splash-proof chemical goggles and face shield unless full facepiece respiratory protection is worn. Employees should wash immediately with soap when skin is wet or contaminated. Provide emergency showers and eyewash.

Respirator Selection: *At any detectable concentration:* SCBAF: Pd,Pp (APF = 10,000) (any NIOSH/MSHA- or European Standard EN 149-approved self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode); or SaF: Pd,Pp: ASCBA (APF = 10,000) (any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary, self-contained breathing apparatus operated in a pressure-demand or other positive-pressure mode). *Escape:* 100F (APF = 50) (any air-purifying, full facepiece respirator with an N100, R100, or P100 filter k-mounted organic vapor canister having a high-efficiency particulate filter); or SCBAE (any appropriate escape-type, self-contained breathing apparatus).

Storage: Color Code-Blue: Health Hazard/Poison: Store in a tightly closed container in a dry, well-ventilated and secure poison location. Prior to working with this chemical you should be trained on its proper handling and storage. Where possible, automatically transfer material from other storage containers to process containers.

Shipping: Environmentally hazardous substances, solid or liquid, usually fall in Hazard Class 9.

Spill Handling: First remove all sources of ignition. Evacuate persons not wearing protective equipment from area of spill or leak until clean up is complete. Collect powdered material in the most convenient and safe manner and deposit in sealed containers. Ventilate area after clean up is complete. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable.

Fire Extinguishing: Decomposition begins >150 °C. Hazardous decomposition includes oxides of nitrogen, carbon, sulfur, and zinc. As an immediate precautionary measure, isolate spill or leak area in all directions for at least 50 meters/150 feet for liquids and at least 25 meters/75 feet for solids. *Fire involving storage or vehicular tanks:* isolate for 800 meters/0.5 mile in all directions; also, consider initial evacuation for 800 meters/0.5 mile in all directions. *On a small fire:* use dry chemical, CO_2, water spray or regular foam. *On a large fire:* use water spray, fog or regular foam. Do not scatter spilled material with high-pressure streams of water. Move containers from fire area if you can do it without risk. Dike fire-control water for later disposal. *Fire involving tanks:* from a secure, explosion-proof location, use water spray to cool exposed containers. If cooling streams are ineffective (venting sound increases in volume and pitch, tank discolors, or shows any signs of deforming), withdraw immediately to a secure position. Always stay away from tanks engulfed in fire. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode.

Disposal Method Suggested: Do not discharge into drains or sewers. Dispose of waste material as hazardous waste using a licensed disposal contractor to an approved landfill. Consult with environmental regulatory agencies for guidance on acceptable disposal practices. A potential candidate for liquid injection incineration at a temperature range of 650 to 1,600 °C and a residence time 0.1 to 2 seconds. Also, a potential candidate for rotary kiln incineration at a temperature range of 820 to 1,600 °C and residence times of seconds for liquids and gases, and hours for solids[83].

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- International Programme on Chemical Safety (IPCS), "Environmental Health Criteria, Dithiocarbamate Pesticides," Geneva, Switzerland (1988). http://www.inchem.org/documents/ehc/ehc/ehc78.htm
- International Programme on Chemical Safety (IPCS), "Propineb," Geneva, Switzerland (1977). http://www.inchem.org/documents/jmpr/jmpmono/v077pr41.htm

Propoxur P:1180

Use Type: Insecticide, Molluscicide

CAS Number: 114-26-1

Formula: $C_{11}H_{15}NO_3$

Synonyms: Carbamic acid, methyl-, *o*-isopropoxyphenyl ester; ENT 25,671; IPMC; 2-Isopropoxyphenyl *N*-methylcarbamate; 2-Isopropoxyphenyl methylcarbamate; *o*-Isopropoxyphenyl methylcarbamate; *o*-(2-Isopropoxyphenyl) *N*-methylcarbamate; *o*-Isopropoxyphenyl *N*-methylcarbamate; 2-(1-Methylethoxy)phenyl *N*-methylcarbamate; OMS 33; PHC; Phenol, 2-(1-methylethoxy)-, methylcarbamate

Trade Names: (There are currently 695 registered active and/or canceled and/or transferred products in the U.S.) ARPROCARB®; BAY®; BAY® 5122; BAYER®; BAYER® B 5122; BAYGON®; BIFEX®; BLATTANEX®; BLATTOSEP®; BOLFO®; BO Q 58-12-315®; BORUHO®; BORUHO® 50; BRIFUR®; BRYGOU®; CHEMAGRO® 9010; COMPOUND 39007; DALF DUST®; INVISI-GARD®; PILLARGON®; PRENTOX CARBAMATE®; PROPOGON®; PROPOTOX®; PROPOXYLOR®; PROPYON®; RHODEN®; SENDRAN®; SUNCIDE®; TENDEX®; TUGEN®; UNDEN®; UNDENE®

Chemical class: Carbamate (N-methyl)

EPA/OPP PC Code: 047802

California DPR Chemical Code: 62

HSDB Number: 603

UN/NA & ERG Number: UN2757 (solid)/151

RTECS® Number: FC3150000

EC Number: 204-043-8 [*Annex I Index No.:* 006-16-00-4]

Uses: Not approved for use in EU countries[115]. A non-systemic insecticide compatible with most fungicides and insecticides except those that are alkaline. It is often used in combination with azinphosmethyl, chlorpyrifos, cyfluthrin, dichlorvos, disulfoton or methocarb. It is used on sugar cane, cocoa, pome and stone fruit, grapes, maize, hops, rice, sugar beets, vegetables, cotton, and forestry and ornamentals to control pests such as chewing and sucking insects, ants, crickets, flies, mosquitoes, millepedes, jassids and cockroaches.

Regulatory Authority and Advisory Information:

Carcinogenicity[83]: EPA Group B2, Probable human carcinogen; ACGIH A3 Confirmed animal carcinogen with unknown relevance to humans

California Proposition 65 Chemical: Cancer (8/11/2006)

Poison (oral) Category: 1, DANGER-POISON

Health Advisory: Nerve Toxin (S!), Mutagen, Developmental/Reproductive Toxin

Clean Air Act: Hazardous Air Pollutants (Title I, Part A, Section 112)

EPA Hazardous Waste Number (RCRA No.): U411

RCRA 40CFR268.48; 61FR15654, Universal Treatment Standards: Wastewater (mg/L), 0.056; Non-wastewater (mg/kg), 1.4

Superfund/EPCRA 40CFR302.4 RQ: CERCLA, 1 lb (0.454 kg)

EPCRA Section 313 Form R *de minimus* concentration reporting level: 1.0%

U.S. DOT Regulated Marine Pollutant (49CFR172.101, Appendix B)

European/International Regulations: Hazard Symbol: T, N; risk phrases: R25; R50/53; safety phrases: S2; S37; S45; S60; S61 (see Appendix 1)

WGK (German Aquatic Hazard Class): 3-Severe hazard to waters

Description: Propoxur is a white to tan crystalline solid or powder. Faint characteristic odor. Molecular weight = 209.27; Boiling point = (decomposes); Freezing/Melting point = 87–90 °C; Vapor pressure = 7×10^{-6} mmHg @ 20 °C; Flash point = >149 °C. Hazard Identification (based on NFPA-704 M Rating System): Health 2, Flammability 1, Reactivity 0. Slightly soluble in water; solubility = 1800 ppm @ 20 °C; 0.2%[9].

Incompatibilities: Propoxur is incompatible with strong oxidizers and alkalis. Carbamates are incompatible with reducing agents, strong acids, oxidizing acids, peroxides, and bases. Contact with active metals or nitrides causes the release of flammable, and potentially explosive, hydrogen gas. May form explosive materials with phosphorus pentachloride. When heated to decomposition, this material forms highly toxic oxides of nitrogen and methyl isocyanate fumes.

Permissible Exposure Limits in Air: OSHA PEL: None

NIOSH REL: 0.5 mg/m^3 TWA

ACGIH TLV®[1]: 0.5 mg/m^3 TWA; confirmed animal carcinogen with unknown relevance to humans. BEI$_A$ issued for Acetylcholinesterase inhibiting pesticide.

Protective Action Criteria (PAC) Ver. 27[89]

PAC-1: 0.5 mg/m^3

PAC-2: 0.5 mg/m^3

PAC-3: 23 mg/m^3

DFG MAK: 2 mg/m^3 measured as the, inhalable fraction TWA; Peak Limitation Category II(8)

Permissible Concentration in Water: Federal Drinking Water Guidelines: EPA 30 μg/L; EPA Health Advisory: 3 ppb; State Drinking Water Guidelines: Arizona 3 μg/L; Maine 28 μg/L; Florida 2.8 μg/L; California 30 μg/L. Runoff from spills or fire control may cause water.

Determination in Water: Log K_{ow} = <2.0. Unlikely to bioaccumulate in marine organisms.

Routes of Entry: Inhalation, ingestion, skin and/or eye contact.

Harmful Effects and Symptoms

Short Term Exposure: Propoxur can affect you when breathed in and quickly enters the body by passing through the skin. Severe poisoning can occur from dermal and/or eye contact. It is a moderately toxic carbamate chemical. Exposure can cause severe carbamate poisoning, with symptoms of headaches, sweating, nausea and vomiting, diarrhea, muscle twitching, loss of coordination and even death. May affect the nervous system, liver, kidneys. Carbamate insecticides inhibit the cholinesterase activity of enzymes, causing accumulation of acetylcholine at synapses and altering the way in which nervous impulses are transmitted. However, within several hours carbamates spontaneously detach from the enzymes. Cholinesterase toxin. Narcotic. Acute effects: Eye, effects other than irritation; Skin irritant, moderate; Heart, cardiovascular system; Brain; Central nervous system; Nervous system toxin; Respiratory toxin, other than severe or moderate irritation; Nose, other than irritation. LD_{50} (oral, rat) = <50 mg/kg; LD_{50} (dermal, rat) = >5 g/kg.

Long Term Exposure: Propoxur may cause mutations. Handle with extreme caution. It may damage the developing fetus. Cholinesterase inhibitor; cumulative effect is possible. This chemical may damage the nervous system with repeated exposure, resulting in convulsions, respiratory failure. May cause liver damage.

Points of Attack: Central nervous system, liver, kidneys, gastrointestinal tract, blood cholinesterase.

Medical Surveillance: This chemical is a suspected or known human carcinogen. Exposed persons should contact a physician for advice regarding the possible long term health effects and advice for medical monitoring. Routine biological monitoring of pesticide applicators and field workers includes testing of plasma and red blood cell acetylcholinesterase levels (for enzyme poisoned by this chemical). These tests are normally accurate only if done within about two hours of exposure. If exposure stops, plasma levels return to normal in 1–2 weeks while red blood cell levels may be reduced for 1–3 months. When acetylcholinesterase enzyme levels are reduced by 25% or more below preemployment levels, risk of poisoning is increased, even if results are in lower ranges of "normal." Reassignment to work not involving carbamate pesticides is recommended until enzyme levels recover. Do not drink any alcoholic beverages before or during use. Also consider complete blood count and chest x-ray following acute overexposure.

First Aid: Speed in removing material from eyes and skin is of extreme importance. *Eyes:* Eye contact can cause dangerous amounts of these chemicals to be quickly absorbed through the mucous membrane into the bloodstream. Immediately and gently flush eyes with plenty of warm or cold water (NO hot water) for at least 15 minutes, occasionally lifting the upper and lower eyelids. Get medical aid immediately. *Skin:* Get medical aid. Dermal contact can cause dangerous amounts of these chemicals to be absorbed into the bloodstream. Wearing the appropriate PPE equipment and respirator for carbamate pesticides, immediately flush skin with plenty of soap and water for at least 15 minutes while removing contaminated clothing and shoes. Shampoo hair promptly if contaminated; protect eyes. *Ingestion:* Call poison control. Loosen all clothing. Never give anything by mouth to an unconscious person. Get medical aid. Do NOT induce vomiting. * If conscious, alert, and able to swallow, rinse mouth and have victim drink 4 to 8 ounces of water. Check to see if poison control instructs you to use ipecac syrup, otherwise administer slurry of activated charcoal (2 oz in 8 oz of water). If victim is *UNCONSCIOUS OR HAVING CONVULSIONS,* do nothing except keep victim warm. **In some cases you may be specifically instructed by poison control to induce vomiting by way of 2 tablespoons of syrup of ipecac (adult) washed down with a cup of water.* Do NOT give activated charcoal before or with ipecac syrup. *Inhalation:* Get medical aid. Do not contaminate yourself. Wearing the appropriate PPE equipment and respirator for carbamate pesticides, immediately remove the victim from the contaminated area to fresh air. If the victim is not breathing, administer artificial respiration. Do not use mouth-to-mouth method if victim ingested or inhaled the substance; give artificial respiration with the aid of a pocket mask equipped with a one-way valve or other proper respiratory medical device. If breathing is difficult, administer oxygen through bag/mask apparatus until medical help arrives. Do not leave victim unattended. *Note to physician or authorized medical personnel.* Administer atropine, 2 mg (1/30 gr) intramuscularly or intravenously as soon as any local or systemic signs or symptoms of an intoxication are noted; repeat the administration of atropine every 3 to 8 minutes until signs of atropinization (mydriasis, dry mouth, rapid pulse, hot and dry skin) occur; initiate treatment in children with 0.05 mg/kg of atropine; repeat at 5 to 10 minute intervals. Watch respiration, and remove bronchial secretions if they appear to be obstructing the airway; intubate if necessary. *Medical note:* 2-PAMCI may be contraindicated in the case of some carbamate poisonings.

Personal Protective Methods: Wear protective gloves and clothing to prevent any reasonable probability of dermal and/or eye contact. Safety equipment suppliers/manufacturers can provide recommendations on the most protective glove/clothing material for your operation. DuPont™ Tychem® suit fabrics[88]. All protective clothing (suits, gloves, footwear, headgear) should be clean, available each day, and put on before work. Contact lenses should not be worn when working with this chemical. Wear dust-proof chemical goggles and face shield unless full facepiece respiratory protection is worn. Employees should wash immediately with soap when skin is wet or contaminated. Provide emergency showers and eyewash.

Respirator Selection: *At concentrations above the NIOSH REL, or where there is no REL, at any detectable concentration:* SCBAF:Pd,Pp (APF = 10,000): (any self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode); or SaF:Pd,Pp:ASCBA (APF = 10,000) (any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary self-contained positive-pressure breathing apparatus). *Escape*: GmFOv100 (APF = 50) [any air-purifying, full facepiece respirator (gas mask) with a chin-style, front- or back-mounted organic vapor canister having an N100, R100, or P100 filter]; or SCBAE (any appropriate escape-type, self-contained breathing apparatus).

Storage: Color Code-Blue: Health Hazard/Poison. Store in a secure poison location. Prior to working with this chemical you should be trained on its proper handling and storage. Store in tightly closed containers in a cool, well-ventilated area away from strong alkalis (such as sodium hydroxide, sodium bicarbonate, etc.). Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: This is a solid toxic carbamate and should be labeled “poisonous materials.” It falls into Hazard Class 6.1.

Spill Handling: For solids, isolate spill or leak area in all directions for at least 25 meters/75 feet. Increase, in the downwind direction, as necessary. Do not touch damaged containers or spilled material unless wearing appropriate protective clothing. Stop leak if you can do it without risk. Prevent entry into waterways, sewers, basements or confined areas. Cover with plastic sheet to prevent spreading. Absorb or cover with dry earth, sand or other non-combustible material and transfer to containers. Do not allow water to get inside containers.

Fire Extinguishing: *Deadly when decomposed in fire*. Hazardous decomposition includes oxides of nitrogen and carbon and highly toxic methyl isocyanate fumes[9]. *On a small fire:* use dry chemical, CO_2 or water spray. *On a large fire:* use water spray, fog or regular foam. Move containers from fire area if you can do it without risk. Dike fire-control water for later disposal; do not scatter the material. Use water spray or fog; do not use straight streams. *Fire involving storage or vehicular tanks:* isolate for 800 meters/0.5 mile in all directions; also, consider initial evacuation for 800 meters/0.5 mile in all directions. Fight fire from maximum distance or use unmanned hose holders or monitor nozzles. Do not get water inside containers. Cool containers with flooding quantities of water until well after fire is out. Withdraw immediately in the case of rising sound from venting safety devices or discoloration of tank. ALWAYS stay away from tanks engulfed in fire. For massive fire, use unmanned hose holders or monitor nozzles; if this is impossible, withdraw from area and let fire burn. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies.

Disposal Method Suggested: Do not discharge into drains or sewers. Dispose of waste material as hazardous waste using a licensed disposal contractor to an approved landfill. Consult with environmental regulatory agencies for guidance on acceptable disposal practices. Generators of waste containing this contaminant (≥100 kg/mo) must conform with EPA regulations governing storage, transportation, treatment, and waste disposal. Incineration with effluent gas scrubbing is recommended. Containers must be disposed of properly by following package label directions or by contacting your local or federal environmental control agency, or by contacting your regional EPA office.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- EXTOXNET, Extension Toxicology Network, “Pesticide Information Profile, Propoxur,” Oregon State University, Corvallis, OR (June 1996). http://extoxnet.orst.edu/pips/propoxur.htm
- New Jersey Department of Health, “Hazardous Substance Fact Sheet: Propoxur,” Trenton, NY (May 1998). http://www.state.nj.us/health/eoh/rtkweb/1604.pdf

Prosulfuron P:1185

Use Type: Herbicide
CAS Number: 94125-34-5
Formula: $C_{15}H_{16}F_3N_5O_4S$
Synonyms: Benzenesulfonamide, *N*-[((4-methoxy-6-methyl-1,3,5-triazin-2-yl)amino)carbonyl]-2-(3,3,3-trifluoropropyl)-; 1-(4-Methoxy-6-methyl-triazin-2-yl)-3-[2-(3,3,3-trifluoropropyl)phenylsuulfonyl]urea; *N*-[((4-Methoxy-6-methyl-1,3,5-triazin-2-yl)amino)carbonyl]-2-(3,3,3-trifluoropropyl)benzenesulfonamide
Trade Names: CGA®-152005; EXCEED®; PEAK®; SPIRIT®
Chemical class: Sulfonylurea
EPA/OPP PC Code: 129031
California DPR Chemical Code: 5115
UN/NA & ERG Number: UN3077(solid)/171
EC Number: 619-000-2 [*Annex I Index No.:* 016-084-00-7]
Uses: Used as a post-emergence herbicide on corn and cereals such as barley, millet, oats, rye, sorghum and wheat. Used on sugar cane in some countries. Currently registered in some EU countries[115]. Registered for use in the U.S.
U.S. Maximum Allowable Residue Levels for Prosulfuron [CFR180.481]: Over the years the U.S. EPA has granted temporary pesticide tolerances for residues of prosulfuron on raw agricultural commodities: corn (forage, fodder, grain and fresh [including sweet kernels], milk, and meat, fat and meat byproducts, of cattle, goats, hogs, horses, and sheep. Tolerances expired 12/31/1999. A petition for new tolerances under 40 CFR 180.481 was filed by Syngenta and reported in the Federal Register December 31, 2002. There is no current information on residue levels or tolerances.
Regulatory Authority and Advisory Information:
Carcinogenicity[83]: EPA Group D, Not classifiable as a human carcinogen
Toxicity (oral) Category 3, CAUTION
U.S. DOT Regulated Marine Pollutant (49CFR172.101, Appendix B)
European/International Regulations: Hazard Symbol: Xn, N; risk phrases: R40; R50/53; safety phrases: S2; S60; S61 (see Appendix 1)
Description: Prosulfuron is beige to tan crystalline solid, granules or powder. Sweet odor. Molecular weight = 419.38; Specific gravity (H_2O:1) = 1.453 @ 20 °C; Boiling point = (decomposes); Freezing/Melting point = (decomposes) 155 °C. Vapor pressure = 3×10^{-8} mmHg @ 25 °C; Autoignition temperature = ~ 400 °C. Hazard Identification (based on NFPA-704 M Rating System): Health 1, Flammability 0, Reactivity 0. Slightly soluble in water; solubility = ~25 mg/L @ 25 °C.
Incompatibilities: Powder is combustible and may form explosive mixture with air. May react with strong oxidizers such as chlorates, peroxides, nitrates, etc.
Permissible Exposure Limits in Air: 4 mg/m^3 TWA [Syngenta MSDS]
Determination in Water: Log K_{ow} = ~1.5. Unlikely to bioaccumulate in marine organisms.
Routes of Entry: Inhalation, passing through the skin and ingestion.
Routes of Entry: Inhalation, dermal contact, ingestion.
Harmful Effects and Symptoms: Human health effects from the sulfonylurea herbicides at low environmental doses or at biomonitored levels from low environmental exposures are unknown. The sulfonylurea herbicides are generally of low toxicity in mammalian studies. Animal studies showed low acute toxicity and little chronic, reproductive, or developmental toxicity or teratogenic effects. Developmental or teratogenic effects tended only to occur at high or maternally toxic doses. At high sublethal, chronic oral doses, such nonspecific effects as weight loss and anemia were observed. Some chemical-specific effects were noted at high doses in animals[96].
Short Term Exposure: May cause skin and eye irritation. Moderately poisonous if ingested or inhaled. LD_{50} (oral, rat) = ~1 g/kg; LD_{50} (dermal, rat) = >2 g/kg.
Long Term Exposure: Fluorides may cause bone disease (pain and tenderness of the bones); mottled teeth in children.
Points of Attack: Bones, teeth, blood.
Medical Surveillance: Preliminary medical exam to detect chronic diseases of central nervous system, liver, heart, kidneys, lung and skin, as well as endocrinological or immunological disturbances, should protect susceptible individuals. Periodical medical exams of internal organs, skin and eyes are important to avoid chronic occupational intoxications. They should include lab and patch tests when necessary[83]. Urinary levels of the sulfonylurea herbicides reflect recent exposure. There is very limited information on the biomonitoring of sulfonylurea herbicides or their metabolites. Detection of the metabolites may reflect exposure to more than one particular sulfonylurea herbicide or from exposure to environmental degradation products. The urinary metabolites dimethoxypyrimidine and dimethylpyrimidine can be used as nonspecific markers of exposure to the pyrimidinylsulfonylureas, a group that includes bensulfuron-methyl,[41] primisulfuron-methyl, and sulfosulfon. The urinary metabolite methoxymethyl triazine can be used as a nonspecific marker of exposure to the triazinylsulfonylureas, a group that includes chlorosulfuron, prosulfuron, and triasulfuron[96].
First Aid: If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least 15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately. If this chemical contacts the skin, remove contaminated clothing and wash immediately with soap and water. Seek medical attention immediately. If this chemical has been inhaled, remove from exposure, begin rescue breathing (using universal precautions) if breathing has stopped, and CPR if heart action has stopped. Transfer promptly to a medical facility. When this chemical has been swallowed, get medical attention. Give large quantities of water and induce vomiting. Do not make an unconscious person vomit.
Personal Protective Methods: Wear protective gloves and clothing to prevent any reasonable probability of

dermal and/or eye contact. Safety equipment suppliers/manufacturers can provide recommendations on the most protective glove/clothing material for your operation. All protective clothing (suits, gloves, footwear, headgear) should be clean, available each day, and put on before work. Contact lenses should not be worn when working with this chemical. Wear dust-proof chemical goggles and face shield unless full facepiece respiratory protection is worn. Employees should wash immediately with soap when skin is wet or contaminated. Provide emergency showers and eyewash.

Respirator Selection: Wherever and whenever workplace conditions warrant respirator use, a respiratory protection program must be followed that meets one or more of the following government standards: OSHA's 29 CFR 1910.134, ANSI Z88.2, or European Standard EN 149.

Storage: Color Code-Blue: Health Hazard/Poison. Store in a secure poison location. Store in a refrigerator and protect from exposure to oxidizers or moisture[52]. A regulated, marked area should be established where this chemical is handled, used, or stored in compliance with OSHA Standard 1910.1045. Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: This material may be classified as Environmentally hazardous substances, solid, n.o.s. It usually falls in Hazard Class 9.

Spill Handling: Evacuate and restrict persons not wearing protective equipment from area of spill or leak until clean up is complete. If a spill occurs, clean it up promptly. Don't wash it away. Instead, sprinkle the spill with sawdust, vermiculite, or kitty litter. Sweep it into a plastic garbage bag, and dispose of it as directed on the pesticide product label. Ventilate area of spill or leak after clean up is complete. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable.

Fire Extinguishing: Hazardous decomposition includes oxides of nitrogen, sulfur and carbon and hydrogen fluoride gas. As an immediate precautionary measure, isolate spill or leak area in all directions for at least 50 meters/150 feet for liquids and at least 25 meters/75 feet for solids. *Fire involving storage or vehicular tanks:* isolate for 800 meters/0.5 mile in all directions; also, consider initial evacuation for 800 meters/0.5 mile in all directions. *On a small fire:* use dry chemical, CO_2, water spray or regular foam. *On a large fire:* use water spray, fog or regular foam. Do not scatter spilled material with high-pressure streams of water. Move containers from fire area if you can do it without risk. Dike fire-control water for later disposal. *Fire involving tanks:* from a secure, explosion-proof location, use water spray to cool exposed containers. If cooling streams are ineffective (venting sound increases in volume and pitch, tank discolors, or shows any signs of deforming), withdraw immediately to a secure position. Always stay away from tanks engulfed in fire. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode.

Disposal Method Suggested: It is the responsibility of chemical waste generators to determine the toxicity and physical properties of a discarded chemical and to properly identify its classification and certification as a hazardous waste and to determine the disposal method. U.S. EPA guidelines for the classification determination are listed in 40 CFR Parts 261.3. Additionally, waste generators must consult and follow all regional, national, state and local hazardous waste laws to ensure complete and accurate classification and disposal methods. Recycle any unused portion of the material for its approved use or return it to the manufacturer or supplier. Ultimate disposal of the chemical must consider: the material's impact on air quality; potential migration in soil or water; effects on animal, aquatic, and plant life; and conformance with environmental and public health regulations[83].

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- United States National Library of Medicine, *ChemIDplus Advanced*, Bethesda, MD. http://chem.sis.nlm.nih.gov/chemidplus/rn/57213-69-1

Pymetrozine P:1325

Use Type: Insecticide

CAS Number: 123312-89-0

Formula: $C_{10}H_{11}N_5O$

Synonyms: *(E)*-4,5-Dihydro-6-methyl-4-[(3-pyridinylmethylene)amino]-1,2,4-triazin-3(2*H*)-one; 1,2,4-Triazin-3(2*H*)-one, 4,5-dihydro-6-methyl-4-[(3-pyridinylmethylene)amino]-, *(E)*-

Trade Names: CGA-215944®; CHESS®; ENDEAVOR®; FULFILL®; PLENUM®; STERLING®

Chemical class: Triazine

EPA/OPP PC Code: 101103

California DPR Chemical Code: 5232

HSDB Number: 7054

UN/NA & ERG Number: UN3077 (solid)/171; UN3082(liquid)/171

EC Number: 602-927-1 [*Annex I Index No.:* 613-202-00-4]

Uses: The U.S. EPA considers pymetrozine a replacement for organophosphate pesticides when used in the same use patterns. Used on pecans, foliar ground plants and ornamentals, potatoes and other tuberous vegetables, leafy and fruiting vegetables, hops, cotton and tobacco.

U.S. Maximum Allowable Residue Levels for Pymetrozine [40 CFR 180.556(a)]: in or on the following raw agricultural commodities. The tolerance level for each commodity is expressed in terms of the parent insecticide only, which serves as an indicator of the use of pymetrozine on these raw agricultural commodities: brassica, head and stem, subgroup (crop subgroup 5-A) 0.5 ppm; brassica, leafy greens, subgroup (crop subgroup 5-B) 0.25 ppm; cotton gin byproducts 2.0 ppm; cotton, undelinted seed 0.3 ppm; hop, dried cones 6.0 ppm; pecans 0.02 ppm; turnip, greens 0.25 ppm; vegetable, fruiting, group (crop group 8) 0.2 ppm; vegetable, cucurbit, group (crop group 9) 0.1 ppm; vegetable, leafy, except brassica, group (crop group 4) 0.6 ppm; and vegetable, tuberous and corm, subgroup (crop subgroup 1-C) 0.02 ppm.

Regulatory Authority and Advisory Information:

Carcinogenicity[83]: EPA, Likely to be a human carcinogen; EU GHS Category 2: Suspected human carcinogen

Toxicity (oral) Category 3, CAUTION

European/International Regulations: Hazard Symbol: Xn; risk phrases: R40; R52/53; safety phrases: S2; S36/37; S61 (see Appendix 1)

Description: White to beige crystalline solid. Slightly sweet odor. Molecular weight = 217.23; Specific gravity (H_2O:1) = 1.373 @ 20 °C; Boiling point = (decomposes); Freezing/Melting point = (decomposes); Freezing/Melting point = 217 °C; Vapor pressure = 1×10^{-8} mmHg @ 25 °C; Soluble in water.

Incompatibilities: May react with strong oxidizers such as chlorates, peroxides, nitrates, etc.

Determination in Water: Log K_{ow} = <1.0. Unlikely to bioaccumulate in marine organisms.

Routes of Entry: Ingestion, inhalation.

Harmful Effects and Symptoms

Short Term Exposure: Harmful, possibly poisonous, if swallowed. May cause irritation of the skin, eyes, and respiratory tract. High levels of exposure may affect all major organs. LD_{50} (oral, rat) = >5 g/kg.; LD_{50} (dermal, rat) = >2 g/kg[83].

Long Term Exposure: Repeated contact or prolonged high dose may affect major organs, lungs, heart, liver, kidney, etc.

Points of Attack: Major organs.

Medical Surveillance: This chemical is a suspected or known human carcinogen. Exposed persons should contact a physician for advice regarding the possible long term health effects and advice for medical monitoring.

First Aid: If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least 15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately. If this chemical contacts the skin, remove contaminated clothing and wash immediately with soap and water. Seek medical attention immediately. If this chemical has been inhaled, remove from exposure, begin rescue breathing (using universal precautions) if breathing has stopped, and CPR if heart action has stopped. Transfer promptly to a medical facility. When this chemical has been swallowed, get medical attention. Give large quantities of water and induce vomiting. Do not make an unconscious person vomit.

Personal Protective Methods: Wear protective gloves and clothing to prevent any reasonable probability of dermal and/or eye contact. Safety equipment suppliers/manufacturers can provide recommendations on the most protective glove/clothing material for your operation. All protective clothing (suits, gloves, footwear, headgear) should be clean, available each day, and put on before work. Contact lenses should not be worn when working with this chemical. Wear dust-proof chemical goggles and face shield unless full facepiece respiratory protection is worn. Employees should wash immediately with soap when skin is wet or contaminated. Provide emergency showers and eyewash.

Respirator Selection: Wherever and whenever workplace conditions warrant respirator use, a respiratory protection program must be followed that meets one or more of the following government standards: OSHA's 29 CFR 1910.134, ANSI Z88.2, or European Standard EN 149.

Storage: Color Code-Blue: Health Hazard/Poison. Store in a tightly closed container in a dry, well-ventilated and secure poison location. Prior to working with this chemical you should be trained on its proper handling and storage. Where possible, automatically transfer material from other storage containers to process containers. Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: Depending on formulation, the dry material may be classified as Environmentally hazardous substances, solid, n.o.s. It usually falls in Hazard Class 9.

Spill Handling: If a spill occurs, clean it up promptly. Don't wash it away. Instead, sprinkle the liquid spill with sawdust, vermiculite, or kitty litter. Sweep it into a plastic garbage bag, and dispose of it as directed on the pesticide product label. Wash all contaminated surfaces with a soap and water solution.

Fire Extinguishing: Decomposes >190 °C. Hazardous decomposition includes oxides of nitrogen and carbon. *Small fires:* dry chemical, carbon dioxide; water spray; or foam. *Large fires:* water spray, fog, or foam. Stay upwind; keep out of low areas. Ventilate closed spaces before entering them. Firefighting gear (including SCBA) may not provide adequate protection. If exposure occurs, remove and isolate gear immediately and thoroughly decontaminate personnel. Wear positive-pressure breathing apparatus and special protective clothing. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode. Remove and isolate contaminated clothing at the site. Move container from fire area if you can do so without risk. Fight fire from maximum distance. Dike fire-control water for later disposal. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies. From a secure, explosion-proof location, use water spray to cool exposed containers. If cooling streams are ineffective (venting sound increases in volume and pitch, tank discolors, or shows any signs of deforming), withdraw immediately to a secure position. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156.

Disposal Method Suggested: Containers must be disposed of properly by following package label directions or by contacting your local or federal environmental control agency, or by contacting your regional EPA office. Dissolve or mix the material with a combustible solvent and burn in a chemical incinerator equipped with an afterburner and scrubber. In accordance with 40CFR165, follow recommendations for the disposal of pesticides and pesticide containers.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- USEPA, Office of Pesticide Programs, "Pesticide Fact Sheet, Pymetrozine." (August 2000). http://www.epa.gov/opprd001/factsheets/pymetrozine.pdf
- USEPA, Office of Pesticide Programs, Pesticide Residue Limits, "Pymetrozine," 40 CFR 180.556. http://www.setonresourcecenter.com/40CFR/Docs/wcd0004d/wcd04de1.asp

Pyrazon P:1328

Use Type: Herbicide
CAS Number: 1698-60-8
Formula: $C_{10}H_8ClN_3O$
Synonyms: 5-Amino-4-chloro-2,3-dihydro-3-*oxo*-2-phenylpyridazine; 5-Amino-4-chloro-2-phenyl-3(2H)-pyridazinone; Chloridazon; 1-Phenyl-4-amino-5-chloropyridazone-6; 1-Phenyl-4-amino-5-chloro-6-pyridazone; 1-Phenyl-4-amino-5-chlorpyridaz-6-one
Trade Names: BUREX®; HS-119-1®; PCA®; PHENOSANE®; PYRAMIN®; PYRAMINE®; PYRAZONE®; PYRAZONL®
Chemical class: Pyridazinone
EPA/OPP PC Code: 069601
California DPR Chemical Code: 509
HSDB Number: 1759
UN/NA & ERG Number: UN3077 (solid)/171; UN3082 (liquid)/171
RTECS® Number: UR6125000
EC Number: 216-920-2 [*Annex I Index No.:* 606-035-00-3]
Uses: Used on sugar beets, red beets and fodder beets for pre-emergence and post-emergence weed control.
U.S. Maximum Allowable Residue Levels for Pyrazon (40 CFR 180.316): beet, garden, roots 0.1(N) ppm; beets, garden, tops 1 ppm; beet, sugar, roots 0.1(N) ppm; beet, sugar, tops 1 ppm; milk 0.01(N) ppm. (N) = negligible amount of residue.
Regulatory Authority and Advisory Information: Acute Oral Category: 3, CAUTION.
Health Advisory: Mutagen, Developmental/Reproductive Toxin, Skin irritant/sensitizer
Potential Ground Water Pollutant [California FAC Section 13145(d)/12811, active]
European/International Regulations: Hazard Symbol: Xi, N; risk phrases: R43; R50/53; safety phrases: S2; S24; S37; S60; S61 (see Appendix 1)
WGK (German Aquatic Hazard Class): 2-Hazard to waters
Description: Tan to brown powder as pure compound; dark brown solid in technical state. Odorless. Molecular weight = 221.63; Specific gravity (H_2O:1) = 1.51 @ 20 °C; Boiling point = (decomposes); Freezing/Melting point = 205 °C; Vapor pressure = 5×10^{-2} mmHg @ 20 °C. Low solubility in water; solubility = 400 mg/L @ 20 °C.
Incompatibilities: Decomposition >350 °C. May react with strong oxidizers such as chlorates, peroxides, nitrates, etc.
Determination in Air: Filter; none; Gravimetric; NIOSH IV [Particulates NOR; #0500 (total), #0600 (respirable)].[18].
Determination in Water: Log K_{ow} = <1.5. Values above 3.0 are likely to bioaccumulate in aquatic organisms.
Routes of Entry: Inhalation and ingestion.
Harmful Effects and Symptoms
Short Term Exposure: Contact may irritate skin and cause eye irritation and possible severe injury. Inhalation should be avoided; use NIOSH- or CEN (UK)-approved air-purifying respirators for pesticides. Poisonous if swallowed. LD_{50} (oral, rat) = >2 g/kg; LD_{50} (dermal, rat) = >2 g/kg.
Long Term Exposure: Skin sensitizer.
Points of Attack: Skin.
Medical Surveillance: Preliminary medical exam to detect chronic diseases of central nervous system, liver, heart, kidneys, lung and skin, as well as endocrinological or immunological disturbances, should protect susceptible individuals. Periodical medical exams of internal organs, skin and eyes are important to avoid chronic occupational intoxications. They should include lab and patch tests when necessary[83]. If poisoning is suspected or of redness, itching, burning of skin or eyes develops. Evaluation by a qualified allergist, including exposure history and testing, may help diagnose allergy.
First Aid: If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least 15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately. If this chemical contacts the skin, remove contaminated clothing and wash immediately with soap and water. If this chemical has been inhaled, remove from exposure, begin rescue breathing (using universal precautions) if breathing has stopped, and CPR if heart action has stopped. Transfer promptly to a medical facility. When this chemical has

been swallowed, get medical attention. Give large quantities of water and induce vomiting. Do not make an unconscious person vomit.

Personal Protective Methods: Applicators and other handlers must wear: Coveralls worn over long-sleeved shirt and long pants; Chemical-resistant gloves such as DuPont^{TM} Tychem® suit fabrics, barrier laminate, or Viton®; Chemical-resistant footwear plus socks; Protective eye wear; Chemical-resistant headgear for overhead exposure; Chemical-resistant apron when cleaning equipment, mixing, or loading[83]. Agricultural Use/Engineering Controls: When handlers use closed systems, enclosed cabs, or aircraft in a manner that meets the requirements listed in the Worker Protection Standard (WPS) for agricultural pesticides, ***40 CFR 170.240(d)(4-6)***, the handler PPE requirements may be reduced or modified as specified in the Worker Protection Standard. Firefighters should wear NIOSH-approved self-contained breathing apparatus and full protective clothing.

Respirator Selection: *At any detectable concentration:* SCBAF: Pd,Pp (APF = 10,000) (any NIOSH/MSHA- or European Standard EN 149-approved self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode); or SaF: Pd,Pp: ASCBA (APF = 10,000) (any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary, self-contained breathing apparatus operated in a pressure-demand or other positive-pressure mode). *Escape:* 100F (APF = 50) (any air-purifying, full facepiece respirator with an N100, R100, or P100 filter k-mounted organic vapor canister having a high-efficiency particulate filter); or SCBAE (any appropriate escape-type, self-contained breathing apparatus).

Storage: Color Code-Blue: Health Hazard/Possible Human Carcinogen: Store in a tightly closed container in a dry, well-ventilated and secure poison location. Prior to working with this chemical you should be trained on its proper handling and storage. Where possible, automatically transfer material from other storage containers to process containers. Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: Environmentally hazardous substances, solid or liquid, usually fall in Hazard Class 9.

Spill Handling: For solids, *small spill*, isolate spill or leak area in all directions for at least 25 meters/75 feet. Increase, in the downwind direction, as necessary. For a *large spill* evacuate downwind at least 100 meters/330 feet. Do not touch damaged containers or spilled material unless wearing appropriate protective clothing. Stop leak if you can do it without risk. Keep combustibles (wood, paper, oil, etc.) away from spilled material. Do not allow water to get inside containers. *Small dry spill*: with clean shovel place material into clean, dry container and cover loosely; move containers from spill area. *Large spill*: dike far ahead of liquid spill for later disposal. Following product recovery, flush area with water. Prevent entry into waterways, sewers, basements or confined areas. Cover with plastic sheet to prevent spreading. Absorb or cover with dry earth, sand or other non-combustible material and transfer to containers. Do not allow water to get inside containers.

Fire Extinguishing: Hazardous decomposition includes toxic oxides of nitrogen and carbon and hydrogen chloride gas. As an immediate precautionary measure, isolate spill or leak area in all directions for at least 50 meters/150 feet for liquids and at least 25 meters/75 feet for solids. *Fire involving storage or vehicular tanks:* isolate for 800 meters/0.5 mile in all directions; also, consider initial evacuation for 800 meters/0.5 mile in all directions. *On a small fire:* use dry chemical, CO_2, water spray or regular foam. *On a large fire:* use water spray, fog or regular foam. Do not scatter spilled material with high-pressure streams of water. Move containers from fire area if you can do it without risk. Dike fire-control water for later disposal. *Fire involving tanks:* from a secure, explosion-proof location, use water spray to cool exposed containers. If cooling streams are ineffective (venting sound increases in volume and pitch, tank discolors, or shows any signs of deforming), withdraw immediately to a secure position. Always stay away from tanks engulfed in fire. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode.

Disposal Method Suggested: It is the responsibility of chemical waste generators to determine the toxicity and physical properties of a discarded chemical and to properly identify its classification and certification as a hazardous waste and to determine the disposal method. U.S. EPA guidelines for the classification determination are listed in 40 CFR Parts 261.3. Additionally, waste generators must consult and follow all regional, national, state and local hazardous waste laws to ensure complete and accurate classification and disposal methods. Follow recommendations for the disposal of pesticides and pesticide containers. Containers must be disposed of properly by following package label directions or by contacting your local or federal environmental control agency, or by contacting your regional EPA office.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- Pesticide Management Education Program, "Pyrazon (Pyramin) Herbicide Profile 2/85," Cornell University, Ithaca, NY (February 1985). http://pmep.cce.cornell.edu/profiles/herb-growthreg/naa-rimsulfuron/pyrazon/herb-prof-pyrazon.html

- USEPA, Office of Pesticide Programs, Pesticide Residue Limits, "Pyrazon," 40 CFR 180.316. http://www.setonresourcecenter.com/40CFR/Docs/wcd0004d/wcd04d16.asp

Pyrethrins P:1340

Use Type: Insecticide
CAS Number: 121-21-1 (I); 121-29-9 (II); 8003-34-7 (pyrethrum)*
Formula: $C_{20-21}H_{28-30}O_{3-5}$
Synonyms: Chrysanthemum cinerariefolium; Cinerin I; Cinerin II; Jasmolin I; Jasmolin II; Persian insect powder; Piretrina (Spanish); Pyrethrin I; Pyrethrin II; Pyrethrum flowers; Trieste flowers
Trade Names: (The U.S. EPA currently registers 7,295 products, including 1,441 active ones and those that have been canceled or transferred.) BUHACH®; CHRYSANTHEMUM CINERAREAEFOLIUM®; DALMATION INSECT FLOWERS®; FIRMOTOX®; INSECT POWDER®; OFIRMOTOX®; PAREXAN®; PRENTOX®; PYRETRINER®; PYRETHRUM INSECTICIDE®
Chemical class: Botanical; Chrysanthemic esters
EPA/OPP PC Code: 069000 (Pyrethrum); 069001 (Mixed Pyrethrins I and Pyrethrins II); 069002 [Ground Pyrethrum (other than pyrethrins)].
California DPR Chemical Code: 510
HSDB Number: 6297
UN/NA & ERG Number: UN3077 (solid)/171
RTECS® Number: UR4200000
EC Number: 232-319-8
Uses: Pyrethrins is the name given to the active insecticidal components of the dried flowers-Pyrethrin I and II-which, in turn, have four different ingredients–Cinerin I and II and Jasmolin I and II. Pyrethrins are registered for use in the U.S. and Canada and EU countries.
U.S. Maximum Allowable Residue Levels for Pyrethrum powder other than pyrethrins (40 CFR 180.905): Pyrethrins or pyrethrum powders, when applied to growing crops in accordance with good agricultural practice, are exempt from the requirements of tolerance. These pesticides are not exempted from the requirement of a tolerance when applied to a crop at the time of, or after, the harvest.
Regulatory Authority and Advisory Information: U.S.
EPA Carcinogens: EPA Suggestive evidence of carcinogenicity, but not sufficient to assess human potential.
Acute Oral Category: 2, WARNING
AB 1803-Well Monitoring Chemical (CAL) as pyrethrins
Pyrethrin I:
Clean Water Act: Section 311 Hazardous Substances/RQ 40CFR117.3 (same as CERCLA, see below)
EPA Hazardous Waste Number (RCRA No.): P008
Superfund/EPCRA 40CFR302.4 RQ: CERCLA, 1 lb (0.454 kg)
Pyrethrin II:
Clean Water Act: Section 311 Hazardous Substances/RQ 40CFR117.3 (same as CERCLA, see below)
Superfund/EPCRA 40CFR302.4 RQ: CERCLA, 1 lb (0.454 kg)
WGK (German Aquatic Hazard Class): 3-Severe hazard to waters. [CAS: 8003-34-7; 121-21-1 (I); 121-29-9 (II)]
Description: The pyrethrins are a variable mixture of compounds which are found in pyrethrum flowers: cinerin, jasmolin, and pyrethrin. Pyrethrins are a brown, viscous oil or solid. Sprays may be dissolved in xylene or kerosene Molecular weight = 328.4 (Pyrethrin I); 372.4; (Pyrethrin II); 316.4 (Cinerin I); 360.4 (Cinerin II)[86]; Specific gravity (H_2O:1) = ~1.0 @ 25 °C; Boiling Point @ 1 atm: 170 °C; (Pyrethrin I) 200 °C (Pyrethrin II) 137 °C (Cinerin I); 183 °C (Cinerin II)[86]; Vapor pressure = Low; Flash point = 82.2–87.8 °C. Hazard Identification (based on NFPA-704 M Rating System): Health 2, Flammability 1, Reactivity 0. Practically insoluble in water.
Incompatibilities: Dust may form explosive mixture with air. Violent reaction with strong oxidizers and alkaline materials. Pyrethrins oxidize rapidly in air. Decompose rapidly in base. May may generate heat on contact with acid or caustic solutions. Contact with hydrides and alkali metals generating flammable and potentially explosive hydrogen gas.
Permissible Exposure Limits in Air:
NIOSH[2] IDLH = 5,000 ppm
OSHA PEL: 5 mg/m^3 TWA
NIOSH REL: 5 mg/m^3 TWA
ACGIH TLV®[1]: 5 mg/m^3 TWA
STEL set by HSE[33] = 10 mg/m^3.
Determination in Air: Collection by impinger or fritted bubbler, analysis by gas liquid chromatography/ultraviolet. See NIOSH IV, Method #5008[18].
Permissible Concentration in Water: Runoff from spills or fire control may cause water pollution.
Routes of Entry: Inhalation, ingestion, skin and/or eye contact.
Harmful Effects and Symptoms: Erythema, dermatitis, papules, pruritus, rhinorrhea (discharge of thin mucus); sneezing; asthma[9].
Short Term Exposure: Pyrethrum can affect you when breathed in and by passing through your skin. Irritates the eyes and respiratory tract. High exposure can affect the nervous system, causing headache, nausea, vomiting, fatigue, and restlessness, rhinorrhea (discharge of thin nasal mucous). LD_{50} (oral, human child) = 200 mg/kg[96]; LD_{50} (dermal, rat) = >1 g/kg.
Long Term Exposure: High or repeated exposure can cause lung allergy (with cough, wheezing and/or shortness of breath) or hay fever symptoms (sneezing, runny or stuffy nose). Allergic "pneumonia" can also occur with cough, chest pain, breathing difficulty and abnormal chest x-ray. Repeated attacks may lead to permanent scarring. Skin allergy may also develop with rash and itching, even with lower exposures. Dermal contact can cause rash with redness, blisters and intense itching. A severe generalized allergy can occur with weakness and collapse.
Points of Attack: Respiratory system, skin, central nervous system.

Medical Surveillance: Before beginning employment and at regular times after that, the following are recommended: Lung function tests. These may be normal if the person is not having an attack at the time of the test. Consider chest x-ray if lung symptoms are present. Evaluation by a qualified allergist, including exposure history and testing, may help diagnose allergy.

First Aid: If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least 15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately. If this chemical contacts the skin, remove contaminated clothing and wash immediately with soap and water. Seek medical attention immediately. If this chemical has been inhaled, remove from exposure, begin rescue breathing (using universal precautions) if breathing has stopped, and CPR if heart action has stopped. Transfer promptly to a medical facility. When this chemical has been swallowed, get medical attention. Give large quantities of water and induce vomiting. Do not make an unconscious person vomit.

Personal Protective Methods: Applicators and other handlers must wear: Coveralls worn over long-sleeved shirt and long pants; Chemical-resistant gloves such as DuPont™ Tychem® suit fabrics, barrier laminate, or Viton®; Chemical-resistant footwear plus socks; Protective eye wear; Chemical-resistant headgear for overhead exposure; Chemical-resistant apron when cleaning equipment, mixing, or loading[83]. Agricultural Use/Engineering Controls: When handlers use closed systems, enclosed cabs, or aircraft in a manner that meets the requirements listed in the Worker Protection Standard (WPS) for agricultural pesticides, ***40 CFR 170.240(d)(4-6)***, the handler PPE requirements may be reduced or modified as specified in the Worker Protection Standard. Firefighters should wear NIOSH-approved self-contained breathing apparatus and full protective clothing.

Respirator Selection: Wherever and whenever workplace conditions warrant respirator use, a respiratory protection program must be followed that meets one or more of the following government standards: OSHA's 29 CFR 1910.134, ANSI Z88.2, or European Standard EN 149.

Storage: Color Code-Blue: Health Hazard/Poison. Store in a secure poison location. Prior to working with this chemical you should be trained on its proper handling and storage. Store in tightly closed containers in a cool, well-ventilated area. Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: These materials may be classified as environmentally hazardous substances, solid or liquid, n. o. s. They usually fall in Hazard Class 9. STN: 49 638 81; Pyrethrins (hazardous substance, liquid, not otherwise specified); 49 638 86; Pyrethrins (pyrethrum extract, not <25% pyrethrum) (hazardous substance, liquid, not otherwise specified); 49 638 72; Pyrethrins (agricultural insecticides, not elsewhere classified, liquid) (hazardous substance, liquid, not otherwise specified); 49 638 77; Pyrethrins (agricultural insecticides, not elsewhere classified, other than liquid) (hazardous substance, solid, not otherwise specified); 49 638 68; Pyrethrins (insecticides, other than agricultural, not elsewhere classified) (hazardous substance, solid, not otherwise specified).

Spill Handling: First remove all sources of ignition. Evacuate persons not wearing protective equipment from area of spill or leak until clean up is complete. Ventilate area of spill or leak. Use water spray to reduce vapor. Absorb liquids in vermiculite, dry sand, earth, or a similar material and deposit in sealed containers. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable.

Fire Extinguishing: Hazardous decomposition oxides of carbon. As an immediate precautionary measure, isolate spill or leak area in all directions for at least 50 meters/150 feet for liquids and at least 25 meters/75 feet for solids. *Fire involving storage or vehicular tanks:* isolate for 800 meters/0.5 mile in all directions; also, consider initial evacuation for 800 meters/0.5 mile in all directions. *On a small fire:* use dry chemical, CO_2, water spray or regular foam. *On a large fire:* use water spray, fog or regular foam. Do not scatter spilled material with high-pressure streams of water. Move containers from fire area if you can do it without risk. Dike fire-control water for later disposal. *Fire involving tanks:* from a secure, explosion-proof location, use water spray to cool exposed containers. If cooling streams are ineffective (venting sound increases in volume and pitch, tank discolors, or shows any signs of deforming), withdraw immediately to a secure position. Always stay away from tanks engulfed in fire. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode.

Disposal Method Suggested: Do not discharge into drains or sewers. Dispose of waste material as hazardous waste using a licensed disposal contractor to an approved landfill. Consult with environmental regulatory agencies for guidance on acceptable disposal practices. Generators of waste containing this contaminant (≥100 kg/mo) must conform with EPA regulations governing storage, transportation, treatment, and waste disposal. Incineration with effluent gas scrubbing is recommended. Containers must be disposed of properly by following package label directions or by contacting your local or federal environmental control agency, or by contacting your regional EPA office.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- EXTOXNET, Extension Toxicology Network, "Pesticide Information Profile," Oregon State University, Corvallis, OR (March 1994). http://extoxnet.orst.edu/pips/pyrethri.htm
- USEPA, Office of Pesticide Programs, Pesticide Residue Limits, "Pyrethrum powder other than pyrethrins," 40 CFR 180.905. http://www.epa.gov/pesticides/food/viewtols.htm
- New Jersey Department of Health and Senior Services, "Hazardous Substance Fact sheet, Pyrethrum," Trenton, NJ (August 2002). http://www.state.nj.us/health/eoh/rtkweb/1623.pdf

Pyridaben P:1342

Use Type: Insecticide, Acaricide

CAS Number: 96489-71-3

Formula: $C_{19}H_{25}ClN_2OS$

Synonyms: 2-(*tert*-Butyl)-5-(4-*tert*-butyl-benzylthio)-4-chloropyridazin-3-(2*H*)one; 3(2*H*)-Pyridazinone, 4-chloro-2-(1,1-dimethylethyl)-5-[((4-(1,1-dimethylethyl) phenyl)methyl)thio]-

Trade Names: BAS®-300; NCI®-129; NESTER®; PYRAMITE®; SANMITE®

Chemical class: Pyridazinone

EPA/OPP PC Code: 129105

California DPR Chemical Code: 3959

HSDB Number: 7052

UN/NA & ERG Number: UN2588 (Pesticide, solid, poisonous, n.o.s.)/151; UN2902 (Pesticide, liquid, poisonous, n.o.s.)/151

RTECS® Number: UR6149000

EC Number: 405-700-3 [*Annex I Index No.:* 613-149-00-7]

Uses: Used to control mites, whiteflies, leafhoppers and psyllids on fruit trees, vegetables, ornamentals and other field crops. Pyramite is a selective contact miticide/insecticide that controls pests in apple, grapes, pear, pistachio, stone fruits, and the tree nuts group[83].

U.S. Maximum Allowable Residue Levels for Pyridaben and its metabolites (2-tert-butyl-5-(4-(1-carboxy-1-methylethyl)benzylthio)-4-chloropyridazin-3(2H)- one) and (2-tert-butyl-5-(4-(1,1-dimethyl-2-hydroxyethyl)benzylthio-4-chloropyridazin-3(2H)-one) on animals, as follows [40 CFR 180.494(a)]: almond, hulls 4.0 ppm; apple 0.5 ppm; apple, wet pomace 0.75 ppm; cattle, fat 0.05 ppm; cattle, meat 0.05 ppm; cattle, meat byproducts 0.05 ppm; citrus 0.5 ppm; citrus, dried pulp 1.5 ppm; citrus, oil 10.0 ppm; goat, fat 0.05 ppm; goat, meat 0.05 ppm; goat, meat byproducts 0.05 ppm; grape 1.5 ppm; hog, fat 0.05 ppm; hog, meat 0.05 ppm; hog, meat byproducts 0.05 ppm; horse, fat 0.05 ppm; horse, meat 0.05 ppm; horse, meat byproducts 0.05 ppm; milk 0.01 ppm; nectarine 2.5 ppm; nut, tree crop group 0.05 ppm; peach 2.5 ppm; pear 0.75 ppm; pistachio 0.05 ppm; plum 2.5 ppm; prune 2.5 ppm; sheep, fat 0.05 ppm; sheep, meat 0.05 ppm; and sheep, meat byproducts 0.05 ppm. *Tolerances with regional registration, as defined in section 180.1(n) are established for residues of pyridaben* ***[40 CFR 180.494(a)]:*** in or on the following raw agricultural commodity: cranberry 0.5 ppm.

Regulatory Authority and Advisory Information:

Carcinogenicity[83]: EPA Group E, evidence of noncarcinogenicity for humans.

EPA Oral reference dose (RfD) = 0.50 mg/kg/day. (NOAEL = 50 mg/kg/day, UF = 100) was selected for use in assessing acute dietary risk for the general population. EPA acute RfD of 0.13 mg/kg/day NOAEL = 13 mg/kg/day, uncertainty factor (UF) = 100 for use in assessing acute dietary risk for females 13 years and older[83].

Health Advisory: Developmental/Reproductive Toxin

Toxicity (oral) Category 3, CAUTION

European/International Regulations: Hazard Symbol: T, N; risk phrases: R23/25; R50/53; safety phrases: S1/2; S36/37; S45; S60; S61 (see Appendix 1)

Description: White to tan crystalline solid or powder. Faint vanilla odor. Commercial product is available as an emulsifiable concentrate or wettable powder. Molecular weight = 364.92; Specific gravity (H_2O:1) = 1.19 @ 20 °C; Boiling point = (decomposes); Freezing/Melting point = 109–112 °C; Vapor pressure = 2×10^{-7} mmHg @ 25 °C; Flash point = >200 °C; Autoignition temperature = 395 °C. Practically insoluble in water; solubility = <0.5 mg/L. Physical and toxicological properties may be affected by carrier solvents in commercial formulations.

Incompatibilities: Dust may form explosive mixture with air. Keep away from strong oxidizers.

Permissible Concentration in Water: Runoff from spills or fire control may cause water pollution.

Determination in Water: Log K_{ow} = >6.0. Values above 3.0 are likely to bioaccumulate in aquatic organisms.

Routes of Entry: Inhalation, ingestion, eyes, dermal absorption.

Harmful Effects and Symptoms

Short Term Exposure: May be fatal if inhaled. Do not breathe dust or spray mist. Avoid contact with skin. Causes moderate injury. Do not get in eyes or on clothing[83]. Absorbed through the unbroken skin. Harmful if swallowed. LD_{50} (oral, rat) = 600–1100 mg/kg; LD_{50} (dermal, rat) = >2 g/kg.

Long Term Exposure: May be a developmental/reproduction hazard.

Points of Attack: Reproductive system; DNA, testes, ovaries.

Medical Surveillance: In addition to comprehensive initial medical and work histories emphasizing reproductive experience and menstrual history, patient should have physical examination and testing of genito-urinary tract, sperm count, motility and morphology. If required, other tests, such as serum testosterone, serum follicle stimulating hormone (FSH), and serum lutenizing hormone (LH), may be indicated.

First Aid: If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least 15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately. Give artificial respiration if victim is not breathing. *Do not* use mouth-to-mouth method if victim ingested or inhaled the substance; give artificial respiration with the aid of a pocket mask equipped with a one-way valve or other proper respiratory medical device. Administer oxygen if breathing is difficult. Remove and isolate contaminated clothing and shoes. In cases of contact with substance, immediately flush skin or eyes with running water for at least 20 minutes. For minor skin contact, avoid spreading material on unaffected skin. Keep victim warm and quiet. Effects of exposure (inhalation, ingestion or skin contact) to substance may be delayed. Ensure that medical personnel are aware of the material(s) involved and take precautions to protect themselves.

Personal Protective Methods: Applicators and other handlers must wear: Coveralls worn over long-sleeved shirt and long pants; Chemical-resistant gloves such as DuPont™ Tychem® suit fabrics, barrier laminate, or Viton®; Chemical-resistant footwear plus socks; Protective eye wear; Chemical-resistant headgear for overhead exposure; Chemical-resistant apron when cleaning equipment, mixing, or loading[83]. Agricultural Use/Engineering Controls: When handlers use closed systems, enclosed cabs, or aircraft in a manner that meets the requirements listed in the Worker Protection Standard (WPS) for agricultural pesticides, ***40 CFR 170.240(d)(4-6)***, the handler PPE requirements may be reduced or modified as specified in the Worker Protection Standard. Firefighters should wear NIOSH-approved self-contained breathing apparatus and full protective clothing.

Respirator Selection: For handling activities, use a dust/mist filtering respirator. or a NIOSH-approved respirator with an N, P, R, or HE prefilter[83]. *At any detectable concentration:* SCBAF: Pd,Pp (APF = 10,000) (any NIOSH/MSHA- or European Standard EN 149-approved self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode); or SaF: Pd,Pp: ASCBA (APF = 10,000) (any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary, self-contained breathing apparatus operated in a pressure-demand or other positive-pressure mode). *Escape:* 100F (APF = 50) (any air purifying, full facepiece respirator with an N100, R100, or P100 filter k-mounted organic vapor canister having a high-efficiency particulate filter); or SCBAE (any appropriate escape-type, self-contained breathing apparatus).

Storage: Color Code-Blue: Health Hazard/Possible Human Carcinogen: Store in a tightly closed container in a dry, well-ventilated and secure poison location. Prior to working with this chemical you should be trained on its proper handling and storage. Where possible, automatically transfer material from other storage containers to process containers. Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: Pesticides, solid, toxic/poisonous, n.o.s require a shipping label of "poisonous materials" and fall in Hazard Class 6.1. Technical name required.

Spill Handling: For solids, *small spill*, isolate spill or leak area in all directions for at least 25 meters/75 feet. Increase, in the downwind direction, as necessary. For a *large spill* evacuate downwind at least 100 meters/330 feet. Do not touch damaged containers or spilled material unless wearing appropriate protective clothing. Stop leak if you can do it without risk. Keep combustibles (wood, paper, oil, etc.) away from spilled material. Do not allow water to get inside containers. *Small dry spill*: with clean shovel place material into clean, dry container and cover loosely; move containers from spill area. *Large spill*: dike far ahead of liquid spill for later disposal. Following product recovery, flush area with water. Prevent entry into waterways, sewers, basements or confined areas. Cover with plastic sheet to prevent spreading. Absorb or cover with dry earth, sand or other non-combustible material and transfer to containers. Do not allow water to get inside containers.

Fire Extinguishing: Hazardous decomposition includes oxides of nitrogen, sulfur, and carbon and hydrogen chloride gas. As an immediate precautionary measure, isolate spill or leak area in all directions for at least 50 meters/150 feet for liquids and at least 25 meters/75 feet for solids. *Fire involving storage or vehicular tanks:* isolate for 800 meters/0.5 mile in all directions; also, consider initial evacuation for 800 meters/0.5 mile in all directions. *On a small fire:* use dry chemical, CO_2, water spray or regular foam. *On a large fire:* use water spray, fog or regular foam. Do not scatter spilled material with high-pressure streams of water. Move containers from fire area if you can do it without risk. Dike fire-control water for later disposal. *Fire involving tanks:* from a secure, explosion-proof location, use water spray to cool exposed containers. If cooling streams are ineffective (venting sound increases in volume and pitch, tank discolors, or shows any signs of deforming), withdraw immediately to a secure position. Always stay away from tanks engulfed in fire. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode.

Disposal Method Suggested: It is the responsibility of chemical waste generators to determine the toxicity and physical properties of a discarded chemical and to properly identify its classification and certification as a hazardous waste and to determine the disposal method. U.S. EPA guidelines for the classification determination are listed in 40 CFR Parts 261.3. Additionally, waste generators must consult and follow all regional, national, state and local hazardous waste laws to ensure complete and accurate classification and disposal methods. Follow recommendations for the disposal of pesticides and pesticide containers. Containers must be disposed of properly by following package label directions or by contacting your local or federal environmental control agency, or by contacting your regional EPA office.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- USEPA, Office of Pesticide Programs, Pesticide Residue Limits, "Pyridaben," 40 CFR 180.494. http://www.epa.gov/pesticides/food/viewtols.htm

Pyridate P:1344

Use Type: Herbicide

CAS Number: 55512-33-9

Formula: $C_{19}H_{23}ClN_2O_2S$

Synonyms: Carbonothioic acid, *O*-(6-chloro-3-phenyl-4-pyridizinyl) *S*-octyl ester; *O*-(6-Chloro-3-phenyl-4-pyridazinyl) *S*-octyl carbonothioate; 6-Chloro-3-phenylpridazin-4-yl-*S*-octyl-thiocarbonate; *O*-(6-Chloro-3-phenyl-4-pyridazinyl)-carbonothioic acid *S*-octyl ester; Fenpyrate; Octyl-*O*-(6-chloro-3-phenylpyridazin-4-yl)carbothioate (BSI)

Trade Names: CL-11344®; LENTAGRAN®; PIRATE®; ST-9551®; TOUGH®

Chemical class: Phenylpyridazine

EPA/OPP PC Code: 128834

California DPR Chemical Code: 3939

UN/NA & ERG Number: UN3077(solid)/171

RTECS® Number: FG3880000

EC Number: 259-686-7 [*Annex I Index No.*: 607-232-00-7].

U.S. Maximum Allowable Residue Levels for Pyridate (40 CFR 180.462): brassica, head and stem, subgroup 5a, 0.03 ppm; ppm; cabbage 0.03 ppm; chickpea, seed 0.1 ppm; collards 0.03 ppm; corn, field, forage 0.03 ppm; corn, forage, grain, stover 0.03 ppm; peanut 0.03 ppm; peppermint, tops 0.2 ppm; spearmint, tops 0.2 ppm.

Regulatory Authority and Advisory Information:

Toxicity (oral) Category 3, CAUTION

European/International Regulations: Hazard Symbol: Xi, N; risk phrases: R20/22; R36/38; R41; R43; R50/53; safety phrases: S2; S24; S37; S60; S61 (see Appendix 1)

Description: Brown oily liquid. Molecular weight = 378.918; Specific gravity (H_2O:1) = 1.16 @ 20 °C; Boiling point = (decomposes); Freezing/Melting point = 27–28 °C; Vapor pressure = 6×10^{-12} mmHg @ 25 °C; Flash point = 220 °C(cc). Hazard Identification (based on NFPA-704 M Rating System): Health 2, Flammability 1, Reactivity 0. Very slightly soluble in water; solubility = 85 ppm.

Incompatibilities: May react with strong oxidizers such as chlorates, peroxides, nitrates, etc.

Routes of Entry: Dermal absorbtion, inhalation, ingestion, eye contact.

Harmful Effects and Symptoms

Short Term Exposure: Harmful if swallowed. May cause irritation of the eyes, skin, and repsiratory tract. May cause skin sensitization. LD_{50} (oral, rat) = >2 g/kg; LD_{50} (dermal, rabbit) = >3 g/kg.

Long Term Exposure: Possible skin allergy.

Points of Attack: Respiratory system, central nervous system, cardiovascular system, skin, eyes.

Medical Surveillance: Preliminary medical exam to detect chronic diseases of central nervous system, liver, heart, kidneys, lung and skin, as well as endocrinological or immunological disturbances, should protect susceptible individuals. Periodical medical exams of internal organs, skin and eyes are important to avoid chronic occupational intoxications. They should include lab and patch tests when necessary[83]. Medical observation is recommended for 24 to 48 hours following breathing overexposure, as pulmonary edema may be delayed. Cigarette smoking may exacerbate pulmonary injury and should be discouraged for at least 72 hours following exposure. Before employment and at regular times after that, the following are recommended: If symptoms develop or overexposure occurs, repeat the above tests as soon as possible and get an exam of the nervous system. Also consider complete blood count and chest x-ray following acute overexposure. Evaluation by a qualified allergist, including exposure history and testing, may help diagnose allergy.

First Aid: If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least 15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately. If this chemical contacts the skin, remove contaminated clothing and wash immediately with soap and water. Seek medical attention immediately. If this chemical has been inhaled, remove from exposure, begin rescue breathing (using universal precautions) if breathing has stopped, and CPR if heart action has stopped. Transfer promptly to a medical facility. When this chemical has been swallowed, get medical attention. If victim is conscious and able to swallow, have victim drink 4 to 8 ounces of water. Do not induce vomiting. *Note to physician or authorized medical personnel*: Medical observation is recommended for 24 to 48 hours following breathing overexposure, as pulmonary edema may be delayed. As first aid for pulmonary edema, a doctor or authorized paramedic might consider administering a corticosteroid spray. Cigarette smoking may exacerbate pulmonary injury and should be discouraged for at least 72 hours following exposure.

Personal Protective Methods: Applicators and other handlers must wear: Coveralls worn over long-sleeved shirt and long pants; Chemical-resistant gloves such as DuPont™ Tychem® suit fabrics, barrier laminate, or Viton®; Chemical-resistant footwear plus socks; Protective eye wear; Chemical-resistant headgear for overhead exposure; Chemical-resistant apron when cleaning equipment, mixing, or loading[83]. Agricultural Use/Engineering Controls: When handlers use closed systems, enclosed cabs, or aircraft in a manner that meets the requirements listed in the Worker Protection Standard (WPS) for agricultural pesticides, ***40 CFR 170.240(d)(4-6)***, the handler PPE requirements may be reduced or modified as specified in the Worker Protection Standard. Firefighters should wear NIOSH-approved self-contained breathing apparatus and full protective clothing.

Respirator Selection: For handling activities, use a dust/mist filtering respirator. or a NIOSH-approved respirator with a N, P, R, or HE prefilter[83]. *At any detectable concentration:* SCBAF: Pd,Pp (APF = 10,000) (any NIOSH/MSHA- or European Standard EN 149-approved self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode); or SaF: Pd,Pp: ASCBA (APF = 10,000) (any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary, self-contained breathing apparatus operated in a pressure-demand or other positive-pressure mode). *Escape:* 100F (APF = 50) (any air-purifying, full facepiece respirator with an N100, R100, or P100 filter k-mounted organic vapor canister having a high-efficiency particulate filter); or SCBAE (any appropriate escape-type, self-contained breathing apparatus).

Storage: Color Code-Blue: Health Hazard/Possible Human Carcinogen: Store in a tightly closed container in a dry, well-ventilated and secure poison location. Prior to working with this chemical you should be trained on its proper handling and storage. Where possible, automatically transfer material from other storage containers to process containers. Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: Environmentally hazardous substances, solid or liquid, usually fall in Hazard Class 9.

Spill Handling: For solids, *small spill*, isolate spill or leak area in all directions for at least 25 meters/75 feet. Increase, in the downwind direction, as necessary. For a *large spill* evacuate downwind at least 100 meters/330 feet. Do not touch damaged containers or spilled material unless wearing appropriate protective clothing. Stop leak if you can do it without risk. Keep combustibles (wood, paper, oil, etc.) away from spilled material. Do not allow water to get inside containers. *Small dry spill*: with clean shovel place material into clean, dry container and cover loosely; move containers from spill area. *Large spill*: dike far ahead of liquid spill for later disposal. Following product recovery, flush area with water. Prevent entry into waterways, sewers, basements or confined areas. Cover with plastic sheet to prevent spreading. Absorb or cover with dry earth, sand or other non-combustible material and transfer to containers. Do not allow water to get inside containers.

Fire Extinguishing: Hazardous decomposition includes toxic oxides of nitrogen, sulfur, and carbon and hydrogen chloride gas. As an immediate precautionary measure, isolate spill or leak area in all directions for at least 50 meters/150 feet for liquids and at least 25 meters/75 feet for solids. *Fire involving storage or vehicular tanks:* isolate for 800 meters/0.5 mile in all directions; also, consider initial evacuation for 800 meters/0.5 mile in all directions. *On a small fire:* use dry chemical, CO_2, water spray or regular foam. *On a large fire:* use water spray, fog or regular foam. Do not scatter spilled material with high-pressure streams of water. Move containers from fire area if you can do it without risk. Dike fire-control water for later disposal. *Fire involving tanks:* from a secure, explosion-proof location, use water spray to cool exposed containers. If cooling streams are ineffective (venting sound increases in volume and pitch, tank discolors, or shows any signs of deforming), withdraw immediately to a secure position. Always stay away from tanks engulfed in fire. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode.

Disposal Method Suggested: It is the responsibility of chemical waste generators to determine the toxicity and physical properties of a discarded chemical and to properly identify its classification and certification as a hazardous waste and to determine the disposal method. U.S. EPA guidelines for the classification determination are listed in 40 CFR Parts 261.3. Additionally, waste generators must consult and follow all regional, national, state and local hazardous waste laws to ensure complete and accurate classification and disposal methods. Follow recommendations for the disposal of pesticides and pesticide containers. Containers must be disposed of properly by following package label directions or by contacting your local or federal environmental control agency, or by contacting your regional EPA office.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- USEPA, Office of Pesticide Programs, Pesticide Residue Limits, "Pyridate," 40 CFR 180.462. http://www.epa.gov/pesticides/food/viewtols.htm

Pyrimethanil P:1348

Use Type: Fungicide
CAS Number: 53112-28-0
Formula: $C_{12}H_{13}N_3$
Synonyms: 4,6-Dimethyl-*N*-phenyl-2-pyrimidinamine
Trade Names: SCALA®; SN 100309®
Chemical class: Pyrimidine
EPA/OPP PC Code: 288201
California DPR Chemical Code:

HSDB Number: 6916

UN/NA & ERG Number: UN3077 (solid)/171; UN3082(liquid)/171

EC Number: 414-2220-3

Uses: Used on grapes, strawberries, tomatoes, onions, beans, cucumbers, eggplant, and ornamental.

Regulatory Authority and Advisory Information:

Carcinogenicity[83]: EPA Group C, Possible human carcinogen

Health Advisory: Endocrine disruptor (S!)

Acute Oral Category: 2, WARNING

European/International Regulations: Hazard Symbol: N; risk phrases: R51/53; safety phrases: S2; S60 (see Appendix 1)

Description: Pyrimethanil is a white to light yellow crystalline powder. Commercial product is available as a brown emulsifiable concentrate. Molecular weight = 199.26; Specific gravity (H_2O:1) = 1.16 @ 20 °C; Freezing/Melting point = 93.3 °C; Vapor pressure = 2×10^{-5} mmHg @ 25 °C. Hazard Identification (based on NFPA-704 M Rating System): Health 2, Flammability 0, Reactivity 0. Practically insoluble in water. Physical and toxicological properties may be affected by carrier solvents in commercial formulations.

Incompatibilities: Strong oxidizers. When heated to decomposition, this material forms toxic oxides of nitrogen.

Determination in Water: Log K_{ow} = 2.5–2.8. Values above 3.0 are likely to bioaccumulate in aquatic organisms.

Routes of Entry: Inhalation, ingestion, dermal and/or eye contact.

Harmful Effects and Symptoms

Short Term Exposure: Harmful if inhaled. May cause skin, eye and respiratory tract irritation. May be harmful if swallowed or if absorbed through skin. LD_{50} (oral, rat) = >4 g/kg; LD_{50} (dermal, rat) = >5 g/kg.

Long Term Exposure: Possible human carcinogen.

Points of Attack: May affect major organs.

Medical Surveillance: This chemical is a suspected or known human carcinogen. Exposed persons should contact a physician for advice regarding the possible long term health effects and advice for medical monitoring.

First Aid: If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least 15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately. If this chemical contacts the skin, remove contaminated clothing and wash immediately with soap and water. Seek medical attention immediately. If this chemical has been inhaled, remove from exposure, begin rescue breathing (using universal precautions) if breathing has stopped, and CPR if heart action has stopped. Transfer promptly to a medical facility. When this chemical has been swallowed, get medical attention. Give large quantities of water and induce vomiting. Do not make an unconscious person vomit.

Personal Protective Methods: Applicators and other handlers must wear: Coveralls worn over long-sleeved shirt and long pants; Chemical-resistant gloves such as DuPont™ Tychem® suit fabrics, barrier laminate, or Viton®; Chemical-resistant footwear plus socks; Protective eye wear; Chemical-resistant headgear for overhead exposure; Chemical-resistant apron when cleaning equipment, mixing, or loading[83]. Agricultural Use/Engineering Controls: When handlers use closed systems, enclosed cabs, or aircraft in a manner that meets the requirements listed in the Worker Protection Standard (WPS) for agricultural pesticides, ***40 CFR 170.240(d)(4-6)***, the handler PPE requirements may be reduced or modified as specified in the Worker Protection Standard. Firefighters should wear NIOSH-approved self-contained breathing apparatus and full protective clothing.

Respirator Selection: Where the neat (undiluted) test chemical is weighed and diluted, wear a NIOSH-approved half-face respirator equipped with a combination filter cartridge, i.e. organic vapor/acid gas/HEPA (specific for organic vapors, HCl, acid gas, SO_2 and a high-efficiency particulate filter)[88]

Storage: Color Code-Blue: Health Hazard/Poison. Store in a tightly closed container in a dry, well-ventilated and secure poison location. Prior to working with this chemical you should be trained on its proper handling and storage. Where possible, automatically transfer material from other storage containers to process containers. Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: This material may be classified as Environmentally hazardous substances, liquid or solid, n.o.s. It usually falls in Hazard Class 9.

Spill Handling: Evacuate and restrict persons not wearing protective equipment from area of spill or leak until clean up is complete. Ventilate area of spill or leak. Absorb liquids in vermiculite, dry sand, earth, peat, carbon, or a similar material and deposit in sealed containers. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable.

Fire Extinguishing: Hazardous decomposition includes oxides of nitrogen and carbon. As an immediate precautionary measure, isolate spill or leak area in all directions for at least 50 meters/150 feet for liquids and at least 25 meters/75 feet for solids. *Fire involving storage or vehicular tanks:* isolate for 800 meters/0.5 mile in all directions; also, consider initial evacuation for 800 meters/0.5 mile in all directions. *On a small fire:* use dry chemical, CO_2, water spray or regular foam. *On a large fire:* use water spray, fog or regular foam. Do not scatter spilled material with high-pressure streams of water. Move containers from fire area if you can do it without risk. Dike fire-control water for later disposal. *Fire involving tanks:* cool containers with flooding quantities of water until well after fire is out. Withdraw immediately in the case of rising sound from venting safety devices or discoloration of tank. Always stay away from tanks engulfed in fire. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies. From a secure, explosion-proof location, use water spray to cool exposed containers. If cooling streams are ineffective (venting sound increases in volume and pitch, tank discolors, or shows any signs of deforming), withdraw immediately to a secure position. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode.

Disposal Method Suggested: Containers must be disposed of properly by following package label directions or by contacting your local or federal environmental control agency, or by contacting your regional EPA office. If this material cannot be disposed of according to label instructions, it may be dissolved or mixed with a combustible solvent and burned in a chemical incinerator equipped with an afterburner and scrubber. In accordance with 40CFR165, follow recommendations for the disposal of pesticides and pesticide containers.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- State of Washington, Department of Ecology, *Fact sheet for the fresh fruit packing general permit* , Lacey, WA (July 2, 2009)

Pyriproxyfen P:1360

Use Type: Insect growth regulator, Insecticide, Veterinary medicine

CAS Number: 95737-68-1

Formula: $C_{20}H_{19}NO_3$

Synonyms: 2-[1-Methyl-2-(4-phenoxyphenoxy)ethoxy] pyridine; 4-Phenoxyphenyl (*RS*)-2-(2-pyridyloxy)propyl ether; Pyridine, 2-[1-methyl-2-(4-phenoxyphenoxy)ethoxy]-

Trade Names: ARCHER®; DALAR®; DISTANCE®; ESTEEM®; NYLAR®; S-9318®; S 31183®; SUMILARV® Pyriproxyfen

Chemical class: Unclassified

EPA/OPP PC Code: 129032

California DPR Chemical Code: 4019

HSDB Number: 7053

UN/NA & ERG Number: UN3077(solid)/171

RTECS® Number: UT5804000

EC Number: 429-800-1

Uses: Pyriproxyfen is found in a number of household products as sprays, powders, baits, mists and shampoos for the control of fleas, ticks, mites and flying insects on pets, in the air, and in carpets and rugs. It's a larvicidal agent that mimics juvenile insect hormone.

U.S. Maximum Allowable Residue Levels for Pyriproxyfen [40 CFR 180.510(a)(1)]: in or on the following food commodities: acerola 0.10 ppm; almond, hulls 2.0 ppm; apple, wet pomace 0.8 ppm; brassica, head and stem, subgroup 5A: 0.70 ppm; brassica, leafy greens, subgroup 5B 2.0 ppm; bushberry subgroup 1.0 ppm; citrus, oil 20 ppm; citrus, dried pulp 2.0 ppm; cotton, gin byproducts 2.0 ppm; cottonseed 0.05 ppm; feijoa 0.10 ppm; fruit, citrus 0.3 ppm; fruit, pome 0.2 ppm; fruit, stone, group 1.0 ppm; guava 0.10 ppm; jaboticaba 0.10 ppm; juneberry 1.0 ppm; lingonbberry 1.0 ppm; logan 0.30 ppm; lychee 0.30 ppm; olive 1.0 ppm; olive, oil 2.0 ppm; passionfruit 0.10 ppm; pistachio 0.02 ppm; pulasan 0.30 ppm; rambutan 0.30 ppm; salal 1.0 ppm; Spanish lime 0.30 ppm; starfruit 0.10 ppm; tree nut 0.02 ppm; vegetable, cucurbit, group 9 0.10 ppm; vegetable, fruiting (except cucurbits) 0.2 ppm; walnut 0.02 ppm; and wax jambu 0.10 ppm. ***[40 CFR 180.510(a)(2)]:*** A tolerance of 0.10 ppm is established for all foods as a result of the proposed use of NYLAR in food handling establishments where food and food products are held, prepared, processed or served. Application is limited to space, general surface, spot, and/or crack and crevice treatment in food handling establishments where food and food products are held, processed, prepared and served. Space and general surface application may be used only when the facility is not in operation provided exposed food is covered or removed from the area being treated prior to application. Spot and/or crack and crevice treatment may be used while the facility is in operation provided exposed food is covered or removed from the area being treated prior to application. Food contact surfaces should be thoroughly washed with an effective cleaning compound and rinsed with potable water after use of the product. To assure safe use of this additive, its label and labeling shall conform to that registered with the U.S. Environmental Protection Agency, and shall be used in accordance with such label and labeling.

Regulatory Authority and Advisory Information:

Carcinogenicity[83]: EPA Group E, evidence of non-carcinogenicity for humans

EPA/OPP Oral reference dose (RfD) = 0.35 mg/kg/day. This RfD is based on a NOAEL of 35.1 mg/kg/day and an uncertainty factor (UF) of 100. The NOAEL was established from the combined chronic feeding/oncogenicity study in rats where the the LOAEL was 3,000 ppm, based on a 16.9% decrease in body weight gain in females when compared to controls[83].

Acute Oral Category: 4, Caution

European/International Regulations: Hazard Symbol: N; risk phrases: R50/53; safety phrases: S2; S60; S61 (see Appendix 1)

Description: Gray to white crystalline solid or powder. Also described as a pale yellow, waxy solid or liquid. Commercial product is available as an emulsifiable concentrate or wettable powders. Molecular weight = 321.37; Specific gravity (H_2O:1) = 1.23 @ 20 °C; Boiling point = (decomposes); Freezing/Melting point = 49.7 °C; Vapor pressure = 1×10^{-5} mmHg @ 25 °C; Flash point = >90 °C. Low solubility in water. Physical and toxicological properties may be affected by carrier solvents in commercial formulations.

Incompatibilities: This material is combustible; dust in air may form an explosive mixture. Reacts with strong acids and strong oxidizers. When heated to decomposition, this material forms toxic oxides of nitrogen and carbon monoxide.

Permissible Concentration in Water: Runoff from spills or fire control may cause water pollution.

Determination in Water: Log K_{ow} = >4.5. Values above 3.0 are likely to bioaccumulate in aquatic organisms.

Routes of Entry: Dermal contact, ingestion, eye contact.

Harmful Effects and Symptoms

Short Term Exposure: May cause irritation of the eyes, skin and respiratory tract. Inhalation may cause mucous membrane and respiratory irritation. Ingestion may cause stomach irritation, nausea, cramps and vomiting. LD_{50} (oral, rat) = >5 g/kg; LD_{50} (dermal, rat) = >2 g/kg.

Long Term Exposure: Possible blood and liver toxin.

Points of Attack: Liver, blood.

Medical Surveillance: Complete blood count. Liver function tests.

First Aid: If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least 15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately. If this chemical contacts the skin, remove contaminated clothing and wash immediately with soap and water. Seek medical attention immediately. If this chemical has been inhaled, remove from exposure, begin rescue breathing (using universal precautions) if breathing has stopped, and CPR if heart action has stopped. Transfer promptly to a medical facility. When this chemical has been swallowed, get medical attention. Give large quantities of water and induce vomiting. Do not make an unconscious person vomit.

Personal Protective Methods: Applicators and other handlers must wear: Coveralls worn over long-sleeved shirt and long pants; Chemical-resistant gloves such as DuPont™ Tychem® suit fabrics, barrier laminate, or Viton®; Chemical-resistant footwear plus socks; Protective eye wear; Chemical-resistant headgear for overhead exposure; Chemical-resistant apron when cleaning equipment, mixing, or loading[83]. Agricultural Use/Engineering Controls: When handlers use closed systems, enclosed cabs, or aircraft in a manner that meets the requirements listed in the Worker Protection Standard (WPS) for agricultural pesticides, ***40 CFR 170.240(d)(4-6)***, the handler PPE requirements may be reduced or modified as specified in the Worker Protection Standard. Firefighters should wear NIOSH-approved self-contained breathing apparatus and full protective clothing.

Respirator Selection: *At any detectable concentration:* SCBAF: Pd,Pp (APF = 10,000) (any NIOSH/MSHA- or European Standard EN 149-approved self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode); or SaF: Pd,Pp: ASCBA (APF = 10,000) (any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary, self-contained breathing apparatus operated in a pressure-demand or other positive-pressure mode). *Escape:* 100F (APF = 50) (any air-purifying, full facepiece respirator with an N100, R100, or P100 filter k-mounted organic vapor canister having a high-efficiency particulate filter); or SCBAE (any appropriate escape-type, self-contained breathing apparatus).

Storage: Color Code-Blue: Health Hazard/Possible Human Carcinogen: Store in a tightly closed container in a dry, well-ventilated and secure poison location. Prior to working with this chemical you should be trained on its proper handling and storage. Where possible, automatically transfer material from other storage containers to process containers. Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: Environmentally hazardous substances, solid or liquid, usually fall in Hazard Class 9.

Spill Handling: For solids, *small spill*, isolate spill or leak area in all directions for at least 25 meters/75 feet. Increase, in the downwind direction, as necessary. For a *large spill* evacuate downwind at least 100 meters/330 feet. Do not touch damaged containers or spilled material unless wearing appropriate protective clothing. Stop leak if you can do it without risk. Keep combustibles (wood, paper, oil, etc.) away from spilled material. Do not allow water to get inside containers. *Small dry spill*: With clean shovel place material into clean, dry container and cover loosely; move containers from spill area. *Large spill*: Dike far ahead of liquid spill for later disposal. Following product recovery, flush area with water. Prevent entry into waterways, sewers, basements or confined areas. Cover with plastic sheet to prevent spreading. Absorb or cover with dry earth, sand or other non-combustible material and transfer to containers. Do not allow water to get inside containers.

Fire Extinguishing: Hazardous decomposition includes toxic oxides of nitrogen and carbon. As an immediate precautionary measure, isolate spill or leak area in all directions for at least 50 meters/150 feet for liquids and at least 25 meters/75 feet for solids. *Fire involving storage or vehicular tanks:* isolate for 800 meters/0.5 mile in all directions; also, consider initial evacuation for 800 meters/0.5 mile in all directions. *On a small fire:* use dry chemical, CO_2, water spray or regular foam. *On a large fire:* use water spray, fog or regular foam. Do not scatter spilled material with high-pressure streams of water. Move containers from fire area if you can do it without risk. Dike fire-control water for later disposal. *Fire involving tanks:* from a secure, explosion-proof location, use water spray to cool exposed containers. If cooling streams are ineffective (venting sound increases in volume and pitch, tank discolors, or shows any signs of deforming), withdraw immediately to a secure position. Always stay away from tanks engulfed in fire. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies. If employees are

expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode.

Disposal Method Suggested: It is the responsibility of chemical waste generators to determine the toxicity and physical properties of a discarded chemical and to properly identify its classification and certification as a hazardous waste and to determine the disposal method. U.S. EPA guidelines for the classification determination are listed in 40 CFR Parts 261.3. Additionally, waste generators must consult and follow all regional, national, state and local hazardous waste laws to ensure complete and accurate classification and disposal methods. Follow recommendations for the disposal of pesticides and pesticide containers. Containers must be disposed of properly by following package label directions or by contacting your local or federal environmental control agency, or by contacting your regional EPA office.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- USEPA, Office of Pesticide Programs, Pesticide Residue Limits, "Pyriproxyfen," 40 CFR 180.510. http://www.epa.gov/pesticides/food/viewtols.htm

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* Substance reported to cause eye irritation or damage; may require eye protection.

* *Note:* When phosphine burns it produces a dense white cloud of phosphorus pentoxide (P_2O_5) fume. This fume is a severe respiratory tract irritant due to the rapid formation of orthophosphoric acid(H_3PO_4) on contact with water.

* *Note* (U.S. EPA): Pyrethrum is the crude extract containing all of the pyrethrins and has nothing to do *per se* with the insecticidal activity.

Q

Quintozene Q:0110

Use Type: Soil fungicide, Nematicide, Seed treatment
CAS Number: 82-68-8
Formula: $C_6Cl_5NO_2$
Synonyms: Benzene, pentachloronitro-; NCI-C00419; Nitropentachlorobenzene; Olipsan; Olpisan; PCNB; Pentachloronitrobenzene; Quinosan; Quintocene; Quintoceno (Spanish)
Trade Names: (EPA lists 290 active and canceled or transferred products) AVICOL (PESTICIDE)®; BOTRILEX®; BLOCKER 4F®; BOTRILEX®; BRASSICOL®; BRASSICOL EARTHCIDE®; BRASSICOL 75®; BRASSICOL SUPER®; CHINOZAN®; EARTHCIDE®; FARTOX®; FOLOSAN®; FOMAC 2®; FUNGICHLOR®; GC 3944-3-4®; KOBU®; KOBUTOL®; KODIAK A-T FUNGICIDE®; KP 2®; MARISAN FORTE®; MEFENOXAM®; PARFLO®; PENTAGEN®; PHOMASAN®; PKhNB®; RTU 1010®; SANICLOR 30®; TERRACHLOR®; TERRACLOR®; TERRACLOR 30G®; TERRA-COAT®; TERRAFUN®; TERRAZAN®; TILCAREX®; TRIPCNB®; TRIQUINTAM®; TRITISAN®; TUBERGRAN®; TURFCIDE®; VITAVAX® Quintozene
Chemical class: Substituted benzene; Chlorophenyl
EPA/OPP PC Code: 056502
California DPR Chemical Code: 464
HSDB Number: 1749 as Pentachloronitrobenzene
UN/NA & ERG Number: UN3077(solid)/171
RTECS® Number: DA6650000
EC Number: 201-435-0 [*Annex I Index No.:* 609-043-00-5]
Uses: Quintozene, the common name for PCNB or pentachlkoronitrobenzene, is an organochlorine fungicide used as a seed dressing or soil treatment to control a wide range of fungi species in such crops as potatoes, wheat, onions, lettuce, tomatoes, tulips, garlic, and others. Depending on the producer and the manufacturing procedure, PCNB impurities can include hexachlorobenzene, pentachlorobenzene, and tetrachloronitrobenzene. The fungicide is often used in combination with insecticides and fungicides including carbaryl, imazalil, tridimenol, etridiazole, and fuberidazole. It is available as a dustable or wettable powder, in granular form, emulsifiable concentrate, and seed treatment. Not approved for use in EU countries[115]. Registered for use in the U.S. and Canada. There are more than 35 global suppliers[97].
U.S. Maximum Allowable Residue Levels for tolerance of the fungicide Pentachloronitrobenzene/Quintozene is established for (N) negligible residues [40 CFR 180.291(a)] in or on the raw agricultural commodity cotton, undelinted seed 0.1 ppm. [40 CFR 180.291(b)]: Collards 0.2 ppm; Kale 0.2 ppm; Mustard greens 0.2 ppm. ***[40 CFR 180.319]:*** While petitions for tolerances for negligible residues are pending and until action is completed on these petitions, interim tolerances are established for residues of the listed pesticide chemicals in or on the following raw agricultural commodities: Substance: pentachloronitrobenzene; Uses: fungicide; Tolerance in parts per million: 1.0; Raw agricultural commodity: peanut. (N) = negligible amount of residue.
Regulatory Authority and Advisory Information:
Carcinogenicity[83]: EPA Group C, Possible human carcinogen; IARC: Group 3, unclassifiable as to carcinogenicity to humans; ACGIH A4, not classified as a human carcinogen
Health Advisory: Mutagen, Developmental/Reproductive Toxin
Acute Oral Category: 3, CAUTION
Potential Ground Water Pollutant [California FAC Section 13145(d)/12811, active]
EPA Hazardous Waste Number (RCRA No.): U185
RCRA 40CFR268.48; 61FR15654, Universal Treatment Standards: Wastewater (mg/L), 0.055; Non-wastewater (mg/kg), 4.8
RCRA 40CFR264, Appendix 9; TSD Facilities Ground Water Monitoring List. Suggested test method(s) (PQL *u*g/L): 8270(10)
Superfund/EPCRA 40CFR302.4 RQ: CERCLA, 100 lb (45.4 kg)
EPCRA Section 313 Form R *de minimis* concentration reporting level: 1.0%
European/International Regulations: Hazard Symbol: Xi, N; risk phrases: R43; R50/53; safety phrases: S2; S13; S24; S37; S60; S61 (see Appendix 1)
Description: Quintozene is a colorless to cream-colored crystalline material. Technical-grade PCNB contains an average of 97.8% PCNB, 1.8% hexachlorobenzene (HCB), 0.4% 2,3,4,5-tetrachloronitrobenzene (TCNB), and <0.1% pentachlorobenzene. Musty camphor-like odor. Molecular weight = 295.34; Specific gravity (H_2O:1) = 1.718 @ 25 °C; Boiling point = 327.78 °C; Freezing/Melting point = 146.11 °C; Vapor pressure = 1.3×10^{-2} mmHg @ 25 °C; Flash point = 160 °C; LEL (Lower Explosive Limit) = 4200 ppm. Practically insoluble in water; solubility = <1 mg/mL @ 22.2 °C
Incompatibilities: This material may be combustible and the dust may form an explosive mixture with air. Reacts with alkalies. When heated to decomposition, this material forms toxic oxides of nitrogen and fumes of chlorine
Permissible Exposure Limits in Air:
Conversion factor(s): 1 mg/m^3 = 0.08 ppm; 1 ppm = 12.3 mg/^{3}
ACGIH TLV®[1]: 0.5 mg/m^3 TWA; A4 not classifiable as a human carcinogen.
Protective Action Criteria (PAC) Ver. 27[89]
PAC-1: 1.5 mg/m^3
PAC-2: 10 mg/m^3
PAC-3: 62 mg/m^3

Permissible Concentration in Water: Federal Drinking Water Guidelines: 0.9 ppb[93]. State Drinking Water Guidelines: California 20 μg/L; Maine 2 μg/L; Florida 15 μg/L. Runoff from spills or fire control may cause water pollution.

Determination in Water: Log K_{ow} = >4.0. Values at or above 3.0 are likely to bioaccumulate in marine organisms.

Routes of Entry: Inhalation, ingestion, skin and/or eye contact.

Harmful Effects and Symptoms

Short Term Exposure: May cause skin and eye irritation, sensitization with erythema, itching and edema. May cause conjunctivitis and corneal injury.

LD_{50} (oral, rat) = <1200 mg/kg; LD_{50} (dermal, rat) = >5 g/kg.

Long Term Exposure: May cause tumors. May cause cancer. Animal studies: liver toxin. May cause skin sensitization. May cause conjunctivitis and corneal injury.

Points of Attack: Liver, skin, eyes.

Medical Surveillance: This chemical is a suspected or known human carcinogen. Exposed persons should contact a physician for advice regarding the possible long term health effects and advice for medical monitoring. Evaluation by a qualified allergist, including exposure history and testing, may help diagnose allergy. Liver function tests.

First Aid: *Dermal contact:* Flood all areas of body that have contacted the substance with water. Don't wait to remove contaminated clothing; do it under the water stream. Use soap to help ensure removal. Isolate contaminated clothing when removed to prevent contact by others. *Eye contact:* Remove any contact lenses at once. Flush eyes well with copious quantities of water or normal saline for at least 20–30 minutes. Seek medical attention. *Inhalation:* Leave contaminated area immediately; breathe fresh air. Proper respiratory protection must be supplied to any rescuers. If coughing, difficult breathing or any other symptoms develop, seek medical attention at once, even if symptoms develop many hours after exposure. *Ingestion:* If convulsions are not present, give a glass or two of water or milk to dilute the substance. Ensure that the person's airway is unobstructed and contact a hospital or poison center immediately for advice on whether or not to induce vomiting.

Personal Protective Methods: Wear protective gloves and clothing to prevent any reasonable probability of dermal and/or eye contact. If this chemical makes direct contact with your gloves, or if a tear, puncture or hole develops, replace them at once. Recommended glove materials: PVA, Edmont Model No. 25-545; Thickness: 0.33 mm; Breakthrough time: 240 min; Viton, North Model No. F-091; Thickness 0.24 mm; Breakthrough time: 240 min; Silvershield[88]. Safety equipment suppliers/manufacturers can provide recommendations on the most protective glove/clothing material for your operation. DuPont™ Tychem® Suit Fabrics[88]. All protective clothing (suits, gloves, footwear, headgear) should be clean, available each day, and put on before work. Contact lenses should not be worn when working with this chemical. Wear dust-proof chemical goggles and face shield unless full facepiece respiratory protection is worn. Employees should wash immediately with soap when skin is wet or contaminated. Provide emergency showers and eyewash.

Respirator Selection: Where there is potential for exposure to this chemical above 0.5 mg/m^3, use a NIOSH/MSHA- or European Standard EN149-approved supplied-air respirator with a full facepiece operated in the positive-pressure mode, or with a full facepiece, hood, or helmet in the continuous-flow mode; or use a NIOSH/MSHA- or European Standard EN149-approved self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive-pressure mode.

Storage: Color Code-Blue: Health Hazard/Poison: Store in a secure poison location. Prior to working with this chemical you should be trained on its proper handling and storage. Store in tightly closed containers in a cool, well-ventilated area away from strong oxidizers. Where possible, automatically transfer material from drums or other storage containers to process containers. If this material contains a flammable carrier, sources of ignition, such as smoking and open flames, are prohibited where this chemical is handled, used, or stored. Metal containers involving the transfer of this chemical should be grounded and bonded. Wherever this chemical is used, handled, manufactured, or stored, use explosion-proof electrical equipment and fittings. Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: Environmentally hazardous substances, solid or liquid, usually fall in Hazard Class 9.

Spill Handling: Evacuate persons not wearing protective equipment from area of spill or leak until clean up is complete. Collect powdered material in the most convenient and safe manner and deposit in sealed containers. Ventilate area after clean up is complete. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable. Soil Adsorption Index (K_{oc}) = 5000 (estimate).

Fire Extinguishing: Hazardous decomposition includes nitrogen oxides and hydrogen chloride. As an immediate precautionary measure, isolate spill or leak area in all directions for at least 50 meters/150 feet for liquids and at least 25 meters/75 feet for solids. *Fire involving storage or vehicular tanks:* isolate for 800 meters/0.5 mile in all directions; also, consider initial evacuation for 800 meters/0.5 mile in all directions. *On a small fire:* use dry chemical, CO_2, water spray or regular foam. *On a large fire:* use water spray, fog or regular foam. Do not scatter spilled material with high-pressure streams of water. Move containers from fire area if you can do it without risk. Dike fire-control water for later disposal. *Fire involving tanks:* from a secure, explosion-proof location, use water spray to cool exposed containers. If cooling streams are ineffective (venting sound increases in volume and pitch, tank discolors, or shows any signs of deforming), withdraw immediately to a secure position. Always stay away from tanks engulfed in fire. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode.

Disposal Method Suggested: Consult with environmental regulatory agencies for guidance on acceptable disposal practices. Generators of waste containing this contaminant (≥100 kg/mo) must conform with EPA regulations governing storage, transportation, treatment, and waste disposal. In accordance with 40CFR165, follow recommendations for the disposal.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- EXTOXNET, Extension Toxicology Network, "Pesticide Information Profile, Quintozene," Oregon State University, Corvallis, OR (June 1986). http://extoxnet.orst.edu/pips/quintoze.htm
- USEPA, "Pentachloronitrobenzene, Health and Environmental Effects Profile," No. 142, Office of Solid Waste, Washington DC (April 30, 1980)
- Lee, C. C., "Environmental Law Index to Chemicals," Government Institutes, Rockville MD (1996)
- Sax, N. I., Ed., "Dangerous Properties of Industrial Materials Report," 5, No. 3, 11-16 (1985)

Quizalofop-ethyl Q:0130

Use Type: Herbicide

CAS Number: 76578-14-8

Formula: $C_{19}H_{17}ClN_2O_4$ (same for *p*-isomer)

Synonyms: Caswell No. 215D; 2-[4-((6-Chloro-2-quinoxalinyl)oxy)phenoxy]ethyl propionate; 2-[4-((6-Chloro-2-quinoxalinyl)oxy)phenoxy]propionic acid, ethyl ester; Ethyl 2-[4-(6-chloro-2-quinoxalyloxy)phenoxy]propionate; NCI-C99983; Propanoic acid, 2-[4-((6-chloro-2-quinoxalinyl)oxy)phenoxy]-, ethyl ester; Quinofop-ethyl; Xylofop-ethyl

Trade Names: ASSURE®[C]; DPX-Y 6202®; FBC®; 32197; INY-6202; MATADOR®; LEOPARD EC (*p*-isomer); MON® 78746; NC-302®; PILOT®; SUPER MATADOR (*p*-isomer); TARGA®; ULTRA TARGA (*p*-isomer)

Chemical class: Chlorophenoxy; Aryloxyphenoxypropionate

EPA/OPP PC Code: 128711; (128201 old EPA code number)

California DPR Chemical Code: 2226

HSDB Number: 6990 (none for *p*-isomer)

UN/NA & ERG Number: UN3077(solid)/171

RTECS® Number: GW71910000

Uses: Not approved for use in EU countries[115]. Registered for use in the U.S.

U.S. Maximum Allowable Residue Levels for Quizalofop-Ethyl and quizalofop ethyl (ethyl-2-[4-(6-chloroquinoxalin-2-yloxy)phenoxy]propanoate), all expressed as Quizaolgop Ethyl [40CFR 180.441(a)]: in or on the following agricultural commodities: soybean flour 0.5 ppm; soybean hulls 0.02 ppm; soybean meal 0.5 ppm; soybean soapstock 1.0 ppm; soybeans 0.05 ppm; cattle, fat 0.05 ppm; cattle, meat 0.02 ppm; cattle, meat byproducts 0.05 ppm; eggs 0.02 ppm; goats, fat 0.05 ppm; goats, meat 0.02 ppm; goats, meat byproducts 0.05 ppm; hogs, fat 0.05 ppm; hogs, meat 0.02 ppm; hogs, meat byproducts 0.05 ppm; horses, fat 0.05 ppm; horses, meat 0.02 ppm; horses, meat byproducts 0.05 ppm; milk 0.01 ppm; milk, fat 0.05 ppm; poultry, fat 0.05 ppm; poultry, meat 0.02 ppm; poultry, meat byproducts 0.05 ppm; sheep, fat 0.05 ppm; sheep, meat 0.02 ppm; sheep, meat byproducts 0.05 ppm.

Regulatory Authority and Advisory Information:

Carcinogenicity[83]: EPA Group D, Not classifiable as a human carcinogen

California Proposition 65 Chemical: Male reproductive toxin (12/24/1999)

Health Advisory: Developmental/Developmental/Reproductive Toxin (male, TRI); Endocrine disruptor (S!)

Acute Oral Category: 3, CAUTION

AB 2588-Air Toxics "Hot Spots" Chemicals (CAL) as chlorophenoxy pesticides

EPCRA Section 313 Form R *de minimis* concentration reporting level: 1.0%

U.S. DOT Regulated Marine Pollutant (49CFR172.101, Appendix B) (severe)

Description: White crystalline solid or powder. Commercial product is available as an emulsifiable concentrate. Practically insoluble in water; solubility = $<2\times10^{-8}$ ppm. Molecular weight = 372.78; 372.80 (*p*-isomer); Vapor pressure = 3×10^{-7} mmHg @ 20 °C. Specific gravity (H_2O:1) = 1.35 @ 20 °C; Boiling point = 92 °C; Freezing/Melting point = 92 °C; 75 °C (*p*-isomer); Vapor pressure = 3×10^{-7} mmHg @ 25 °C; Practically insoluble in water; solubility = 0.5 mg/L @ 25 °C. Physical and toxicological properties may be affected by carrier solvents in commercial formulations.

Determination in Water: Log K_{ow} = >4.0 (both isomers). Values above 3.0 are likely to bioaccumulate in aquatic organisms.

Routes of Entry: Inhalation, ingestion, absorbtion through the skin.

Harmful Effects and Symptoms

Short Term Exposure: Poisonous; may be fatal if inhaled, swallowed, or absorbed through skin. Severely irritates eyes, skin and respiratory tract, with burning sensation, pain, redness and swelling. Metabolic stimulant. If inhaled, causes coughing, dilated pupils, headache, profuse perspiration, intense thirst, extreme fatigue, rapid pulse, high fever, clammy, flushed skin, rapid breathing, nausea, vomiting, cyanosis (bluish tint to skin and lips), anxiety and confusion, convulsions, risk of lung edema. If swallowed, face and lips turn bluish. Liver injury with associated jaundice, kidney failure, and cardiac arrhythmias are commonly noted. Nerve damage, which may be delayed, may include swelling of legs and feet, muscle twitch and stupor. Severe exposure can cause death from heart failure. Dust or liquid left in contact with the skin for several hours may be absorbed. This may result in severe delayed symptoms as listed above. These symptoms may last for months or years. LD_{50} (oral, rat) = 1500 mg/kg; 1200 mg/kg (*p*-isomer); LD_{50} (dermal, rat) = >5 g/kg.

Long Term Exposure: Workers exposed to chlorophenoxy compounds over a 5 to 10 year period at levels above 10 mg/m^3 complained of weakness, rapid fatigue, headache and vertigo. Liver damage, low blood pressure and slowed heartbeat were also found. Based on animal tests, may affect human reproduction.

Points of Attack: Eyes, skin, respiratory system, central nervous system, cardiovascular system, liver, kidney. A possible liver toxin.

Medical Surveillance: Preliminary medical exam to detect chronic diseases of central nervous system, liver, heart, kidneys, lung and skin, as well as endocrinological or immunological disturbances, should protect susceptible individuals. Periodical medical exams of internal organs, skin and eyes are important to avoid chronic occupational intoxications. They should include lab and patch tests when necessary[83]. Comprehensive physical examination with emphasis on the genito-urinary tract including testicle size and consistency in males. Semen analysis to include sperm count, motility and morphology. Other tests, such as serum testosterone, serum follicle stimulating hormone (FSH), and serum lutenizing hormone (LH), may be carried out if, in the opinion of a physician, they are indicated. If symptoms develop or overexposure is suspected, the following may be useful: Liver and kidney function tests. Exam of the nervous system

First Aid: If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least 15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately. If this chemical contacts the skin, remove contaminated clothing and wash immediately with soap and water. Seek medical attention immediately. If this chemical has been inhaled, remove from exposure, begin rescue breathing (using universal precautions) if breathing has stopped, and CPR if heart action has stopped. Transfer promptly to a medical facility. When this chemical has been swallowed, get medical attention. *Do not induce vomiting when formulations containing petroleum solvents are ingested*. Otherwise, give large quantities of water and induce vomiting. Do not make an unconscious person vomit.

Personal Protective Methods: Applicators and other handlers must wear: Coveralls worn over long-sleeved shirt and long pants; Chemical-resistant gloves such as DuPont™ Tychem® suit fabrics, barrier laminate, or Viton®; Chemical-resistant footwear plus socks; Protective eyewear; Chemical-resistant headgear for overhead exposure; Chemical-resistant apron when cleaning equipment, mixing, or loading[83]. Agricultural Use/Engineering Controls: When handlers use closed systems, enclosed cabs, or aircraft in a manner that meets the requirements listed in the Worker Protection Standard (WPS) for agricultural pesticides, ***40 CFR 170.240(d)(4-6)***, the handler PPE requirements may be reduced or modified as specified in the Worker Protection Standard. Firefighters should wear NIOSH-approved self-contained breathing apparatus and full protective clothing.

Respirator Selection: *At concentrations above the NIOSH REL, or where there is no REL, at any detectable concentration:* SCBAF:Pd,Pp (APF = 10,000): (any self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode); or SaF:Pd,Pp:ASCBA (APF = 10,000) (any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary self-contained positive-pressure breathing apparatus). *Escape*: GmFOv100 (APF = 50) [any air-purifying, full facepiece respirator (gas mask) with a chin-style, front- or back-mounted organic vapor canister having an N100, R100, or P100 filter]; or SCBAE (any appropriate escape-type, self-contained breathing apparatus).

Storage: Color Code-Blue: Health Hazard/Poison. Store in a secure poison location. Prior to working with this chemical you should be trained on its proper handling and storage. Store in tightly closed containers in a cool, well-ventilated area. Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: Environmentally hazardous substances, solid or liquid, usually fall in Hazard Class 9.

Spill Handling: First remove all sources of ignition. Evacuate persons not wearing protective equipment from area of spill or leak until clean up is complete. Ventilate area of spill or leak. Use water spray to reduce vapor. Absorb liquids in vermiculite, dry sand, earth, or a similar material and deposit in sealed containers. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable.

Fire Extinguishing: Hazardous decomposition includes fluorine and nitrogen oxides. As an immediate precautionary measure, isolate spill or leak area in all directions for at least 50 meters/150 feet for liquids and at least 25 meters/75 feet for solids. *Fire involving storage or vehicular tanks:* isolate for 800 meters/0.5 mile in all directions; also, consider initial evacuation for 800 meters/0.5 mile in all directions. *On a small fire:* use dry chemical, CO_2, water spray or regular foam. *On a large fire:* use water spray, fog or regular foam. Do not scatter spilled material with high-pressure streams of water. Move containers from fire area if you can do it without risk. Dike fire-control water for later disposal. *Fire involving tanks:* from a secure, explosion-proof location, use water spray to cool exposed containers. If cooling streams are ineffective (venting sound increases in volume and pitch, tank discolors, or shows any signs of deforming), withdraw immediately to a secure position. Always stay away from tanks engulfed in fire. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode.

Disposal Method Suggested: It is the responsibility of chemical waste generators to determine the toxicity and physical properties of a discarded chemical and to properly identify its classification and certification as a hazardous waste and to determine the disposal method. U.S. EPA guidelines for the classification determination are listed in 40 CFR Parts 261.3. Additionally, waste generators must consult and follow all regional, national, state and local hazardous waste laws to ensure complete and accurate classification and disposal methods.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- USEPA, Office of Pesticide Programs, Pesticide Residue Limits, "Quizalofop-Ethyl," ***40 CFR 180.441***. http://www.epa.gov/pesticides/food/viewtols.htm

R

Resmethrin R:0105

Use Type: Insecticide
CAS Number: 10453-86-8; 28434-01-7 (*d-trans*-isomer); 35764-59-1 (*cis*-isomer); 33911-28-3 (–)-(*trans*-isomer)
Formula: $C_{22}H_{26}O_3$
Synonyms: AI3-27474; Benzofuroline; Benzyfuroline; 5-Benzylfurfuryl chrysanthemate; (5-Benzyl-3-furyl)methyl chrysanthemate; 5-Benzyl-3-furylmethyl (±)-*cis-trans*-chrysanthemate; 5-Benzyl-3-furylmethyl(+)-trans-chrysanthemate; *d-trans*(5-Benzyl-3-furyl)methyl 2,2-dimethyl-3-(2-methylpropenyl) cyclopropanecarboxylate; 5-Benzyl-3-furylmethyl (1RS)-*cis,trans*-2,2-dimethyl-3-(2-methylprop-1-enyl)cyclopropanecarboxylate; 5-Benzyl-3-furylmethyl (1RS)-*(Z)*,*(E)*-2,2-dimethyl-3-(2-methylprop-1-enyl)cyclopropanecarboxylate; 5-Benzyl-3-furylmethyl (1RS,3RS; 1RS,3SR)-2,2-dimethyl-3-(2-methylprop-1-enyl)cyclopropanecarboxylate; (5-Benzyl-3-furyl)methyl 2,2-dimethyl-3-(2-methylpropenyl) cyclopropanecarboxylate; Bioresmethrin (*d-trans* isomer); Caswell No. 083E; Cyclopropanecarboxylic acid, 2,2-dimethyl-3-(2-methylpropenyl)-, (4-(2-benzyl)furyl) methyl ester; Cyclopropanecarboxylic acid, 2,2-dimethyl-3-(2-methylpropenyl)-, (5-benzyl-3-furyl)methyl ester (8CI); Cyclopropanecarboxylic acid, 2,2-dimethyl-3-(2-methyl-1-propenyl)-, (5-(phenylmethyl)-3-furanyl)methyl ester, *cis,trans*-(±)-; Cyclopropanecarboxylic acid, 2,2-dimethyl-3-(2-methyl-1-propenyl)-, [5-(phenylmethyl)-3-furanyl]methyl ester, *(Z)*,*(E)*-(±)-; Cyclopropanecarboxylic acid, 2,2-dimethyl-3-(2-methyl-1-propenyl)-, [5-(phenylmethyl)-3-furanyl] methyl ester; Cyclopropanecarboxylic acid, 2,2-dimethyl-3-(2-methyl-1-propenyl)-(5-(phenylmethyl)-3-furanyl)methyl ester, (1R-*cis*)-; Dimethyl 3-(2-methyl-1-propenyl) cyclopropanecarboxylate; 2,2-Dimethyl-3-(2-methyl-1-propenyl)cyclopropanecarboxylic acid; ENT 27474; NSC 195022; [5-(Phenylmethyl)-3-furanyl]methyl 2,2-dimethyl-3-furylmethyl-2,2-dimethyl-3-(2-methylpropenyl) cyclopropanecarboxylate; [5-(Phenylmethyl)-3-furanyl] methyl 2, 2-dimethyl-3-(2-methyl-1-propenyl)cyclopropanecarboxylate); 5-(Phenylmethyl)-3-furanyl)methyl 2,2-dimethyl-3-(2-methyl-1-propenyl)cyclopropanecarboxylate; [5-(Phenylmethyl)-3-furanyl]methyl ester; Resmethrin, (±)-; Resmethrin, (+)-*trans,cis*-; Resmethrin, (+)-*(E)*,*(Z)*-
Trade Names: BIORESMETHRIN® (*d-trans*-isomer); CHRYSRON®; CISMETHRIN® (*cis*-isomer); CROSSFIRE®; DERRINGER®; FMC® 17370; ISATHRIN®; NRDC® 107 (*d-trans*-isomer); NIA 26021® (*cis*-isomer); NIA-17370®; NIAGARA® 18739 (*d-trans*-isomer); NIAGARA® 26021 (*cis*-isomer); NRDC® 119 (*cis*-isomer); OBLIQUE®; PYNOSECT®; PYRETHERM®; RAID®; RESPOND®; RU-11484® (*d-trans*-isomer); SBP® 1382 (*d-trans*-isomer); *d-trans*-SBP® 1382 (*d-trans*-isomer); SBP®-1390; S. B. PENICK 1382®; SCOURGE®; SUN-BUGGER®; SYNTHRIN®; SYNTOX®; VECTRIN®; WHITMIRE® PT-110
Chemical class: Pyrethroid
EPA/OPP PC Code: 097801; 097802 (*d-trans*-isomer); 097804 (*cis*-isomer)
California DPR Chemical Code: 2119
HSDB Number: 1516
UN/NA & ERG Number: UN3082 (liquid)/151; UN3352 (liquid)/151; UN3349 (solid)/151
RTECS® Number: GZ1310000
EC Number: 233-940-7 [*Annex I Index No.:*613-060-00-3]
Uses: Resmethrin is currently used for mosquito control (by aerial application) in the USA, and may can also be used in greenhoused to control white fly. Resmethrin is a synthetic Type I pyrethroid insecticide registered for control of insects in residential, commercial and industrial settings, and in animal living areas. Resmethrin is also registered for use in food-handling establishments and as a restricted use pesticide when used in ULV spray to control adult mosquitoes in the interest of public health[83]. Restricted Use Pesticide (RUP) when formulated for use in mosquito abatement and pest control treatments at non-agricultural sites. Restricted due to extreme fish toxicity. Not approved for use in EU countries[115].
U.S. Maximum Allowable Residue Levels for Resmethrin [40 CFR 180.525]: in or on food commodities at 3.0 ppm resulting from use of the insecticide in food handling and storage areas as a space concentration for spot/or crack and crevice treatment and shall be limited to a maximum of 3.00 % of the active ingredient by weight, and as a space treatment shall be limited to a maximum of 0.5 fluid ounce of 3.0 % active ingredient by weight/1000 ft^3 of space provided that the food is removed or covered prior to such use. To assure safe use of the additive, its label and labeling shall conform to that registered with the U.S. Environmental Protection Agency, and shall be used in accordance with such label and labeling.
Regulatory Authority and Advisory Information:
Carcinogenicity[83]: EPA, Likely to be carcinogenic to humans
California Proposition 65 Chemical: Cancer (7/1/2008); Developmental/Reproductive toxin (7/1/2008).
Health Advisory: Endocrine disruptor (S!); Developmental/Reproductive Toxin
Toxicity (oral) Category 3, CAUTION
EPA Oral reference dose (RfD) = 0.03 mg/kg/day
EPCRA Section 313 Form R *de minimis* concentration reporting level: 1.0%

European/International Regulations: Hazard Symbol: Xn, N; risk phrases: R22; R50/53; safety phrases: S2; S60; S61 (see Appendix 1)

Description: Off-white to tan waxy solid or colorless crystals. Chrysanthemum-like odor. Commercial products may be dissolved in flammable organic solvents. Molecular weight = 338.48 (all isomers); Specific gravity (H_2O:1) = 0.96 @ 20 °C; Boiling point = (decomposes); Freezing/Melting point = 56–57 °C; Vapor pressure = 1×10^{-8} mmHg @ 20 °C; Flash point = 129 °C. Henry's Law constant = 1.3×10^{-7} atm-m^3/mol @ 25 °C (est)[83]. Low solubility in water. Physical and toxicological properties may be affected by carrier solvents in commercial formulations.

Incompatibilities: Decomposed by air, light, alkaline media, and temperatures >175 °C. May react violently with strong oxidizers, bromine, 90% hydrogen peroxide, phosphorus trichloride, silver powders or dust. Incompatible with silver compounds. Mixture with some silver compounds forms explosive salts of silver oxalate.

Permissible Exposure Limits in Air:

NIOSH[2] IDLH = 5,000 ppm
OSHA PEL: 5 mg/m^3 TWA
NIOSH REL: 5 mg/m^3 TWA
ACGIH TLV®[1]: 5 mg/m^3 TWA

Determination in Air: Collection by impinger or fritted bubbler, analysis by gas liquid chromatography/ultraviolet. See NIOSH IV, Method #5008[18]. (pyrethrum).

Permissible Concentration in Water: EPA Acceptable Daily Intake (ADI) = 0.1250 mg/kg/day.

Determination in Water: Log K_{ow} = >5.0. Values above 3.0 are likely to bioaccumulate in aquatic organisms.

Routes of Entry: Inhalation, ingestion, dermal contact.

Harmful Effects and Symptoms

Short Term Exposure: Pyrethrins can affect you when breathed in and by passing through your skin. Irritates the eyes and respiratory tract. High exposure can affect the nervous system causing headache, nausea, vomiting, fatigue, and restlessness, rhinorrhea (discharge of thin nasal mucous). Potential thyroid toxin. LD_{50} (oral, rat) = >2 g/kg; LD_{50} (dermal, rat) = >3 g/kg.

Long Term Exposure: High or repeated exposure can cause lung allergy (with cough, wheezing and/or shortness of breath) or hay fever symptoms (sneezing, runny or stuffy nose). Allergic "pneumonia" can also occur with cough, chest pain, breathing difficulty and abnormal chest x-ray. Repeated attacks may lead to permanent scarring. Skin allergy may also develop with rash and itching, even with lower exposures. Dermal contact can cause rash with redness, blisters and intense itching. A severe generalized allergy can occur with weakness and collapse.

Points of Attack: Respiratory system, skin, central nervous system; thyroid.

Medical Surveillance: Comprehensive physical examination with emphasis on the genito-urinary tract analysis to include sperm count, motility and morphology. Other tests, such as serum testosterone, serum follicle stimulating hormone (FSH), and serum lutenizing hormone (LH), may be carried out if, in the opinion of a physician, they are indicated. Before beginning employment and at regular times after that, the following are recommended: Employees should be screened for history of certain medical conditions which might place the employee at increased risk from pyrethroid exposure. Chronic respiratory disease: In persons with chronic respiratory disease, especially asthma, the inhalation of pyrethroids might cause exacerbation of symptoms due to its sensitizing properties. Lung function tests. These may be normal if the person is not having an attack at the time of the test. Consider chest x-ray if lung symptoms are present. Skin disease: Pyrethroids can cause dermatitis which may be allergic in nature. Persons with pre-existing skin disorders may be more susceptible to the effects of this agent. Evaluation by a qualified allergist, including exposure history and testing, may help diagnose allergy. Any employee developing the above-listed conditions should be referred for further medical examination[9].

First Aid: If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least 15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately. If this chemical contacts the skin, remove contaminated clothing and wash immediately with soap and water. Seek medical attention immediately. If this chemical has been inhaled, remove from exposure, begin rescue breathing (using universal precautions) if breathing has stopped, and CPR if heart action has stopped. Transfer promptly to a medical facility. When this chemical has been swallowed, get medical attention. *Do not induce vomiting when formulations containing petroleum solvents are ingested*. Otherwise, give large quantities of water and induce vomiting. Do not make an unconscious person vomit.

Personal Protective Methods: Applicators and other handlers must wear: Coveralls worn over long-sleeved shirt and long pants; Chemical-resistant gloves such as DuPont™ Tychem® suit fabrics, barrier laminate, or Viton®; Chemical-resistant footwear plus socks; Protective eye wear; Chemical-resistant headgear for overhead exposure; Chemical-resistant apron when cleaning equipment, mixing, or loading[83]. Agricultural Use/Engineering Controls: When handlers use closed systems, enclosed cabs, or aircraft in a manner that meets the requirements listed in the Worker Protection Standard (WPS) for agricultural pesticides, ***40 CFR 170.240(d)(4-6)***, the handler PPE requirements may be reduced or modified as specified in the Worker Protection Standard. Firefighters should wear NIOSH-approved self-contained breathing apparatus and full protective clothing.

Respirator Selection: NIOSH/OSHA *for pyrethrum*: *50 mg/m^3:* CcrOv95 (APF = 10) [any air-purifying half-mask respirator equipped with an organic vapor cartridge(s) in combination with an N95, R95, or P95 filter. The following filters may also be used: N99, R99, P99, N100, R100, P100]; or Sa (APF = 10) (any supplied-air respirator). *125 mg/m³:* Sa:Cf (APF = 25) (any supplied-air respirator operated in a continuous-flow mode); or PaprOvHie (APF = 25) (any air-purifying full facepiece respirator equipped with an organic vapor cartridge in combination with a high-efficiency particulate filter). *250 mg/m³:* CcrFOv100 (APF = 50) [any air-purifying full facepiece respirator equipped with organic vapor cartridge(s) in combination with an N100, R100, or P100 filter]; or PaprTOvHie (APF = 50) [any powered, air-purifying respirator with a tight-fitting face-piece and organic vapor cartridge(s) in combination with a high-efficiency particulate filter]; or SCBAF (APF = 50) (any self-contained breathing apparatus with full facepiece); or SaF (APF = 50) (any supplied-air respirator with a full facepiece). *5000 mg/m³:* SaF:Pd,Pp (APF = 2000) (any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode). *Emergency or planned entry into unknown concentrations or IDLH conditions:* SCBAF:Pd,Pp (APF = 10,000) (any self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode); or SaF:Pd,Pp:ASCBA (APF = 10,000) (any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary self-contained breathing apparatus operated in a pressure-demand or other positive-pressure mode). *Escape:* GmFOv100 (APF = 50) [any air-purifying, full facepiece respirator (gas mask) with a chin-style, front- or back-mounted organic vapor canister having an N100, R100, or P100 filter]; or SCBAE (any appropriate escape-type, self-contained breathing apparatus).

Note: Substance reported to cause eye irritation or damage; may require eye protection.

Storage: Color Code-Blue: Health Hazard/Poison. Store in a secure poison location at temperature <35 °C and away from alkaline materials. Prior to working with this chemical you should be trained on its proper handling and storage. Store in tightly closed containers in a cool, well-ventilated area. Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: Environmentally hazardous substances, solid or liquid, usually fall in Hazard Class 9.

Spill Handling: First remove all sources of ignition. Evacuate persons not wearing protective equipment from area of spill or leak until clean up is complete. Ventilate area of spill or leak. Use water spray to reduce vapor. Absorb liquids in vermiculite, dry sand, earth, or a similar material and deposit in sealed containers. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable.

Fire Extinguishing: Hazardous decomposition includes oxides of carbon. As an immediate precautionary measure, isolate spill or leak area in all directions for at least 50 meters/150 feet for liquids and at least 25 meters/75 feet for solids. *Fire involving storage or vehicular tanks:* isolate for 800 meters/0.5 mile in all directions; also, consider initial evacuation for 800 meters/0.5 mile in all directions. *On a small fire:* use dry chemical, CO_2, water spray or regular foam. *On a large fire:* use water spray, fog or regular foam. Do not scatter spilled material with high-pressure streams of water. Move containers from fire area if you can do it without risk. Dike fire-control water for later disposal. *Fire involving tanks:* from a secure, explosion-proof location, use water spray to cool exposed containers. If cooling streams are ineffective (venting sound increases in volume and pitch, tank discolors, or shows any signs of deforming), withdraw immediately to a secure position. Always stay away from tanks engulfed in fire. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode.

Disposal Method Suggested: Incineration would be an effective disposal procedure where permitted. If an efficient incinerator is not available, the product should be mixed with large amounts of combustible material and contact with the smoke should be avoided. In accordance with 40CFR165. Follow recommendations for the disposal of pesticides and pesticide containers[83]. Bury in non-crop land away from water. It would be better to mix the product with lime. Incineration would be an effective disposal procedure where permitted. If an efficient incinerator is not available, the product should be mixed with large amount of combustible material. Recommendable methods: Hydrolysis, landfill, incineration, and open burning. *Not recommendable method*: Discharge to sewer. Mix with sawdust and burn at a remote place[UN].

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- EXTOXNET, Extension Toxicology Network, "Pesticide Information Profile, Resmethrin," Oregon State University, Corvallis, OR (June 1996). http://extoxnet.orst.edu/pips/resmethr.htm
- United Nations, Treatment and Disposal Methods for Waste Chemicals (IRPTC File). Data Profile Series No. 5. P. 157, Geneva, Switzerland (December 1985)
- Jackson, D.; Luukinen, B.; Buhl, K.; Stone, D., *Resmethrin Technical Fact Sheet*; National Pesticide Information Center, Oregon State University Extension Services, Corvallis, OR (2008)

Rimsulfuron R:0135

Use Type: Herbicide
CAS Number: 122931-48-0
Formula: $C_{14}H_{17}N_5O_7S_2$
Synonyms: *N*-[(4,6-Dimethoxypyrimidin-2-yl)aminocarbonyl]-3-(ethylsulfonyl)-2-pyridinesulfonamide; 1-(4,6-Dimethoxypyrimidin-2-yl)-3-(3-ethylsulfonyl-2-pyridylsulfonyl)urea; *N*-[((4,6-Dimethoxy-2-pyrimidinyl) amino)carbonyl]-3-(ethylsulfonyl)-2-pyridinesulfonamide;2-Pyridinesulfonamide,*N*-[((4,6-dimethoxy-2-pyrimidinyl) amino)carbonyl]-3-(ethylsulfonyl)-
Trade Names: ACCENT®; BASIS® (rimsulfuron + thifensulfuron methyl); DPX-E9636®; DPX 79406® (nicosulfuron + rimsulfuron); Matrix® (nicosulfuron + rimsulfuron); SHADEOUT®; STEADFAST®, (nicosulfuron + rimsulfuron); TRANXIT®
Chemical class: Sulfonylurea
EPA/OPP PC Code: 129009; (129024 old EPA code number)
California DPR Chemical Code: 3835
HSDB Number: 7947
UN/NA & ERG Number: UN3077(solid)/171
RTECS® Number: UT7900000
Uses: For controlling broadleaf weeds. Registered for use in the U.S. and Canada. A U.S. EPA restricted Use Pesticide (RUP) for some formulations. Registered for use in some EU countries[115].

U.S. Maximum Allowable Residue Levels for Rimsulfuron [40 CFR 180.478]: almond, hulls 0.09 ppm; corn, field, forage 0.4 ppm; corn, field, grain 0.1 ppm; corn, field, stover 2.5 ppm; fruit, citrus, group 10, 0.01 ppm; fruit, pome, group 11, 0.01 ppm; fruit, stone, group 12, 0.01 ppm; grain, aspirated fractions 4.5 ppm; grape 0.01 ppm; nut, tree, group 14, 0.01 ppm; pistachio 0.01 ppm; potato 0.1 ppm; soybean, forage 0.25 ppm; soybean, hay 1.2 ppm; soybean, hulls 0.04 ppm; soybean, seed 0.01 ppm; tomato 0.05 ppm.

Regulatory Authority and Advisory Information: Carcinogenicity: IARC and NTP have not classified the sulfonylurea herbicides with respect to human carcinogenicity. U.S. EPA considers the sulfonylureas not classifiable, not rated, or noncarcinogenic, *with the exception of* sulfosulfuron (141776-32-1), a likely human carcinogen, and triflusulfuron-methyl (126535-15-7), a possible human carcinogen[96].
Toxicity (oral) Category 4, Caution
Health Advisory: Mutagen
Potential Ground Water Pollutant [California FAC Section 13145(d)/12811, active]
European/International Regulations: Hazard Symbol: N; risk phrases: R20; R53; safety phrases: S2; S60; S61 (see Appendix 1)

Description: Colorless crystalline solid or powder. Molecular weight = 432.43; Specific gravity (H_2O:1) = 0.79 @ 20 °C; Boiling point = (decomposes); Freezing/Melting point = 177 °C; Vapor pressure = 1×10^{-7} mmHg @ 25 °C; Henry's Law constant = 6.42×10^{-10} atm-m^3/mol @ 25 °C (est)[83]. Soluble in water; solubility = 8 mg/L @ 25 °C.

Incompatibilities: Slowly hydrolyzes in water, releasing ammonia and forming acetate salts.

Determination in Water: Log K_{ow} = Negative. Unlikely to bioaccumulate in marine organisms.

Routes of Entry: Inhalation; dermal and/or eye contact. Passes through the unbroken skin.

Harmful Effects and Symptoms

Human health effects from the sulfonylurea herbicides at low environmental doses or at biomonitored levels from low environmental exposures are unknown. The sulfonylurea herbicides are generally of low toxicity in mammalian studies. Animal studies showed low acute toxicity and little chronic, reproductive, or developmental toxicity or teratogenic effects. Developmental or teratogenic effects tended only to occur at high or maternally toxic doses. At high sublethal, chronic oral doses, such nonspecific effects as weight loss and anemia were observed. Some chemical-specific effects were noted at high doses in animals[96].

Short Term Exposure: May cause skin and eye irritation. Moderately poisonous if ingested or inhaled. LD_{50} (oral, rat) = >5 g/kg; LD_{50} (dermal, rat) = >2 g/kg.

Long Term Exposure: A possible mutagen. Possible liver and kidney toxin.

Medical Surveillance: Preliminary medical exam to detect chronic diseases of central nervous system, liver, heart, kidneys, lung and skin, as well as endocrinological or immunological disturbances, should protect susceptible individuals. Periodical medical exams of internal organs, skin and eyes are important to avoid chronic occupational intoxications. They should include lab and patch tests when necessary[83]. Urinary levels of the sulfonylurea herbicides reflect recent exposure. There is very limited information on the biomonitoring of sulfonylurea herbicides or their metabolites. Detection of the metabolites may reflect exposure to more than one particular sulfonylurea herbicide or from exposure to environmental degradation products. The urinary metabolites dimethoxypyrimidine and dimethylpyrimidine can be used as nonspecific markers of exposure to the pyrimidinylsulfonylureas, a group that includes bensulfuron-methyl,[41] primisulfuron-methyl, and sulfosulfon. The urinary metabolite methoxymethyl triazine can be used as a nonspecific marker of exposure to the triazinylsulfonylureas, a group that includes chlorosulfuron, prosulfuron, and triasulfuron[96]. Comprehensive physical examination with emphasis on the genito-urinary tract analysis to include sperm count, motility and morphology. Other tests, such as serum testosterone, serum follicle stimulating hormone (FSH), and serum lutenizing hormone (LH), may be carried out if, in the opinion of a physician, they are indicated.

First Aid: If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least 15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately. If this chemical contacts the skin, remove contaminated clothing and wash immediately with soap and water. Seek medical attention immediately. If this chemical has been inhaled, remove from exposure, begin rescue breathing (using universal precautions) if breathing has stopped, and CPR if heart action has stopped. Transfer promptly to a medical facility. When this chemical has been swallowed, get medical attention. Give large quantities of water and induce vomiting. Do not make an unconscious person vomit.

Respirator Selection: Wherever and whenever workplace conditions warrant respirator use, a respiratory protection program must be followed that meets one or more of the following government standards: OSHA's 29 CFR 1910.134, ANSI Z88.2, or European Standard EN 149.

Storage: Color Code-Blue: Health Hazard/Poison. Store in a secure poison location. Store in a refrigerator and protect from exposure to oxidizers or moisture[52]. A regulated, marked area should be established where this chemical is handled, used, or stored in compliance with OSHA Standard 1910.1045. Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: Environmentally hazardous substances, solid or liquid, usually fall in Hazard Class 9.

Spill Handling: Evacuate and restrict persons not wearing protective equipment from area of spill or leak until clean up is complete. If a spill occurs, clean it up promptly. Don't wash it away. Instead, sprinkle the spill with sawdust, vermiculite, or kitty litter. Sweep it into a plastic garbage bag, and dispose of it as directed on the pesticide product label. Ventilate area of spill or leak after clean up is complete. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable.

Fire Extinguishing: Hazardous decomposition includes oxides of nitrogen, sulfur, and carbon. As an immediate precautionary measure, isolate spill or leak area in all directions for at least 50 meters/150 feet for liquids and at least 25 meters/75 feet for solids. *Fire involving storage or vehicular tanks:* isolate for 800 meters/0.5 mile in all directions; also, consider initial evacuation for 800 meters/0.5 mile in all directions. *On a small fire:* use dry chemical, CO_2, water spray or regular foam. *On a large fire:* use water spray, fog or regular foam. Do not scatter spilled material with high-pressure streams of water. Move containers from fire area if you can do it without risk. Dike fire-control water for later disposal. *Fire involving tanks:* from a secure, explosion-proof location, use water spray to cool exposed containers. If cooling streams are ineffective (venting sound increases in volume and pitch, tank discolors, or shows any signs of deforming), withdraw immediately to a secure position. Always stay away from tanks engulfed in fire. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode.

Disposal Method Suggested: It is the responsibility of chemical waste generators to determine the toxicity and physical properties of a discarded chemical and to properly identify its classification and certification as a hazardous waste and to determine the disposal method. U.S. EPA guidelines for the classification determination are listed in 40 CFR Parts 261.3. Additionally, waste generators must consult and follow all regional, national, state and local hazardous waste laws to ensure complete and accurate classification and disposal methods. Recycle any unused portion of the material for its approved use or return it to the manufacturer or supplier. Ultimate disposal of the chemical must consider: the material's impact on air quality; potential migration in soil or water; effects on animal, aquatic, and plant life; and conformance with environmental and public health regulations[83].

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- USEPA, Office of Pesticide Programs, Pesticide Residue Limits, "Rimsulfuron," 40 CFR 180.478. http://www.epa.gov/pesticides/food/viewtols.htm

Rotenone R:0150

Use Type: Insecticide, Acaracide, Veterinary medicine

CAS Number: 83-79-4

Formula: $C_{23}H_{22}O_6$

Synonyms: (1)Benzopyrano(3,4-b)furo(2,3-H)(1) benzopyrano-6(6a*H*)-one,1,2,12,12a-tetrahydro-8,9-dimethoxy-2-(1-methylethenyl)-, [2R(-2α,6aα,12aα)]; ENT 133; NCI-C55210; Hydrogenated rotenone; Rotenon; Rotenona (Spanish); Rotenone, hydrogenated; [2r-(2a,6a_,12a_)]-1,2,12,12a-Tetrahydro-8,9-dimethoxy-2-(1-methylethenyl)[1]-benzopyrano[3,4-b]furo[2,3-H][1]-benzopyran-6(6a*H*)one

Trade Names: ACME® Rotenone; AROL GORDON DUST®; BARBASCO®; BONIDE CUKE AND MELON DUST®; CENOL GARDEN DUST®; CHEM FISH®; CHEM-MITE®; CUBE®; CUBE EXTRACT®; CUBE-PULVER®; CUBEROL®; CUBE ROOT®; CUBOR®; CUREX FLEA DUSTER®; DACTINOL®; DERIL®; DERRIN®; DERRIS®; DRI-KIL®; ENT-133®; EXTRAX®; FISH-TOX®; GREEN CROSS WARBLE POWDER®; HAIARI®; LIQUID DERRIS®; MEXIDE®; NICOULINE®; NOXFIRE®; NOXFISH®; PARADERIL®; POWDER AND ROOT®; PRENTOX®; PRO-NOX FISH®; RO-KO®; RONONE®; ROTACIDE®; ROTEFIVE®; ROTEFOUR®; ROTESSENOL®; SINID®; TOX-R®; TUBATOXIN®

Chemical class: Botanical; often formulated with pyrethrins

EPA/OPP PC Code: 071003

California DPR Chemical Code: 518

HSDB Number: 1762

UN/NA & ERG Number: UN2588 (Pesticide, solid, poisonous, n.o.s.)/151; UN2902 (Pesticide, liquid, poisonous, n.o.s.)/151

RTECS® Number: DJ2800000

EC Number: 201-501-9 [*Annex I Index No.:* 650-005-00-2]

Uses: The use of rotenone as a pesticide to kill invasive fish species is currently the only allowable use of this pesticide. Rotenone is a selective, nonspecific botanical insecticide with some acaricidal properties, and has been used in agriculture to control insects on vine fruit, flowers and vegetables. Registered for use in the U.S.A U.S. EPA restricted Use Pesticide (RUP) due to acute inhalation, acute oral, and aquatic toxicity. Agricultural and residential uses and all food uses were voluntarily cancelled in 2006[83]. In 2006, registrants requested voluntarily cancellation of all livestock, residential and home owner uses, domestic pet uses, and all other uses except for pesticide uses. In 2011 the use of this pesticide chemical was linked to Parkinson's disease. Not listed for use in EU countries[115].

U.S. Maximum Allowable Residue Levels for Rotenone [40 CFR 180.905]: This pesticide is not exempted from the requirement of a tolerance when applied to a crop at the time of or after harvest.

Human toxicity (long-term)[101]: High–28 ppb, Health Advisory.

Fish toxicity (threshold)[101]: High–1.4 ppb, MATC (Maximum Acceptable Toxicant Concentration).

Regulatory Authority and Advisory Information:
Carcinogenicity[83]: EPA Group E, evidence of non-carcinogenicity for humans
Health Advisory: Mutagen, Developmental/Reproductive Toxin, Skin irritant/sensitizer
Acute Oral Category: 1, DANGER-Poison
U.S. DOT Regulated Marine Pollutant (49CFR172.101, Appendix B)
European/International Regulations: Hazard Symbol: T, N; risk phrases: R25; R36/37/38; R50/53; safety phrases: S1/2; S22; S24/25; S36; S45; S60; S61 (see Appendix 1)

Description: Rotenone is a colorless to red odorless crystalline solid; a white crystalline solid when pure; oxidation will cause yellowing to bright red coloring. Commercial product can be a soluble concentrate that may be mixed with water and used as a spray. Odorless. Molecular weight = 394.43; Specific gravity (H_2O:1) = 1.27 @ 20 °C; Boiling point = (decomposes below BP); 210–220 °C @ 0.5 mm; Freezing/Melting point = 165.6 °C; 176 °C; Vapor pressure = 8×10^{-4} mmHg @ 20 °C. Hazard Identification (based on NFPA-704 M Rating System): Health 3, Flammability 1, Reactivity 0. Practically insoluble in water; solubility = 10–12 ppm @ 100 °C. Henry's Law constant = 1.12×10^{-13} atm-m³/mol @ 25 °C (est)[83]. Physical and toxicological properties may be affected by carrier solvents in commercial formulations.

Incompatibilities: Strong oxidizers and alkalis.

Permissible Exposure Limits in Air:
NIOSH IDLH: 2500 mg/m³
OSHA PEL: 5 mg/m³ TWA
NIOSH REL: 5 mg/m³ TWA
ACGIH TLV®[1]: 5 mg/m³ TWA; not classifiable as a human carcinogen
Protective Action Criteria (PAC) Ver. 27[89]
PAC-1: 5 mg/m³
PAC-2: 5 mg/m³
PAC-3: 160 mg/m³
DFG MAK: [skin]

Determination in Air: Filter; CH_3CN; High-pressure liquid chromatography/Ultraviolet detection; NIOSH IV, Method #5007[18]. NIOSH Method 5007. Analyte: Rotenone. Matrix: Air. Sampler: Filter (1 µm polytetrafluoroethylene membrane). Flow Rate: 1 to 3 liters/min. Sample Size: 100 L. Shipment: Routine. Sample Stability: At least 7 days @ 25 °C in dark.

Permissible Concentration in Water: Federal Drinking Water Guidelines: 30 ppb[93]. State Drinking Water Guidelines: Maine 28 µg/L; Florida 28 µg/L.

Determination in Water: Log K_{ow} = >4.0. Values at or above 3.0 are likely to bioaccumulate in marine organisms. Very toxic to fish[83].

Routes of Entry: Inhalation, ingestion, skin and/or eye contact.

Harmful Effects and Symptoms

Short Term Exposure: Irritates the eyes, skin, and respiratory tract. Eye contact can cause severe irritation and permanent damage. Exposure can cause numbness of the mucous membrane; nausea, vomiting, abdominal pain; muscular tremors, incoherence, clonic convulsions; stupor. May cause a severe drop in blood sugar. Higher exposures can cause pulmonary edema, a medical emergency that can be delayed for several hours. This can cause death. LD_{50} (oral, rat) = <50 mg/kg; LD_{50} (dermal, rat) = <2 g/kg.

Long Term Exposure: May cause tumors. May affect the liver and kidneys. There is limited evidence that rotenone causes cancer of the liver and breast in animals, and damage to the developing fetus. There is limited evidence that this chemical is stored in breast milk and passed on to nursing infants. Repeated dermal contact can cause severe rash. In 2011 this chemical and paraquat were linked to the potential for Parkinson's disease.

Points of Attack: Central nervous system, eyes, respiratory system; liver and kidney.

Medical Surveillance: Consider the points of attack in preplacement and periodic physical examinations. Lung function tests. Blood sugar. Liver or function test.

First Aid: If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least 15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately. Give artificial respiration if victim is not breathing. *Do not* use mouth-to-mouth method if victim ingested or inhaled the substance; give artificial respiration with the aid of a pocket mask equipped with a one-way valve or other proper respiratory medical device. Administer oxygen if breathing is difficult. Remove and isolate contaminated clothing and shoes. In cases of contact with substance, immediately flush skin or eyes with running water for at least 20 minutes. For minor skin contact, avoid spreading material on unaffected skin. Keep victim warm and quiet. Effects of exposure (inhalation, ingestion or skin contact) to substance may be delayed. Ensure that medical personnel are aware of the material(s) involved and take precautions to protect themselves. Medical observation is recommended for 24 to 48 hours following breathing overexposure, as pulmonary edema may be delayed. As first aid for pulmonary edema, a doctor or authorized paramedic may consider administering a corticosteroid spray.

Personal Protective Methods: Wear protective gloves and clothing to prevent any reasonable probability of dermal and/or eye contact. Safety equipment suppliers/manufacturers can provide recommendations on the most protective glove/clothing material for your operation. All protective clothing (suits, gloves, footwear, headgear) should be clean, available each day, and put on before work. Contact lenses should not be worn when working with this chemical. Wear dust-proof chemical goggles and face shield unless full facepiece respiratory protection is worn. Employees should wash immediately with soap when skin is wet or contaminated. Provide emergency showers and eyewash.

Respirator Selection: SCBA >5 mg/m^3 NIOSH: *Up to 50 mg/m^3:* CcrOv95 (APF = 10) [any air-purifying half-mask respirator with organic vapor cartridge(s) in combination with an N95, R95, or P95 filter. The following filters may also be used: N99, R99, P99, N100, R100, P100]; or Sa (APF = 10) (any supplied-air respirator). *Up to 125 mg/m^3:* Sa:Cf (APF = 25) (any supplied-air respirator operated in a continuous-flow mode); or PaprOvHie (APF = 25) (any powered air-purifying respirator with an organic vapor cartridge in combination with a high-efficiency particulate filter). *Up to 250 mg/m^3:* CcrFOv100 (APF = 50) [any air-purifying full facepiece respirator equipped with organic vapor cartridge(s) in combination with an N100, R100, or P100 filter]; or GmFOv100 (APF = 50) [any air-purifying, full facepiece respirator (gas mask) with a chin-style, front- or back-mounted organic vapor canister having an N100, R100, or P100 filter]; or PaprTOvHie (APF = 50) [any powered, air-purifying respirator with a tight-fitting face-piece and organic vapor cartridge(s) in combination with a high-efficiency particulate filter]; or SaT: Cf (APF = 50) (any supplied-air respirator that has a tight-fitting face-piece and is operated in a continuous-flow mode); or SCBAF (APF = 50) (any self-contained breathing apparatus with a full facepiece); or SaF (APF = 50) (any supplied-air respirator with a full facepiece). *Up to 2,500 mg/m^3:* Sa: Pd,Pp (APF = 1000) (any supplied-air respirator operated in a pressure-demand or other positive-pressure mode). *Emergency or planned entry into unknown concentrations or IDLH conditions:* SCBAF: Pd,Pp (APF = 10,000) (any NIOSH/MSHA- or European Standard EN 149-approved self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode); or SaF: Pd,Pp: ASCBA (APF = 10,000) (any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary, self-contained breathing apparatus operated in a pressure-demand or other positive-pressure mode). *Escape:* GmFOv100 (APF = 50) [any air-purifying, full facepiece respirator (gas mask) with a chin-style, front- or back-mounted organic vapor canister having an N100, R100, or P100 filter]; or SCBAE (any appropriate escape-type, self-contained breathing apparatus).

Storage: Color Code-Blue: Health Hazard/Poison. Store in a secure poison location. Prior to working with this chemical you should be trained on its proper handling and storage. Store in a refrigerator under an inert atmosphere and protect from prolonged exposure to light. Incompatible with oxidizers, chlorates nitrates, peroxides and alkalis. Where possible, automatically transfer material from drums or other storage containers to process containers. If this material contains a flammable carrier, sources of ignition, such as smoking and open flames, are prohibited where this chemical is handled, used, or stored. Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: Pesticides, solid, toxic/poisonous, n.o.s require a shipping label of "poisonous materials" and fall in Hazard Class 6.1. Technical name required.

Spill Handling: First remove all sources of ignition. Evacuate persons not wearing protective equipment from area of spill or leak until clean up is complete. Dampen spilled material with alcohol to avoid dust, then transfer material to a suitable container. Use absorbent dampened with alcohol to pick up remaining material. Wash surfaces well with soap and water. Collect powdered material in the most convenient and safe manner and deposit in sealed containers. Ventilate area after clean up is complete. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable. Soil Adsorption Index (K_{oc}) = 10000 (estimate).

Fire Extinguishing: This chemical is a combustible solid; flammable if pre-heated. Hazardous decomposition includes oxides of carbon, are released in fire. *On a small fire:* use dry chemical, CO_2 or water spray. *On a large fire:* use water spray, fog or regular foam. Move containers from fire area if you can do it without risk. Dike fire-control water for later disposal; do not scatter the material. Use water spray or fog; do not use straight streams. *Fire involving storage or vehicular tanks:* isolate for 800 meters/0.5 mile in all directions; also, consider initial evacuation for 800 meters/0.5 mile in all directions. Fight fire from maximum distance or use unmanned hose holders or monitor nozzles. Do not get water inside containers. Cool containers with flooding quantities of water until well after fire is out. Withdraw immediately in the case of rising sound from venting safety devices or discoloration of tank. ALWAYS stay away from tanks engulfed in fire. For massive fire, use unmanned hose holders or monitor nozzles; if this is impossible, withdraw from area and let fire burn. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies.

Disposal Method Suggested: Rotenone is decomposed by light and alkali to less insecticidal products. It is readily detoxified by the action of light and air. It is also detoxified by heating; 2 hours @ 100 °C results in 76% decomposition. Oxidation products are probably nontoxic. Incineration has been recommended as a disposal procedure. Burial with lime would also present minimal danger to the environment. Containers must be disposed of properly by following package label directions or by contacting your local or federal environmental control agency, or by contacting your regional EPA office.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- EXTOXNET, Extension Toxicology Network, "Pesticide Information Profile, Rotenone," Oregon State University, Corvallis, OR (June 1996). http://extoxnet.orst.edu/pips/rotenone.htm
- New Jersey Department of Health and Senior Services, "Hazardous Substance Fact Sheet, Rotenone," Trenton, NJ (March, 1989, rev. October 2000). http://www.state.nj.us/health/eoh/rtkweb/1638.pdf

S

Sethoxydim S:0205

Use Type: Herbicide
CAS Number: 74051-80-2
Formula: $C_{17}H_{29}NO_3S$
Synonyms: Caswell No. 072A; 2-Cyclohexen-1-one, 2-[1-(ethoxyimino)butyl]-5-[2-(ethylthio)propyl]-3-hydroxy-;2-[1-(Ethoxyimino)butyl]-5-[2-(ethylthio)propyl]-3-hydroxyl-2-cyclohexen-1-one; Cyethoxydim; (±)-2-[1-(ethoxyimino)butyl]-5-[2-(ethylthio)propyl]-3-hydroxy-2-cyclohexen-1-one; 2-[1-(Ethoxyimino)butyl]-5-[2-(ethylthio)propyl]-3-hydroxy-2-cyclohexen-1-one; 2-[1-(Ethoxyimino)butyl]-5-[2-(ethylthio)propyl]-3-hydroxyl-2-cyclohexen-1-one;(*ZE*)-2-(1-Ethoxyiminobutyl)-5-[2-(ethylthio)propyl]-3-hydroxycyclohex-2-enone; Sethoxydim cyclohexanone herbicide
Trade Names: ALJADEN®; ALLOXOL® S; ARD 34/02®; BASF 9052®; CHECKMATE®; CONCLUDE®; EXPAND®; FERVINAL®; GRASIDIM®; GRASSOUT®; NABU®; NP-55®; POAST®; TRITEX-EXTRA®; ULTIMA®; VANTAGE®
Chemical class: Cyclohexadione; Cyclohexenone
EPA/OPP PC Code: 121001
California DPR Chemical Code: 2177
HSDB Number: 7342
UN/NA & ERG Number: UN3082 (liquid)/171
RTECS® Number: GW7191000
EC Number: 277-682-3
Uses: A selective post-emergence herbicide used to control annual and perennial grass weeds in broad-leaved vegetables, field crops, fruit, ornamentals and indoor applications. Not approved for use in EU countries[115]. Registered for use in the U.S. and Canada.
U.S. Maximum Allowable Residue Levels for Sethoxydim and its motabolites containing the 2-cyclohexen-1-one moiety (calculated as the herbicide) [40 CFR 180.412(a)]: in or on the following commodities: alfalfa, forage, 40.0 ppm; alfalfa, hay 40.0 ppm; almond, hulls 2.0 ppm; apple, dry pomace 0.8 ppm; apple, wet pomace 0.8 ppm; apricot 0.2 ppm; asparagus 4.0 ppm; bean, dry, seed 20.0 ppm; bean, forage 15.0 ppm; bean, hay 50.0 ppm; bean, succulent 15.0 ppm; beet, garden 1.0 ppm; beet, sugar, molasses 10.0 ppm; beet, sugar, roots 1.0 ppm; beet, sugar, tops 3.0 ppm; blueberry 4.0 ppm; caneberry subgroup 13A, 5.0 ppm; canola/rapeseed 35.0 ppm; canola/rapeseed, meal 40.0 ppm; carrot, roots 1.0 ppm; cattle, fat 0.2 ppm; cattle, meat byproducts 1.0 ppm; cattle, meat 0.2 ppm; cherry, sweet, 0.2 ppm; cherry, tart 0.2 ppm; citrus, molasses 1.5 ppm; citrus, dried pulp 1.5 ppm; clover, forage 35.0 ppm; clover, hay 50.0 ppm; coriander 4.0 ppm; corn, field, grain 0.5 ppm; corn fodder 2.5 ppm; corn forage 2.0 ppm; corn, sweet, forage 3.0 ppm; corn, sweet, kernel plus cob with husks removed 0.4 ppm; corn, sweet stover 3.5 ppm; cotton, seed, soapstock 15 ppm; cotton, undelinted seed 5.0 ppm; cranberry 2.0 ppm; egg 2.0 ppm; flax, meal 7 ppm; flax, seed 5.0 ppm; flax, straw 2.0 ppm; fruit, citrus 0.5 ppm; fruit, pome 0.2 ppm; goat, fat 0.2 ppm; goat, meat byproducts 1.0 ppm; goat, meat 0.2 ppm; grape 1.0 ppm; grape, raisin 2.0 ppm; hog, fat 0.2 ppm; hog, meat byproducts 1.0 ppm; hog, meat 0.2 ppm; horseradish 4.0 ppm; horse, fat 0.2 ppm; horse, meat byproducts 1.0 ppm; horse, meat 0.2 ppm; juneberry 5.0 ppm; lentil, seed 30.0 ppm; lingonberry 5.0 ppm; milk 0.5 ppm; nectarine 0.2 ppm; peach 0.2 ppm; peanut 25.0 ppm; peanut, soapstock 75.0 ppm; pea, dry, seed 40.0 ppm; pea, field vines 20.0 ppm; pea, field, hay 40.0 ppm; pea, succulent 10.0 ppm; peppermint, tops (stems and leaves) 30.0 ppm; pistachio 0.2 ppm; potato flakes 8.0 ppm; potato granules 8.0 ppm; potato waste, processed (wet and dry) 8.0 ppm; poultry, fat 0.2 ppm; poultry, meat byproducts 2.0 ppm; poultry, meat 0.2 ppm; salal, 5.0 ppm; safflower 15.0 ppm; sheep, fat 0.2 ppm; sheep, meat byproducts 1.0 ppm; sheep, meat 0.2 ppm; soybean, hay 10.0 ppm; soybean 16.0 ppm; spearmint, tops (stems and leaves) 30.0 ppm; strawberry 10.0 ppm; sunflower meal 20.0 ppm; sunflower, seed 7.0 ppm; tomato, concentrated products 24 ppm; tomato, dry pomace 12.0 ppm; tree nut 0.2 ppm; tuberous and corm vegetable crop subgroup 4.0 ppm; vegetable, brassica, leafy, group 5, 5.0 ppm; vegetable, bulb, group 3, 1.0 ppm; vegetable, cucurbit, group 9, 4.0 ppm; vegetable, fruiting 4.0 ppm; and vegetable, leafy, except brassica, group 4, 4.0 ppm. ***Tolerances with regional registration, as defined in section 180.1(n) are established for the combined residues and its metabolites containing the 2-cyclohexen-1-one moiety (calculated as the herbicide)*** **[***40 CFR 180.412(c)***]***:* in or on the following commodities: artichoke, globe, 5.0 ppm and rhubarb, 0.3 ppm.
Regulatory Authority and Advisory Information:
Carcinogenicity[83]: EPA, Not likely to be carcinogenic to humans
Toxicity (oral) Category 4, CAUTION
EPCRA Section 313 Form R *de minimis* concentration reporting level: 1.0%
Description: Amber color, oily liquid. Odorless. Flammable. Commercial product is available as an emulsifiable concentrate. Molecular weight = 327.53; Specific gravity (H_2O:1) = 1.04 @ 20 °C; Vapor pressure = 1.6×10^{-7} mmHg @ 20 °C. Hazard Identification (based on NFPA-704 M Rating System): Health 2, Flammability 2, Reactivity 0. Highly soluble in water. Henry's Law constant = 2.2×10^{-11} atm-m^3/mol @ 25 °C (est)[83]. Highly soluble in water. Physical and toxicological properties may be affected by carrier solvents in commercial formulations.

Incompatibilities: Incompatible with strong acids, oxidizers (chlorates, nitrates, peroxides, permanganates, perchlorates, chlorine, bromine, fluorine, etc.). Contact with oxidizers may cause fire and explosions. Incompatible with all copper compounds.

Permissible Concentration in Air: Protective Action Criteria (PAC) Ver. 27[89]

PAC-1: 9.6 mg/m^3
PAC-2: 110 mg/m^3
PAC-3: 630 mg/m^3

Determination in Water: Log K_{ow} = >4.0 @ (pH = 5). Values above 3.0 are likely to bioaccumulate in aquatic organisms.

Routes of Entry: Ingestion, inhalation, dermal and/or eye contact. May be absorbed through the unbroken skin.

Harmful Effects and Symptoms

Short Term Exposure: Contact may burn eyes, skin, and respiratory tract. Toxic if ingested. If swallowed, this chemical may cause pulmonary edema and other lung damage. LD_{50} (oral, rat) = 3145 mg/kg [FR48128(8/5/1998)]; LD_{50} (dermal, rat) = >5 g/kg[9].

Long Term Exposure: May cause liver, thyroid, or bone marrow damage.

Points of Attack: liver, thyroid, lungs, bone marrow.

Medical Surveillance: Preliminary medical exam to detect chronic diseases of central nervous system, liver, heart, kidneys, lung and skin, as well as endocrinological or immunological disturbances, should protect susceptible individuals. Periodical medical exams of internal organs, skin and eyes are important to avoid chronic occupational intoxications. They should include lab and patch tests when necessary[83]. Consult a physician if poisoning is suspected or if redness, itching, or burning of the eyes or skin develops. Complete blood count. Thyroid and liver function tests.

First Aid: If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least 15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately. If this chemical contacts the skin, remove contaminated clothing and wash immediately with soap and water. Seek medical attention immediately. If this chemical has been inhaled, remove from exposure, begin rescue breathing (using universal precautions) if breathing has stopped, and CPR if heart action has stopped. Transfer promptly to a medical facility. When this chemical has been swallowed, get medical attention. *Do not induce vomiting when formulations containing petroleum solvents are ingested*. Otherwise, give large quantities of water and induce vomiting. Do not make an unconscious person vomit.

Personal Protective Methods: Applicators and other handlers must wear: Coveralls worn over long-sleeved shirt and long pants; Chemical-resistant gloves such as DuPont™ Tychem® suit fabrics, barrier laminate, or Viton®; Chemical-resistant footwear plus socks; Protective eye wear; Chemical-resistant headgear for overhead exposure; Chemical-resistant apron when cleaning equipment, mixing, or loading[83]. Agricultural Use/Engineering Controls: When handlers use closed systems, enclosed cabs, or aircraft in a manner that meets the requirements listed in the Worker Protection Standard (WPS) for agricultural pesticides, 40 CFR 170.240(d)(4-6), the handler PPE requirements may be reduced or modified as specified in the Worker Protection Standard. Firefighters should wear NIOSH-approved self-contained breathing apparatus and full protective clothing.

Respirator Selection: SCBA >9.6 mg/m^3. Wherever and whenever workplace conditions warrant respirator use, a respiratory protection program must be followed that meets one or more of the following government standards: OSHA's 29 CFR 1910.134, ANSI Z88.2, or European Standard EN 149.

Shipping: This material may be classified as environmentally hazardous substances, solid or liquid, n. o. s. It usually falls in Hazard Class 9.

Spill Handling: First remove all sources of ignition. Evacuate persons not wearing protective equipment from area of spill or leak until clean up is complete. Do not touch spilled material; stop leak if you can do so without risk. Use water spray to reduce vapors. Small spills: absorb with sand or other noncombustible absorbent material and place into containers for later disposal. Small dry spills: with clean shovel place material into clean, dry container and cover; move containers from spill area. Large spills: dike far ahead of spill for later disposal. Ventilate area after clean up is complete. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable.

Fire Extinguishing: Hazardous decomposition includes toxic oxides of nitrogen, sulfur and carbon. As an immediate precautionary measure, isolate spill or leak area in all directions for at least 50 meters/150 feet for liquids and at least 25 meters/75 feet for solids. *Fire involving storage or vehicular tanks:* isolate for 800 meters/0.5 mile in all directions; also, consider initial evacuation for 800 meters/0.5 mile in all directions. *On a small fire:* use dry chemical, CO_2, water spray or regular foam. *On a large fire:* use water spray, fog or regular foam. Do not scatter spilled material with high-pressure streams of water. Move containers from fire area if you can do it without risk. Dike fire-control water for later disposal. *Fire involving tanks:* from a secure, explosion-proof location, use water spray to cool exposed containers. If cooling streams are ineffective (venting sound increases in volume and pitch, tank discolors, or shows any signs of deforming), withdraw immediately to a secure position. Always stay away from tanks engulfed in fire. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode.

Disposal Method Suggested: It is the responsibility of chemical waste generators to determine the toxicity and physical properties of a discarded chemical and to properly identify its classification and certification as a hazardous waste and to determine the disposal method. U.S. EPA guidelines for the classification determination are listed in 40 CFR Parts 261.3. Additionally, waste generators must consult and follow all regional, national, state and local hazardous waste laws to ensure complete and accurate classification and disposal methods. Follow recommendations for the disposal of pesticides and pesticide containers. Containers must be disposed of properly by following package label directions or by contacting your local or federal environmental control agency, or by contacting your regional EPA office.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- USEPA, Office of Pesticide Programs, Pesticide Residue Limits, "*Sethoxydim*," 40 CFR 180.412. http://www.epa.gov/pesticides/food/viewtols.htm
- EXTOXNET, Extension Toxicology Network, "Pesticide Information Profile, Sethoxydim," Oregon State University, Corvallis, OR (June 1996). http://extoxnet.orst.edu/pips/sethoxyd.htm

Siduron S:0208

Use Type: Herbicide

CAS Number: 1982-49-6

Formula: $C_{14}H_{20}N_2O$

Synonyms: 1-(2-Methylcyclohexyl)-3-phenylurea; *N*-(2-Methylcyclohexyl)-*N'*-phenylurea; Urea, *N*-(2-methylcyclohexyl)-*N'*-phenyl-

Trade Names: GREENFIELD®; GRO-TONE®[C]; H-1318®; TREY®; TUPERSAN®

Chemical class: Urea

EPA/OPP PC Code: 035509

California DPR Chemical Code: 603

HSDB Number: 1764

UN/NA & ERG Number: UN3077 (solid)/171; UN3082(liquid)/171

RTECS® Number: YT7350000

EC Number: 217-844-2

Uses: A pre-emergence herbicide used to control annual grasses, e.g., crabgrass, foxtail, and barnyard grass. Used on newly seeded or established turf and lawn grasses and as pre-emergence treatment to bare soil following spring seeding. Not listed for use in EU countries[115]. Registered for use in the U.S.

Regulatory Authority and Advisory Information:

Health Advisory: Mutagen

Toxicity (oral) Category 4, Caution

Potential Ground Water Pollutant [California FAC Section 13145(d)/12811, active]

European/International Regulations: Hazard Symbol: Xi, N; risk phrases: R36/37/38; R52/53; safety phrases: S2; S26; S61 (see Appendix 1)

WGK (German Aquatic Hazard Class): 2-Hazard to waters

Description: Colorless or white crystalline solid or powder. Odorless. Commercial product is available as an emulsifiable concentrate. Molecular weight = 232.33; Specific gravity (H_2O:1) = 1.08 @ 20 °C; Boiling point = (decomposes); Freezing/Melting point = 135 °C; Vapor pressure = 4×10^{-9} mmHg @ 20 °C. Low solubility in water; solubility = 18.3 ppm @ 25 °C. Henry's Law constant = 6.8×10^{-11} atm-m^3/mol @ 25 °C (est)[83]. Physical and toxicological properties may be affected by carrier solvents in commercial formulations.

Determination in Water: Log K_{ow} = >3.5. Values above 3.0 are likely to bioaccumulate in marine organisms.

Determination in Air: Filter; none; Gravimetric; NIOSH IV [Particulates NOR; #0500 (total), #0600 (respirable)][18].

Harmful Effects and Symptoms

Short Term Exposure: Contact with eyes or skin may cause irritation or injury. Inhalation should be avoided; use NIOSH- or CEN (UK)-approved air-purifying respirators for pesticides. May be harmful if swallowed. Dermal contact may cause severe irritation or burns. LD_{50} (oral, rat) = >5 g/kg; LD_{50} (dermal, rat) = >5 g/kg.

Long Term Exposure: May cause skin sensitization. May cause reproductive and fetal effects.

Points of Attack: Skin. Reproductive cells.

Medical Surveillance: Evaluation by a qualified allergist, including exposure history and testing, may help diagnose allergy. Preliminary medical exam to detect chronic diseases of central nervous system, liver, heart, kidneys, lung and skin, as well as endocrinological or immunological disturbances, should protect susceptible individuals. Periodical medical exams of internal organs, skin and eyes are important to avoid chronic occupational intoxications. They should include lab and patch tests when necessary[83].

First Aid: If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least 15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately. If this chemical contacts the skin, remove contaminated clothing and wash immediately with soap and water. Seek medical attention immediately. If this chemical has been inhaled, remove from exposure, begin rescue breathing (using universal precautions) if breathing has stopped, and CPR if heart action has stopped. Transfer promptly to a medical facility. When this chemical has been swallowed, get medical attention. Give large quantities of water. Do not induce vomiting when formulations containing petroleum solvents are ingested. Do not make an unconscious person vomit.

Personal Protective Methods: Wear protective gloves and clothing to prevent any reasonable probability of dermal and/or eye contact. Safety equipment suppliers/manufacturers can provide recommendations on the most protective glove/clothing material for your operation. All protective clothing (suits, gloves, footwear, headgear) should be clean, available each day, and put on before work. Contact lenses should not be worn when working with this chemical. Wear dust-proof chemical goggles and face shield unless full facepiece respiratory protection is worn. Employees should wash immediately with soap when skin is wet or contaminated. Provide emergency showers and eyewash.

Respirator Selection: Where the neat (undiluted) test chemical is weighed and diluted, wear a NIOSH-approved half face respirator equipped with a combination filter cartridge, i.e. organic vapor/acid gas/HEPA (specific for organic vapors, HCl, acid gas, SO_2 and a high-efficiency particulate filter)[88]

Storage: Color Code-Blue: Health Hazard/Poison. Store in a tightly closed container in a dry, well-ventilated and secure poison location. Prior to working with this chemical you should be trained on its proper handling and storage. Where possible, automatically transfer material from other storage containers to process containers. Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: Environmentally hazardous substances, solid or liquid, n. o. s. It usually falls in Hazard Class 9.

Spill Handling: First remove all sources of ignition. Evacuate persons not wearing protective equipment from area of spill or leak until clean up is complete. Do not touch spilled material; stop leak if you can do it without risk. Use water spray to reduce vapors. Collect powdered material in the most convenient and safe manner and deposit in sealed containers. *Large spills:* dike far ahead of spill for later disposal. Ventilate area after clean up is complete. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable.

Fire Extinguishing: Hazardous decomposition includes oxides of nitrogen and carbon. As an immediate precautionary measure, isolate spill or leak area in all directions for at least 50 meters/150 feet for liquids and at least 25 meters/75 feet for solids. *Fire involving storage or vehicular tanks:* isolate for 800 meters/0.5 mile in all directions; also, consider initial evacuation for 800 meters /0.5 mile) in all directions. *On a small fire:* use dry chemical, CO_2, water spray or regular foam. *On a large fire:* use water spray, fog or regular foam. Do not scatter spilled material with high-pressure streams of water. Move containers from fire area if you can do it without risk. Dike fire-control water for later disposal. *Fire involving tanks:* from a secure, explosion-proof location, use water spray to cool exposed containers. If cooling streams are ineffective (venting sound increases in volume and pitch, tank discolors, or shows any signs of deforming), withdraw immediately to a secure position. Always stay away from tanks engulfed in fire. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode.

Disposal Method Suggested: Incinerate in a unit with effluent gas scrubbing. Containers must be disposed of properly by following package label directions or by contacting your local or federal environmental control agency, or by contacting your regional EPA office.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- Pesticide Management Education Program, “Siduron (Tupersan) Herbicide Profile 2/85,” Cornell University, Ithaca, NY (February 1985). http://pmep.cce.cornell.edu/profiles/herb-growthreg/sethoxydim-vernolate/siduron/herb-prof-siduron.html

Simazine S:0310

Use Type: Pre-emergence herbicide, Algaecide

CAS Number: 122-34-9

Formula: $C_7H_{12}ClN_5$

Synonyms: A 2079; AI3-51142; 2,4-Bis(ethylamino)-6-chloro-*s*-triazine; Caswell No. 740; 2-Chloro-4,6-bis (ethylamino)-1,3,5-triazine; 1-Chloro-3,5-bis(ethylamino)-2,4,6-triazine; 2-Chloro-4,6-bis(ethylamino)-*s*-triazine; 6-Chloro-*N,N*'-diethyl-1,3,5-triazine-2,4-diamine; 6-Chloro-*N*2,*N*4-diethyl-1,3,5-triazine-2,4-diamine; 6-Chloro-*N,N*'-diethyl-1,3,5-triazine-2,4-diyldiamine; NSC 25999; Simazina (Spanish); *s*-Triazine, 2-chloro-4,6-bis(ethylamino)-; 1,3,5-Triazine-2,4-diamine, 6-Chloro-*N,N*'-diethyl-

Trade Names: AKTINIT S®; ALCO® Simizine; AQUAZINE®; ATLAS SIMAZINE®; BATAZINA®; BITEMOL®; CALIBER®; CDT®; CEKUSAN®; CEKUZINA-S®; FRAMED®; G 27692®; GEIGY 27692®; GESARAN®; GESATOP®; GESATOP-50®; H 1803®; HARLEQUIN®; HERBAZIN® 500 BR; HERBAZIN® 50; HERBEX®; HERBOXY®; HUNGAZIN DT®; OXON ITALIA SIM-TROL®; PREMAZINE®; PRIMATEL S®; PRIMATOL S®; PRINCEP®; PRINCEP® 80W; SIMADEX®; SIMANEX®; SIMAZINE® 80W; SIMAZAT®; SIM-TROL®; TAFAZINE®; TAFAZINE® 50-W; TANZINE®; TAPHAZINE®; TOTAZINE®; TRIAZINE A 384®; W 6658®; WEEDEX®; ZEAPUR®

Chemical class: Triazine

EPA/OPP PC Code: 080807

California DPR Chemical Code: 531

HSDB Number: 1765

UN/NA & ERG Number: UN2763/151

RTECS® Number: XY5250000

EC Number: 204-535-2 [*Annex I Index No.:* 612-088-00-3]

Uses: Simazine, a pre-emergence selective systemic herbicide, is severely regulated because of effect on humans through ground and drinking water. It is used to control broad-leaved weeds and annual grasses in corn, sorghum, sugar cane and other field crops, artichokes, asparagus, berry fruit, nuts, citrus crops, coffee, hops, oil palms, olives, vegetables and ornamental crops, turf grass, orchards, and vineyards. At higher rates, it is used for non-selective weed control in industrial areas. Before 1992, simazine was used to control submerged weeds and algae in large aquariums, farm ponds, fish hatcheries, swimming pools, ornamental ponds, and cooling towers. Simazine is available in wettable powder, water-dispersible granule, liquid, and granular formulations. It may be soil-applied. Not approved for use in EU countries[115]. A U.S. EPA restricted Use Pesticide (RUP) for all land uses because of its potential to contaminate ground water.

U.S. Maximum Allowable Residue Levels for Simazine [40 CFR 180.213(a)(1)]: alfalfa 15 ppm; alfalfa, forage 15 ppm; alfalfa, hay 15 ppm; almond 0.25 ppm; almond, hulls 0.25 ppm; apple 0.25 ppm; avocado 0.25 ppm; bermuda grass 15 ppm; bermudagrass, forage 15 ppm; bermudagrass, hay 15 ppm; blackberry 0.25 ppm; blueberry 0.25 ppm; boysenberry 0.25 ppm; cattle, fat 0.02 (N) ppm; cattle, meat byproducts 0.02 (N) ppm; cattle, meat 0.02 (N) ppm; cherry 0.25 ppm; corn, forage 0.25 ppm; corn, sweet, kernel plus cob with husks removed 0.25 ppm; corn, grain 0.25 ppm; corn, stover 0.25 ppm; cranberry 0.25 ppm; currant 0.25 ppm; dewberry 0.25 ppm; egg 0.02 (N) ppm; filbert 0.25 ppm; goat, fat 0.02 (N) ppm; goat, meat byproducts 0.02 (N) ppm; goat, meat 0.02 (N) ppm; grapefruit 0.25 ppm; grape 0.25 ppm; grass 15 ppm; grass, forage 15 ppm; grass, hay 15 ppm; hog, fat 0.02 (N) ppm; hog, meat byproducts 0.02 (N) ppm; hog, meat 0.02 (N) ppm; horse, fat 0.02 (N) ppm; horse, meat byproducts 0.02 (N) ppm; horse, meat 0.02 (N) ppm; lemon 0.25 ppm; loganberry 0.25 ppm; milk 0.02 (N) ppm; nut, macadamia 0.25 ppm; olive 0.25 ppm; orange, sweet 0.25 ppm; peach 0.25 ppm; pear 0.25 ppm; pecan 0.1 (N) ppm; plum 0.25 ppm; poultry, fat 0.02 (N) ppm; poultry, meat byproducts 0.02 (N) ppm; poultry, meat 0.02 (N) ppm; raspberry 0.25 ppm; sheep, fat 0.02 (N) ppm; sheep, meat byproducts 0.02 (N) ppm; sheep, meat 0.02 (N) ppm; strawberry 0.25 ppm; sugarcane, cane 0.25 ppm; sugarcane, molasses 1 ppm; walnut 0.2 ppm. ***Tolerances are established for the combined residues of the herbicide simazineand its metabolites 2-amino-4-chloro-6-ethylamino-s-triazine and 2,4-diamino-6-chloro-s-triazine*** **[***40 CFR 180.213(a)***(2)]***:* in or on raw agricultural commodities as follows: Banana 0.2 ppm; Fish 12 ppm. (N) = negligible amount of residue.

Regulatory Authority and Advisory Information:

Carcinogenicity[83]: EPA, Not likely to be carcinogenic to humans; EU GHS Category 2: Suspected human carcinogen

Poison Category: 3, CAUTION

Health Advisory: Mutagen, Developmental/Reproductive Toxin, Skin irritant/sensitizer, Endocrine disruptor (S!)

Potential Ground Water Pollutant [California FAC Section 13149]

ADI (Acceptable Daily Intake) = 0.215 mg/kg/day[Sittig]

Safe Drinking Water Act: MCL, 0.004 mg/L; MCLG, 0.004 mg/L; Regulated chemical (47 FR 9352)

EPCRA Section 313 Form R *de minimis* concentration reporting level: 1.0%

European/International Regulations: Hazard Symbol: Xn, N; risk phrases: R40; R50/53; safety phrases: S2; S36/37; S46; S60; S61 (see Appendix 1)

WGK (German Aquatic Hazard Class): 3-Severe hazard to waters

Description: Simazine is a combustible, white to off-white crystalline solid or powder. Practically odorless. Molecular weight = 201.66; Specific gravity (H_2O:1) = 1.302 @ 20 °C; Boiling point = (decomposes); Freezing/Melting point = (decomposes); Vapor pressure = 2.2×10^{-8} mmHg @ 20 °C; Flash point = ~170 °C. Hazard Identification (based on NFPA-704 M Rating System): Health 1, Flammability 1, Reactivity 0. Practically insoluble in water; solubility = 4 ppm @ 20 °C.

Incompatibilities: A combustible solid. Incompatible with strong oxidizers.

Permissible Concentration in Water: Federal Drinking Water Standards: EPA 4 μg/L; State Drinking Water Guidelines: Arizona 35 μg/L; Maine 3.5 μg/L; Minnesota 4 μg/L. EU Drinking Water Guidelines (MAC) = 0.2 μg/L. Canadian Drinking Water Standards: IMAC 0.01 mg/L.

Determination in Water: Analysis of simazine is by a gas chromatographic (GC) method applicable to the determination of certain nitrogen-phosphorus-containing pesticides in water samples. In this method, approximately 1 liter of sample is extracted with methylene chloride. The extract is concentrated and the compounds are separated using capillary column GC. Measurement is made using a nitrogen-phosphorus detector. The method detection limit has not been determined for this compound but it is estimated that the detection limits for the method analytes are in the range of 0.1 to 2 μg/L. Log K_{ow} = <2.5. Unlikely to bioaccumulate in marine organisms.

Routes of Entry: Inhalation, ingestion, skin and/or eye contact.

Harmful Effects and Symptoms

Short Term Exposure: May cause skin or eye irritation. Moderately poisonous if ingested; may cause tremor, convulsions, paralysis, cyanosis, slowed respiration and diarrhea. Approximate lethal dose = 1.5 cupful/150 lb man. LD_{50} in range (rat) 1780–7000 mg/kg. LD_{50} (oral, rat) = >500 mg/kg; LD_{50} (dermal, rat) = >5 g/kg.

Long Term Exposure: May cause tumors. Repeated exposure may cause weight loss and reduced red blood cell count. Simazine fed to rats for 2 years @ 1.0, 10, and 100 ppm produced no difference between treated and control animals in gross appearance or behavior. The rats fed 100 ppm had approximately twice as many thyroid and mammary tumors as the control animals, but it was stated that these were not attributable to simazine. A 2-year chronic-feeding study of simazine in dogs with simazine 80 W fed at 15, 150, and 1500 ppm showed only a slight thyroid hyperplasia at 1500 ppm and slight increases in serum alkaline phosphatase and serum glutamic oxalacetic transaminase in several of the dogs fed 1500 ppm. May cause dermatitis.

Points of Attack: Blood, skin.

Medical Surveillance: This chemical is a suspected or known human carcinogen. Exposed persons should contact a physician for advice regarding the possible long term health effects and advice for medical monitoring. Complete blood count. Evaluation by a qualified allergist, including exposure history and testing, may help diagnose allergy.

First Aid: If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least 15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately. If this chemical contacts the skin, remove contaminated clothing and wash immediately with soap and water. Seek medical attention immediately. If this chemical has been inhaled, remove from exposure, begin rescue breathing (using universal precautions) if breathing has stopped, and CPR if heart action has stopped. Transfer promptly to a medical facility. When this chemical has been swallowed, get medical attention. Give large quantities of water and induce vomiting. Do not make an unconscious person vomit.

Personal Protective Methods: Applicators and other handlers must wear: Coveralls worn over long-sleeved shirt and long pants; Chemical-resistant gloves such as DuPont™ Tychem® suit fabrics, barrier laminate, or Viton®; Chemical-resistant footwear plus socks; Protective eye wear; Chemical-resistant headgear for overhead exposure; Chemical-resistant apron when cleaning equipment, mixing, or loading[83]. Agricultural Use/Engineering Controls: When handlers use closed systems, enclosed cabs, or aircraft in a manner that meets the requirements listed in the Worker Protection Standard (WPS) for agricultural pesticides, 40 CFR 170.240(d)(4-6), the handler PPE requirements may be reduced or modified as specified in the Worker Protection Standard. Firefighters should wear NIOSH-approved self-contained breathing apparatus and full protective clothing.

Respirator Selection: Follow regulations in OSHA 29CFR1910.134 or European Standard EN149. Use a NIOSH/MSHA- or European Standard EN149-approved respirator; or use an approved supplied-air respirator with a full facepiece operated in the positive-pressure mode, or with a full facepiece, hood, or helmet in the continuous-flow mode; or use a NIOSH/MSHA- or European Standard EN149-approved self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive-pressure mode.

Storage: Color Code-Blue: Health Hazard/Poison: Store in a secure poison location. Prior to working with this chemical you should be trained on its proper handling and storage. Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: Triazine pesticides, solid, toxic, require a shipping label of "POISONOUS MATERIALS." They fall in Hazard Class 6.1 and Packing Group I to III.

Spill Handling: Evacuate persons not wearing protective equipment from area of spill or leak until clean up is complete. Collect powdered material in the most convenient and safe manner and deposit in sealed containers. Ventilate area after clean up is complete. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable. Soil Adsorption Index (K_{oc}) = 130.

Fire Extinguishing: This chemical pesticide is a combustible solid. Hazardous decomposition includes oxides of nitrogen, carbon, and hydrogen chloride gas. *On a small fire:* use dry chemical, CO_2 or water spray. *On a large fire:* use water spray, fog or regular foam. Move containers from fire area if you can do it without risk. Dike fire-control water for later disposal; do not scatter the material. Use water spray or fog; do not use straight streams. *Fire involving storage or vehicular tanks:* isolate for 800 meters/0.5 mile in all directions; also, consider initial evacuation for 800 meters/0.5 mile in all directions: Fight fire from maximum distance or use unmanned hose holders or monitor nozzles. Do not get water inside containers. Cool containers with flooding quantities of water until well after fire is out. Withdraw immediately in the case of rising sound from venting safety devices or discoloration of tank. ALWAYS stay away from tanks engulfed in fire. For massive fire, use unmanned hose holders or monitor nozzles; if this is impossible, withdraw from area and let fire burn. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies.

Disposal Method Suggested: Strong acid or alkaline hydrolysis leads to complete degradation of simazine. However, large quantities of simazine should be incinerated in a unit operating @ 850 °C equipped with off-gas scrubbing equipment. Containers must be disposed of properly by following package label directions or by contacting your local or federal environmental control agency, or by contacting your regional EPA office.

References

- Sax, N. I., Ed., "*Dangerous Properties of Industrial Materials Report*," 7, No. 4, 109–113 (1987)
- U.S. Environmental Protection Agency, "Health Advisory: Simazine, Washington DC, Office of Drinking Water (August 1987)
- EXTOXNET, Extension Toxicology Network, "Pesticide Information Profile, Simazine," Oregon State University, Corvallis, OR (June 1996). http://extoxnet.orst.edu/pips/simazine.htm
- USEPA, Office of Pesticide Programs, Pesticide Residue Limits, "Simazine," 40 CFR 180.213. http://www.epa.gov/pesticides/food/viewtols.htm
- Sax, N. I., Ed., "Dangerous Properties of Industrial Materials Report," 7, No. 4, 109–113 (1987)
- USEPA, "Health Advisory: Simazine," Washington DC, Office of Drinking Water (August 1987)

- Sittig, Marshall (ed.), Pesticide Manufacturing and Toxic Materials Control Encyclopedia, Noyes Data Corporation, page 672, Park Ridge, NJ (1980)

Sodium aluminum fluoride

S:0350

Use Type: Insecticide
CAS Number: 15096-52-3
Formula: AlF_6Na_3; Na_3AlF_6
Synonyms: Aluminum sodium fluoride; Cryolite; ENT 24,984; Greenland spar; Hexafluoroaluminato de trisodio (Spanish); Ice Spar; Sodium aluminofluoride; Sodium fluoaluminate; Sodium hexafluoroaluminate; Villiaumite; Synthetic cryolite
Trade Names: KRYOCIDE®; CHIOLITE®; CRYOLITE 93®; ICE-SPAR®; ICETONE®; KOYOSIDE®; KRIOLIT®; PROKIL® Sodium aluminum fluoride; VILLIAUMITE®
Chemical class: Inorganic fluorine compound; Inorganic, aluminofluoride salt
EPA/OPP PC Code: 075101
California DPR Chemical Code: 173
HSDB Number: 1548
UN/NA & ERG Number: UN3077(solid)/171
RTECS® Number: WA9625000
EC Number: 239-148-8 [*Annex I Index No.:* 009-016-00-2]
Uses: Sodium aluminum fluoride is used as an insecticide on food crops and ornamentals, and also in aluminum refining and making ceramics, glass and polishes. Cryolite is used to control a variety of pests on cucurbits (melons, cantaloupe, water melon, pumpkins, all types of squash), fruiting vegetables (eggplant, pepper, broccoli, Brussels sprouts, cabbage, cauliflower, collards, head and leaf lettuce, kohlrabi), kiwi (in California only), pears, radish, cranberry and peaches, grapefruit, lemon, lime, orange, tangelo, tangerines, tomatoes, apples, potatoes, beans and grapes. Also on ornamental plants, woody shrubs and vines. Not listed for use in EU countries[115]. Registered for use in the U.S.
U.S. Maximum Allowable Residue Levels for insecticidal fluorine compounds cryolite and synthetic cryolite (sodium aluminum fluoride) [40 CFR 180.145(a)(1)]: in or on the following agricultural commodities: apricot 7.0 ppm; blackberry 7.0 ppm; blueberry (huckleberry) 7.0 ppm; boysenberry 7.0 ppm; broccoli 7.0 ppm; Brussels sprouts 7.0 ppm; cabbage 7.0 ppm; cauliflower 7.0 ppm; collards 7.0 ppm; cranberry 7.0 ppm; cucumber 7.0 ppm; dewberry 7.0 ppm; eggplant 7.0 ppm; fruit, citrus 7.0 ppm; grape 7.0 ppm; kale 7.0 ppm; kohlrabi 7.0 ppm; lettuce 7.0 ppm; loganberry 7.0 ppm; melon 7.0 ppm; nectarine 7.0 ppm; peach 7.0 ppm; pepper 7.0 ppm; plum, prune, fresh 7.0 ppm; pumpkin 7.0 ppm; raspberry 7.0 ppm; squash, summer 7.0 ppm; squash, winter 7.0 ppm; strawberry 7.0 ppm; tomato and youngberry 7.0 ppm. ***Tolerances with regional registration, as defined by section 180.1(n) [40 CFR 180.145 (c)(1)]:*** in or on the folowing raw agricultural commodities: kiwifruit, 15.0 ppm.
Fish toxicity (threshold)[101]: Very low–7784.44797 ppb, MATC (Maximum Acceptable Toxicant Concentration)
Regulatory Authority and Advisory Information:
Carcinogenicity[83]: EPA Group D, Not classifiable as a human carcinogen
Health Advisory: Mutagen: Acute Oral Category: 4, Caution
European/International Regulations: Hazard Symbol (*natural and synthetic*): T, Xn, N; risk phrases: R20/22; R48/23/25; R51/53; safety phrases: S1/2; S22; S37; S45; S61 (see Appendix 1)
WGK (German Aquatic Hazard Class): 3-Severe hazard to waters
Description: Sodium aluminum fluoride is a snow-white solid or vitreous mass. Crystalline solid (natural product may be colored reddish or brown or even black but loses this discoloration on heating); synthetic product is an amorphous powder. Odorless. Molecular weight = 209.95; Specific gravity (H_2O:1) = 2.254 @ 20 °C; Boiling point = (decomposes); Freezing/Melting point = 960–1027 °C[83]. Very slightly soluble in water.
Incompatibilities: Strong acids and strong oxidizers. Decomposes in alkaline envionment[83].
Permissible Exposure Limits in Air: *as fluorides* [F]
NIOSH IDLH: 250 mg[F]/m^3 TWA
OSHA PEL: 3 ppm/2.5 mg[F]/m^3 TWA
NIOSH REL: 3 ppm/2.5 mg[F]/m^3 TWA
ACGIH TLV: 2.5 mg[F]/m^3 TWA; Excursion Limit Recommendation: Excursions in worker exposure levels may exceed 3 times the TLV-TWA for no more than a total of 30 minutes during a work day, and under no circumstances should they exceed 5 times the TLV-TWA, provided that the TLV-TWA is not exceeded. Biological Exposure Index (BEI): Determinant: fluorides in urine; Sampling Time: prior to shift; BEI: 3 mg/g creatinine. Determinant: fluorides in urine; Sampling Time: end of shift; BEI: 10 mg/g creatinine. The determinant may be present in biological specimens collected from subjects who have not been occupationally exposed, at a concentration which could affect interpretation of the result. Such background concentrations are incorporated in the BEI value. The determinant is nonspecific, since it is also observed after exposure to other chemicals.
as aluminum, soluble salts
OSHA PEL: None
NIOSH REL: 2 mg[Al]/m^3 TWA
ACGIH TLV: 1 mg/m^3 [Al] (soluble fraction) TWA; Excursion Limit Recommendation: Excursions in worker exposure levels may exceed 3 times the TLV-TWA for no more than a total of 30 minutes during a work day, and under no circumstances should they exceed 5 times the TLV-TWA, provided that the TLV-TWA is not exceeded.
Determination in Air: Method: OSHA ID-110, Fluoride (F and HF) in Workplace Atmospheres; Procedure: ion-specific electrode analysis; Analyte: fluoride ion; Matrix: air, wipe (smear tabs for particulate fluoride); Detection

Level: 25 μg per sample. Method: NIOSH 7906, Issue 1, Fluorides aerosol and gas; ion chromatography/conductivity; Analyte: fluoride ion; Matrix: air; Estimated Level of Detection: 3 μg fluoride ion per sample (gas); 120 μg fluoride ion per sample (particulate. Method: NIOSH 7902, Issue 2; Procedure: ion-specific electrode; Analyte: fluoride ion; Matrix: air; Estimated Level of Detection: 3 μg fluoride ion per sample.

Permissible Concentration in Water: Federal Drinking Water Guidelines: EPA 50-200[Al]μg/L; State Drinking Water Standards: California 1000 [Al]μg/L; State Drinking Water Guidelines: Arizona 73 [Al]μg/L; Maine 1430 [Al]μg/L; California 200 [Al]μg/L.

Routes of Entry: Inhalation, ingestion, skin and/or eye contact.

Harmful Effects and Symptoms

Short Term Exposure: Sodium aluminum fluoride can affect you when breathed in. Eye contact can cause severe irritation, burns with possible loss of vision. Dermal contact can cause irritation and even burns, especially if prolonged. Inhalation can irritate the nose, throat and air passages. Higher exposures can cause pulmonary edema, a medical emergency that can be delayed for several hours. This can cause death. Exposure can cause nausea, abdominal pain, diarrhea; salivation, thirst, sweating. LD_{50} (oral, rat) = >5 g/kg.

Long Term Exposure: Fluorides may cause bone disease (pain and tenderness of the bones); mottled teeth in children. Repeated exposure can cause stiff spine; calcification of ligaments of ribs, pelvis. Repeated or high exposures may cause permanent lung damage.

Points of Attack: Eyes, skin, lungs and skeletal system.

Medical Surveillance: Before beginning employment and at regular times after that, the following are recommended: Lung function tests. Urine fluoride test (levels above 3 to 4 mg/L at the end of exposure represent increased exposure).

First Aid: Speed in removing material from eyes and skin is of extreme importance. If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least 15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately. If this chemical contacts the skin, remove contaminated clothing and wash immediately with soap and water. Seek medical attention immediately. If this chemical has been inhaled, remove from exposure, begin rescue breathing (using universal precautions) if breathing has stopped, and CPR if heart action has stopped. Transfer promptly to a medical facility. When this chemical has been swallowed, get medical attention. If victim is *conscious*, administer water, or milk. Do not induce vomiting. Medical observation is recommended for 24 to 48 hours following breathing overexposure, as pulmonary edema may be delayed. As first aid for pulmonary edema, a doctor or authorized paramedic may consider administering a corticosteroid spray.

Personal Protective Methods: Wear protective gloves and clothing to prevent any reasonable probability of dermal and/or eye contact. Safety equipment suppliers/manufacturers can provide recommendations on the most protective glove/clothing material for your operation. All protective clothing (suits, gloves, footwear, headgear) should be clean, available each day, and put on before work. Contact lenses should not be worn when working with this chemical. Wear dust-proof chemical goggles and face shield unless full facepiece respiratory protection is worn. Employees should wash immediately with soap when skin is wet or contaminated. Provide emergency showers and eyewash. Specific engineering controls are recommended in NIOSH Criteria Document #76-103: *Inorganic fluorides*.

Respirator Selection: NIOSH/OSHA *12.5 mg/m³:* Qm (APF = 25) (any quarter-mask respirator). *25 mg/m³:* 95XQ (APF = 10)* [any particulate respirator equipped with an N95, R95, or P95 filter (including N95, R95, and P95 filtering face-pieces) except quarter-mask respirators. The following filters may also be used: N99, R99, P99, N100, R100, P100]; or SA* (any supplied-air respirator). *62.5 mg/m³:* Sa:Cf (APF = 25)*+ (any supplied-air respirator operated in a continuous-flow mode); or PaprHie (APF = 25)* *if not present as a fume* (any powered, air-purifying respirator with a high-efficiency particulate filter). *125 mg/m³:* 100 F (APF = 50)+ [any particulate respirator equipped with an N95, R95, or P95 filter (including N95, R95, and P95 filtering face-pieces) except quarter-mask respirators. The following filters may also be used: N99, R99, P99, N100, R100, P100]; or SCBAF (APF = 50) (any self-contained breathing apparatus with a full facepiece); or SaF (APF = 50) (any supplied-air respirator with a full facepiece). *250 mg/m³:* Sa: Pd,Pp (APF = 1000) (any supplied-air respirator operated in a pressure-demand or other positive-pressure mode). *Emergency or planned entry into unknown concentrations or IDLH conditions:* SCBAF: Pd,Pp (APF = 10,000) (any self-contained breathing apparatus that has a full faceplate and is operated in a pressure-demand or other positive-pressure mode); or SaF: Pd,Pp: ASCBA (APF = 10,000) (any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary, self-contained breathing apparatus operated in a pressure-demand or other positive-pressure mode). *Escape:* 100 F (APF = 50)+ [any particulate respirator equipped with an N95, R95, or P95 filter (including N95, R95, and P95 filtering face-pieces) except quarter-mask respirators. The following filters may also be used: N99, R99, P99, N100, R100, P100]; or SCBAE (any appropriate escape-type, self-contained breathing apparatus).

Storage: Color Code-Green: General storage may be used. Prior to working with this chemical you should be trained on its proper handling and storage. Sodium aluminum fluoride must be stored to avoid contact with strong acids (such as hydrochloric, sulfuric and nitric), since violent reactions occur. Store in tightly closed containers in a cool, well-ventilated area. Store pesticides in original containers, complete with labels listing ingredients, use

directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: Environmentally hazardous substances, solid or liquid, usually fall in Hazard Class 9 and Packing Group III.

Spill Handling: Evacuate persons not wearing protective equipment from area of spill or leak until clean up is complete. Collect powdered material in the most convenient and safe manner and deposit in sealed containers. Ventilate area after clean up is complete. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable.

Fire Extinguishing: Highly hazardous decomposition includes disodium oxide and hydrogen fluoride. As an immediate precautionary measure, isolate spill or leak area in all directions for at least 50 meters/150 feet for liquids and at least 25 meters/75 feet for solids. *Fire involving storage or vehicular tanks:* isolate for 800 meters/0.5 mile in all directions; also, consider initial evacuation for 800 meters/0.5 mile in all directions. *On a small fire:* use dry chemical, CO_2, water spray or regular foam. *On a large fire:* use water spray, fog or regular foam. Do not scatter spilled material with high-pressure streams of water. Move containers from fire area if you can do it without risk. Dike fire-control water for later disposal. *Fire involving tanks:* from a secure, explosion-proof location, use water spray to cool exposed containers. If cooling streams are ineffective (venting sound increases in volume and pitch, tank discolors, or shows any signs of deforming), withdraw immediately to a secure position. Always stay away from tanks engulfed in fire. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode.

Disposal Method Suggested: In accordance with 40CFR 165 recommendations for the disposal of pesticides and pesticide containers. Containers must be disposed of properly by following package label directions or by contacting your local or federal environmental control agency, or by contacting your regional EPA office.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- USEPA, Office of Pesticide Programs, Pesticide Residue Limits, "Cryolite," 40 CFR 180.145. http://www.epa.gov/pesticides/food/viewtols.htm
- USEPA, "Reregistration Eligibility Decision (RED), Cryolite", Office of Prevention, Pesticides and Toxic Substances, Washington DC (August 1996). http://www.epa.gov/REDs/0087.pdf
- Pesticide Management Education Program, "Chemical Fact Sheet, Cryolite (Kryocide)," Cornell University, Ithaca, NY (June 1983). http://pmep.cce.cornell.edu/profiles/insect-mite/cadusafos-cyromazine/cryolite/insect-prof-cryolite.html
- New Jersey Department of Health and Senior Services, "Hazardous Substance Fact Sheet: Sodium Aluminum Fluoride," Trenton, NJ (September 1987, rev. April 2000). http://www.state.nj.us/health/eoh/rtkweb/1676.pdf

Sodium cacodylate S:0420

Use Type: Herbicide, Rodenticide, Defoliant, Veterinary medicine

CAS Number: 124-65-2

Formula: $C_2H_6AsNaO_2$; $(CH_3)_2AsOONa$

Synonyms: Cacodilato sodico (Spanish); Cacodylic acid sodium salt; Dimethylarsinic acid, sodium salt; [(Dimethylarsino)oxy]sodium-As-oxide; [(Dimethylarsino)oxy]sodium-arsenic-oxide; Hydrodimethylarsine oxide, sodium salt; Sodium cacodylate trihydrate; Sodium dimethylarsinate; Sodium dimethyl arsonate; Sodium salt of cacodylic acid

Trade Names: ACME® Sodium cacodylate; ALKARSODYL®; ANSAR 160®; ARSECODILE®; ARSYCODILE®; BOLLS-EYE®; CHEMAID®; DREXEL EZY-PICKIN COTTON DEFOLIANT®; DREXEL KACK HERBICIDE®; DUTCH-TREAT®; HERB-ALL®; PHYTAR 560® (with Cacodylic acid); RAD-E-CATE®; SILVISAR®

Chemical class: Organoarsenic

EPA/OPP PC Code: 012502

California DPR Chemical Code: 1673

HSDB Number: 731

UN/NA & ERG Number: UN1688/152

RTECS® Number: CH7890000; CH7700000

EC Number: 204-708-2

Uses: This material has been used as a non-selective herbicide and defoliant for general weed control. Severely restricted for use in EU countries[115]. Not registered for use in the U.S. There are 47 global suppliers[97].

U.S. Maximum Allowable Residue Levels for total residues of combined arsenic (calculated as As) [21 CFR 556.60]: in food are established as follows: (a) In edible tissues and in eggs of chickens and turkeys: in uncooked muscle tissue 0.5 ppm; in uncooked edible byproducts 2 ppm; in eggs 0.5 ppm. (b) In edible tissues of swine: in uncooked liver and kidney 2 ppm; in uncooked muscle tissue and byproducts other than liver and kidney 0.5 ppm.

Regulatory Authority and Advisory Information:

Carcinogenicity[83]: EPA Group D, Not classifiable as a human carcinogen

Health Advisory: Nerve Toxin (S!); Endocrine disruptor (S!): *As arsenic,* Mutagen, Reproductive Toxin

Acute Oral Category: 3, CAUTION
Carcinogen User Register Chemical (CAL/OSHA) as inorganic arsenic compound
Superfund/EPCRA 302 Extremely Hazardous Substances: TPQ = 100/10,000 lb (45.4/4,540 kg)
Superfund/EPCRA 40CFR302.4 RQ: EHS, 1 lb (0.454 kg) as arsenic compounds
Clean Air Act: Hazardous Air Pollutants (Title I, Part A, Section 112) as arsenic compounds
Clean Water Act: Toxic Pollutant (Section 401.15) as arsenic and compounds
RCRA, 40CFR261, Appendix 8, Hazardous Constituents, waste number D004
EPCRA (Section 313): Includes any unique chemical substance that contains arsenic as part of that chemical's infrastructure. Form R *de minimis* concentration reporting level: organics 1.0%
U.S. DOT Regulated Marine Pollutant (49CFR172.101, Appendix B) as arsenates, liquid, n. o. s; arsenates, solid, n. o. s; arsenical pesticides liquid, toxic, flammable, n. o. s.

Description: Sodium cacodylate is a white to yellowish crystalline solid or powder. It liquifies in the water of hydration at 60 °C and becomes anhydrous at 120 °C. Odorless. Molecular weight = 159.98; Specific gravity (H_2O:1) = <1 @ 20 °C (solid)[86]; Boiling point = 200 °C; Freezing/Melting point = 60 °C. Hazard Identification (based on NFPA-704 M Rating System): Health 4, Flammability 0, Reactivity 0. Soluble in water.

Incompatibilities: Incompatible with oxidizers, strong bases, acids, active metals (iron, aluminum, zinc). Contact with acids reacts to form highly toxic dimethylarsine gas. Attacks some metals.

Permissible Exposure Limits in Air: *arsenic, organic compounds*
OSHA PEL: 0.5 mg[As]/m^3 TWA
NIOSH REL: See NIOSH Pocket Guide, Appendix A
ACGIH TLV®[1]: 0.01 mg[As]/m^3 TWA; Confirmed Human Carcinogen; BEI established
Protective Action Criteria (PAC) Ver. 27[89]
PAC-1: 1.1 mg/m^3
PAC-2: 4 mg/m^3
PAC-3: 510 mg/m^3
arsenic, organic compounds
OSHA PEL: 0.5 mg[As]/m^3 TWA
ACGIH TLV®[1]: 0.01 mg[As]/m^3 TWA; Confirmed Human Carcinogen; Biological Exposure Index (BEI): Determinant: Inorganic arsenic plus methylated metabolites in urine; Sampling Time: end of workweek; BEI = 35 μg[As]/L. The determinant may be present in biological specimens collected from subjects who have not been occupationally exposed, at a concentration which could affect interpretation of the result. Such background concentrations are incorporated in the BEI value.
NIOSH IDLH: 5 mg[As]/m^3

Determination in Air: Filter; Reagent; Ion chromatography/Hydride generation atomic absorption spectrometry; NIOSH IV, Method #5022, Arsenic, Organo-[18].

Permissible Concentration in Water: Federal Drinking Water Standard: EPA 10 μg/L; State Drinking Water Guidelines: Arizona 10 μg/L; Connecticut 10 μg/L. Canadian Drinking Water Standards: IMAC 0.025 [As] mg/L. Runoff from spills or fire control may cause water pollution.

Determination in Water: *For arsenic:* The atomic absorption graphite furnace technique is often used for measurement of total arsenic in water. It also has been standardized by the EPA. Total arsenic may be determined by digestion followed by silver diethyldithiocarbamate; an alternative is atomic absorption; another is inductively coupled plasma optical emission spectrometry. See OSHA Method #ID-105 for arsenic[58].

Routes of Entry: Inhalation, ingestion, skin and/or eye contact.

Harmful Effects and Symptoms

Short Term Exposure: Sodium cacodylate is corrosive to the skin, eyes, and mucous membranes. It may cause disturbances of the blood, kidneys, and nervous system. Acute exposure to sodium cacodylate may be fatal. Headache, red-stained eyes, and a garlicky odor of the breath may be the first effects noticed. Other signs and symptoms include generalized weakness, intense thirst, muscle cramping, seizures, toxic delirium, and shock. Nausea, vomiting, anorexia, abdominal pain, and diarrhea may occur. Hypotension (low blood pressure), tachycardia (rapid heart rate), pulmonary edema, ventricular fibrillation, and other cardiac abnormalities are usually found following severe exposure. LD_{50} (oral, rat) = >2.5 g/kg.

Long Term Exposure: Repeated exposure may cause ulcers and hole in the nasal septum. Hoarseness and sore eyes also occur. Repeated contact may cause thickened skin, pigmentation changes. May cause liver damage and nerve damage causing sensation of “pins and needles,” weakness and loss of coordination in the limbs. May cause gastrointestinal tract and reproductive effects. Repeated exposures can cause metallic taste, poor appetite, nausea, vomiting, diarrhea and stomach pain, seizures and death. Birth defects have been observed in animals exposed to inorganic arsenic. It is likely that health effects seen in children exposed to high amounts of arsenic will be similar to the effects seen in adults.

Points of Attack: Arsenic may cause skin damage or problems with circulatory systems, and may have increased risk of causing cancer. Several studies have shown that *inorganic* arsenic can increase the risk of lung cancer, skin cancer, bladder cancer, liver cancer, kidney cancer, and prostate cancer. This chemical may also attack central nervous system, gastrointestinal tract, and reproductive system.

Medical Surveillance: Preliminary medical exam to detect chronic diseases of central nervous system, liver, heart, kidneys, lung and skin, as well as endocrinological or immunological disturbances, should protect susceptible individuals. Periodical medical exams of internal organs, skin and eyes are important to avoid chronic occupational intoxications. They should include lab and patch tests when necessary[83]. This chemical is a suspected or known human carcinogen. Exposed persons should contact a physician for advice regarding the possible long term health effects and advice for medical monitoring. Examination of the nose, skin, eyes and nails. Examination of the nervous system. Liver function tests. Test for urine arsenic. NIOSH recommended exposure levels should not exceed 100 micrograms per liter of creatinine in the urine. Results may be accurate within 2 days of eating shellfish or fish (which may increase arsenic levels); they are most accurate at the end of a workday.

First Aid: If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least 15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately. If this chemical contacts the skin, remove contaminated clothing and wash immediately with soap and water. Seek medical attention immediately. If this chemical has been inhaled, remove from exposure, begin rescue breathing (using universal precautions) if breathing has stopped, and CPR if heart action has stopped. Transfer promptly to a medical facility. When this chemical has been swallowed, get medical attention. Give a slurry of activated charcoal in water to drink and induce vomiting. Do not make an unconscious person vomit. Obtain authorization and/or further instructions from the local hospital for administration of an antidote or performance of other invasive procedures. Rush to health care facility

Personal Protective Methods: Wear protective gloves and clothing to prevent any reasonable probability of dermal and/or eye contact. Safety equipment suppliers/manufacturers can provide recommendations on the most protective glove/clothing material for your operation. All protective clothing (suits, gloves, footwear, headgear) should be clean, available each day, and put on before work. Contact lenses should not be worn when working with this chemical. Wear dust-proof chemical goggles and face shield unless full facepiece respiratory protection is worn. Employees should wash immediately with soap when skin is wet or contaminated. Provide emergency showers and eyewash. Specific engineering controls are required under OSHA 1910.1018*, Inorganic Arsenic.* See also NIOSH Criteria Document #75-149, *"Inorganic Arsenic."*

Respirator Selection: SCBA >1.1 mg/m^3. *At concentrations above the NIOSH REL, or where there is no REL, at any detectable concentration:* Sa (APF = 10) (any supplied-air respirator); or SCBAF (APF = 50) (any self-contained breathing apparatus with a full facepiece). *Emergency or planned entry into unknown concentrations or IDLH conditions:* SCBAF: Pd,Pp (APF = 10,000) (any self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode); or SaF: Pd,Pp: ASCBA (APF = 10,000) (any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary, self-contained breathing apparatus operated in a pressure-demand or other positive-pressure mode). *Escape:* GmFAg100 (APF = 50) [any air-purifying, full facepiece respirator (gas mask) with a chin-style, front- or back-mounted acid gas canister having an N100, R100, or P100 filter]; or SCBAE (any appropriate escape-type, self-contained breathing apparatus).

Storage: Color Code-Blue: Health Hazard/Poison: Store in a secure poison location. Prior to working with calcium arsenate you should be trained on its proper handling and storage. Store in tightly closed containers in a cool, well-ventilated area. A regulated, marked area should be established where this chemical is handled, used, or stored in compliance with OSHA Standard 1910.1045. Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: The DOT label requirement[19] is "poisonous materials." Hazard Class 6.1; Packing Group II. Standard Transportation number 49-239-85.

Spill Handling: First remove all sources of ignition. Evacuate persons not wearing protective equipment from area of spill or leak until clean up is complete. Collect powdered material in the most convenient and safe manner and deposit in sealed containers. Ventilate area after clean up is complete. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable.

Fire Extinguishing: Hazardous decomposition includes highly toxic oxides of arsenic, sodium and carbon and arsine gas. This chemical is a noncombustible solid. Use any extinguishing agent suitable for surrounding fires. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies. Containers may explode in fire. From a secure, explosion-proof location, use water spray to cool exposed containers. If cooling streams are ineffective (venting sound increases in volume and pitch, tank discolors, or shows any signs of deforming), withdraw immediately to a secure position. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode.

Disposal Method Suggested: Do not discharge into drains or sewers. Dispose of waste material as hazardous waste using a licensed disposal contractor to an approved landfill. Consult with environmental regulatory agencies for guidance on acceptable disposal practices. If allowed, incineration with effluent gas scrubbing is recommended. Containers must be disposed of properly by following package label directions or by contacting your local or federal environmental control agency, or by contacting your regional EPA office. Chemical

Treatability of Arsenic–(1) Concentration Process: Chemical Precipitation; Chemical Classification: Metal; Scale of Study: Pilot Scale; Type of Wastewater Used: Domestic Wastewater+Pure Compound; Results of Study: 5 ppm @ 4 gpm @ pH = 7.0. Iron system–90% reduction; low lime system–80% reduction; high lime system–76% reduction; (three coagulant systems were used; Iron system used 45 ppm as Fe of $Fe_2(SO_4)_3$ @ pH = 6.0. Low lime system used 20 ppm Fe of $Fe_2(SO_4)_3$ and 260 ppm of CaO @ pH = 10.0. High lime system used 600 ppm of CaO @ pH = 11.5. Chemical coagulation was followed by multimedia filtration). (2) Concentration Process: Chemical Precipitation; Chemical Classification: Metal; Scale of Study: Full Scale Continuous Flow; Type of Wastewater Used: Domestic Wastewater; Results of Study: Effluent character (ppb): 2.5, 56% reduction with lime; 3.3, 24% reduction with lime; (lime dose of 350–400 ppm as calcium oxide @ pH = 11.3)[83].

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- USEPA, "Chemical Profile: Sodium Cacodylate," Washington DC, Chemical Emergency Preparedness Program (November 30, 1987)
- New Jersey Department of Health and Senior Services, "Hazardous Substance Fact Sheet, Sodium Cacodylate," Trenton, NJ (August 1999). http://www.state.nj.us/health/eoh/rtkweb/1687.pdf

Sodium chlorate S:0430

Use Type: Herbicide, Defoliant, Fungicide, Soil sterilent, Microbiocide

CAS Number: 7775-09-9

Formula: ClNaO3; NaClO3

Synonyms: Chlorate of soda; Chlorate salt of sodium; Chloric acid, sodium salt

Trade Names: ASEX®; ATLACIDE[C]; ATRATOL B-HERBATOX®[C]; BAREGROUND®; BEST MAGCHLOR DEFOLIANT®; CHAPMAN WEED FREE®; CHLORAX®; D-LEAF COTTON DEFOLIANT®; DE-FOL-ATE®; DESOLET®; DREXEL DEFOL®; DROP LEAF®; EVAU-SUPERFALL®; FALL®; GRAIN SORGHUM HARVEST AID®; GRANEX OK®; HARVEST-AID®; KLOREX®; KM SODIUM CHLORATE®; KUSA-TOHRUKUSATOL®; LOREX®; ORTHO C-1 DEFOLIANT & WEED KILLER®; OXYCIL®; RASIKAL®; SHED-A-LEAF®; TRAVEX®; TUMBLEAF®; 20 MULE TEAM HIBOR®[C]; UNITED CHEMICAL DEFOLIANT NO.1®; VAL-DROP®

Chemical class: Inorganic

EPA/OPP PC Code: 073301

California DPR Chemical Code: 536

HSDB Number: 732

UN/NA & ERG Number: UN1495 (solid)/140; UN2428 (solution)/140

RTECS® Number: FO0525000

EC Number: 231-887-4 [*Annex I Index No.:* 017-005-00-9]

Uses: Sodium chlorate is a non-selective herbicide that is used on cotton, corn, flax, soybeans, peppers, grain sorghum, peas, greens, sunflower crops, Sudan grass forage, rice and safflower crops to control, among others, Canadian thistle, Johnson grass, morning glory and St. Johns wort. It is also used on non-crop lands, ditches, fences and roadways for vegetation control. It has a soil-sterilant effect. The pesticidal uses of sodium chlorate are a small percentage (approximately 2%) of the total used in the United States. Approximately 3 million pounds of sodium chlorate are applied annually to agricultural, residential, and commercial use sites. Not approved for use in EU countries[115]. Registered for use in the U.S.

U.S. Maximum Allowable Residue Levels for Sodium Chlorate [40 CFR 180.1020(a)]: Sodium chlorate is exempted from the requirement of a tolerance for residues in or on the following raw agricultural commodities when used as a defoliant, desiccant, or fungicide in accordance with good agricultural practice: beans, dry, edible; corn, fodder; corn, forage; corn, grain; cottonseed; flaxseed; flax, straw; guar beans; peas, southern; peppers, chili; potatoes; rice; rice, straw; safflower, grain; sorghum, grain; sorghum, fodder; sorghum, forage; soybeans; and sunflower seed. **[*21 CFR 175.105*]:** Sodium chlorate is an indirect food additive for use only as a component of adhesives[FDA].

Regulatory Authority and Advisory Information:

Health Advisory: Mutagen, Skin irritant/sensitizer

Toxicity (oral) Category 3, CAUTION

Highly Reactive Substance and Explosive (World Bank)[15]

Department of Homeland Security Screening Threshold Quantity (pounds): *Theft hazard* 400 (Commercial grade)

European/International Regulations: Hazard Symbol: Xn, H, N; risk phrases: R9; R22; R51/53; safety phrases: S2; S23; S17; S53; S46; S61 (see Appendix 1)

WGK (German Aquatic Hazard Class): 2-Hazard to water

Description: Sodium chlorate is a white crystalline solid. Molecular weight = 106.44; Specific gravity (H_2O:1) = 2.5 @ 20 °C; Boiling point = (decomposes) ~300 °C; Freezing/Melting point = 248 °C (also listed @ 255 °C and 264 °C); Vapor pressure = negligible (room temperature). Hazard Identification (based on NFPA-704 M Rating System): Health 1, Flammability 0, Reactivity 2 (Oxidizer). Highly soluble in water.

Incompatibilities: A strong oxidizer. Reacts violently with combustibles, sulfuric acid, and reducing materials. Reacts with strong acids, giving off carbon dioxide. Explosions may be caused by contact with ammonia salts, ammonium thiosulfate, antimony sulfide, arsenic, carbon, charcoal, organic matter, organic acids, thiocyanates, chemically active metals, oils, metal sulfides, nitrobenzene, powdered metals, sugar. Reacts with organic contaminants, forming shock-sensitive mixtures. Decomposes on heating above 250 °C or on burning, producing oxygen and toxic chlorine fumes. Attacks zinc, magnesium, and mild steel.

Permissible Exposure Limits in Air: Protective Action Criteria (PAC) Ver. 27[89]

PAC-1: 0.11 mg/m^3
PAC-2: 1.2 mg/m^3
PAC-3: 32 mg/m^3

Permissible Concentration in Water: State Drinking Water Guidelines: California 800 μg/L; Maine 7 μg/L.

Determination in Water: Log K_{ow} = negative. Unlikely to bioaccumulate in marine organisms.

Routes of Entry: Inhalation, ingestion, skin and/or eye contact.

Harmful Effects and Symptoms

Short Term Exposure: Sodium chlorate can affect you when breathed in. Eye or dermal contact can cause severe irritation and even burns. Breathing sodium chlorate, especially dust or mist, can irritate the nose and throat. It can also cause cyanosis causing the skin to turn blue (methemoglobinemia) because it interferes with the blood's ability to carry oxygen. Damage to red blood cells (hemolytic anemia) can also occur. If severe or repeated, this can cause kidney damage. Ingestion can cause kidney damage. The effects may be delayed. Delayed pulmonary edema may occur after inhalation. LD_{50} (oral, rat) = >1000 mg/kg; LD_{50} (dermal, rat) = >2 g/kg.

Long Term Exposure: May cause tumors. Repeated or prolonged contact with skin may cause dermatitis. Kidney damage can occur from severe or repeated damage to red blood cells resulting from exposure. Very irritating substances may cause lung damage.

Points of Attack: Kidneys, lungs, blood, and skin.

Medical Surveillance: Preliminary medical exam to detect chronic diseases of central nervous system, liver, heart, kidneys, lung and skin, as well as endocrinological or immunological disturbances, should protect susceptible individuals. Periodical medical exams of internal organs, skin and eyes are important to avoid chronic occupational intoxications. They should include lab and patch tests when necessary[83]. Medical observation is recommended for 24 to 48 hours following breathing overexposure, as pulmonary edema may be delayed. Before beginning employment and at regular times after that, for those with frequent or potentially high exposures, the following are recommended: Lung function tests. If symptoms develop or overexposure is suspected, the following may be useful: Complete blood count. Test for methemoglobin if skin is blue. Evaluation by a qualified allergist, including exposure history and testing, may help diagnose allergy.

First Aid: If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least 15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately. If this chemical contacts the skin, remove contaminated clothing and wash immediately with soap and water. Seek medical attention immediately. If this chemical has been inhaled, remove from exposure, begin rescue breathing (using universal precautions) if breathing has stopped, and CPR if heart action has stopped. Transfer promptly to a medical facility. When this chemical has been swallowed, get medical attention. Give large quantities of water and induce vomiting. Do not make an unconscious person vomit. Keep victim under medical observation. If ingested, seek medical attention. If individual is drowsy or unconscious, do not give anything by mouth; place individual on the left side with the head down. Contact a physician, medical facility, or poison control center for advice about whether to induce vomiting. If possible, do not leave individual unattended. If inhaled, and if symptoms develop, move individual away from exposure and into fresh air. If symptoms persist, seek medical attention. If breathing is difficult, administer oxygen. Keep person warm and quiet; seek immediate medical attention. Following dermal contact, remove contaminated clothing. Wash exposed area with soap and water. If symptoms persist, seek medical attention. Launder clothing before reuse. Following eye contact, immediately move individual away from exposure and into fresh air. Flush eyes gently with water for at least 15 minutes while holding eyelids apart; seek immediate medical attention. *Antidotes and special procedures:* Do not use *Methylene blue* to treat methemoglobinemia from sodium chlorate as it can cause increased toxicity. *Note to physician or authorized medical personnel:* Treat for methemoglobinemia. Spectrophotometry may be required for precise determination of levels of methemoglobinemia in urine.

Personal Protective Methods: Wear protective gloves and clothing to prevent any reasonable probability of dermal and/or eye contact. Safety equipment suppliers/manufacturers can provide recommendations on the most protective glove/clothing material for your operation. All protective clothing (suits, gloves, footwear, headgear) should be clean, available each day, and put on before work. Contact lenses should not be worn when working with this chemical. Wear dust-proof chemical goggles and face shield unless full facepiece respiratory protection is worn. Employees should wash immediately with soap when skin is wet or contaminated. Provide emergency showers and eyewash.

Respirator Selection: SCBA > 0.11 mg/m^3. Where potential exists for exposure to sodium chlorate, use a NIOSH/MSHA- or European Standard EN149-approved full facepiece respirator equipped with particulate (dust/fume/mist) filters. Particulate filters must be checked every day before work for physical damage, such as rips or tears, and replaced as needed. *Where potential for high exposures exists*, use a NIOSH/MSHA- or European Standard EN149-approved supplied-air respirator with a full facepiece operated in the positive-pressure mode, or with a full facepiece, hood, or helmet in the continuous-flow mode; or use a NIOSH/MSHA- or European Standard EN149-approved self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive-pressure mode.

Storage: Color Code-Yellow: Reactive Hazard; Store in a location separate from other materials, especially flammables and combustibles. Prior to working with this chemical you should be trained on its proper handling and storage. Sodium chlorate must be stored to avoid contact with ammonium thiosulfate, antimony sulfide; arsenic, carbon, charcoal, organic matter; organic acids; sulfuric acid; thiocyanates and chemically active metals (such as potassium, sodium, magnesium, and zinc), since violent reactions occur. Protect storage containers against physical damage. Store in tightly closed containers in a cool, well-ventilated area away from sources of heat. See OSHA Standard 1910.104 and NFPA 43A *Code for the Storage of Liquid and Solid Oxidizers* for detailed handling and storage regulations. Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: This compound requires a shipping label of "OXIDIZER." It falls in Hazard Class 5.1 and Packing Group II. ***STN:*** 49-187-43; Sodium chlorate (chlorate of soda); 49-187-65; Sodium chlorate and sodium chloride, in water solution (oxidizing material).

Spill Handling: Evacuate persons not wearing protective equipment from area of spill or leak until clean up is complete. Collect powdered material in the most convenient and safe manner and deposit in sealed containers. Ventilate area after clean up is complete. Keep sodium chlorate out of a confined space, such as a sewer, because of the possibility of an explosion, unless the sewer is designed to prevent the build-up of explosive concentrations. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable.

Fire Extinguishing: Sodium chlorate may burn, but does not readily ignite. Heat above 300 °C produces oxygen which can increase the intensity of fire and may ignite other combustible materials. Flood areas with water unless that is incompatible with other materials in the fire area. Hazardous decomposition includes chlorine. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies. Containers may explode in fire. From a secure, explosion-proof location, use water spray to cool exposed containers. If cooling streams are ineffective (venting sound increases in volume and pitch, tank discolors, or shows any signs of deforming), withdraw immediately to a secure position. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode.

Disposal Method Suggested: In accordance with 40CFR 165 recommendations for the disposal of pesticides and pesticide containers. Containers must be disposed of properly by following package label directions or by contacting your local or federal environmental control agency, or by contacting your regional EPA office.:

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- Pesticide Management Education Program, "Pesticide Information Profile, Sodium Chlorate," Cornell University, Ithaca, NY (September 1995). http://pmep.cce.cornell.edu/profiles/extoxnet/pyrethrins-ziram/sodium-chlorate-ext.html
- USEPA, Office of Pesticide Programs, Pesticide Residue Limits, "Sodium Chlorate," 40 CFR 180.1020. http://www.epa.gov/pesticides/food/viewtols.htm
- Sax, N. I., Ed., "Dangerous Properties of Industrial Materials Report," 3, No. 1, 28–32 (1983)
- New Jersey Department of Health and Senior Services, "Hazardous Substance Fact Sheet: Sodium Chlorate," Trenton, NJ (May 1986, rev. February 2001). http://www.state.nj.us/health/eoh/rtkweb/1688.pdf

Sodium diacetate S:0455

Use Type: Fungicide, Bactericide

CAS Number: 126-96-5

Formula: $CH_3COONa \cdot CH_3COOH$

Synonyms: Acetic acid, sodium salt (2:1); Sodium acid acetate

Trade Names: CROP CURE®; DYKON®; GRAIN CURE®[C]; SENTRY SODIUM ACETATE®[C]

EPA/OPP PC Code: 044008

California DPR Chemical Code: 5065

HSDB Number: 736

RTECS® Number: AJ4375000

EC Number: 204-814-9

Uses: Sodium diacetate is a fungicide and bactericide registered to control molds and bacteria, thereby preventing spoilage in stored grains. The pesticide is applied to hay as a dust or soluble concentrate (liquid spray) during the baling process. It is applied to silage as a fermentation "aid" to preserve the quality of field corn, alfalfa, sorghum, oats and grasses, stored in silos. Sodium diacetate is composed of acetic acid and sodium acetate. It dissociates to acetate, sodium and hydrogen ions, normal components of plants and animals, and of human foods. Acetates are formed in living organisms during the metabolism of food. Acetates and acetic acid have long been used in both human and animal foods, without significant adverse effects. Sodium diacetate is also used as an antimicrobial agent in baked goods and other foods, and in medicine and cosmetics manufacturing as a freshener, flavoring and pH regulator. Not listed for use in EU countries[115]. 126-96-5. Registered for use in the U.S.

U.S. Maximum Allowable Residue Levels for Sodium Diacetate (40 CFR 180.1058): Sodium diacetate, when used post-harvestarvest as a fungicide, is exempt from the requirement of a tolerance for residues in or on alfalfa hay, Bermuda grass hay, bluegrass hay, brome grass hay, clover hay, corn grain, oat grain, orchard grass hay, sorghum grain, sudan grass hay, rye grass hay, and timothy hay,

Regulatory Authority and Advisory Information:

Acute Oral Category: 4, Caution

WGK (German Aquatic Hazard Class): 1-Low hazard to water

Description: A white crystalline solid or powder. May be combustible. Acetic acid odor. Molecular weight = 142.09; Specific gravity (H_2O:1) = 1529 @ 20°C; Boiling point = (decomposes). Soluble in water.

Incompatibilities: Dust may form combustible mixture with air. Contact with water liberates acetic acid. May not be compatible with nitrates or strong mineral acids. Moisture may cause hydrolysis or other forms of decomposition.

Routes of Entry: Inhalation, ingestion, may pass through the unbroken skin, eyes.

Harmful Effects and Symptoms

Short Term Exposure: Contact with the dust can cause eye irritation including burning, stinging, tearing, redness, and swelling. Can cause permanent injury to the cornea and may lead to other problems and blindness. May cause mild skin irritation with redness and burning. Symptoms of exposure include stomach or intestinal upset, nausea, vomiting, diarrhea. LD_{50} (oral, rat) = 5600 mg/kg[83]; LD_{50} (dermal, rat) = >2 g/kg[83].

First Aid: If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least 15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately. If this chemical contacts the skin, remove contaminated clothing and wash immediately with soap and water. Seek medical attention immediately. If this chemical has been inhaled, remove from exposure, begin rescue breathing (using universal precautions) if breathing has stopped, and CPR if heart action has stopped. Transfer promptly to a medical facility. When this chemical has been swallowed, get medical attention. *Do not induce vomiting when formulations containing petroleum solvents are ingested*. Otherwise, give large quantities of water and induce vomiting. Do not make an unconscious person vomit.

Personal Protective Methods: Applicators and other handlers must wear: Coveralls worn over long-sleeved shirt and long pants; Chemical-resistant gloves such as DuPont™ Tychem® suit fabrics, barrier laminate, or Viton®; Chemical-resistant footwear plus socks; Protective eye wear; Chemical-resistant headgear for overhead exposure; Chemical-resistant apron when cleaning equipment, mixing, or loading[83]. Agricultural Use/Engineering Controls: When handlers use closed systems, enclosed cabs, or aircraft in a manner that meets the requirements listed in the Worker Protection Standard (WPS) for agricultural pesticides, 40 CFR 170.240(d)(4-6), the handler PPE requirements may be reduced or modified as specified in the Worker Protection Standard. Firefighters should wear NIOSH-approved self-contained breathing apparatus and full protective clothing.

Respirator Selection: Wherever and whenever workplace conditions warrant respirator use, a respiratory protection program must be followed that meets one or more of the following government standards: OSHA's 29 CFR 1910.134, ANSI Z88.2, or European Standard EN 149.

Spill Handling: For solids, isolate spill or leak area in all directions for at least 25 meters/75 feet. Increase, in the downwind direction, as necessary. Do not touch damaged containers or spilled material unless wearing appropriate protective clothing. Stop leak if you can do it without risk. Prevent entry into waterways, sewers, basements or confined areas. Cover with plastic sheet to prevent spreading. Absorb or cover with dry earth, sand or other non-combustible material and transfer to containers. Do not get water inside containers.

Fire Extinguishing: Combustible at high temperature. Hazardous decomposition includes toxic oxides of carbon and metallic oxides. Move containers from fire area if you can do it without risk. *On a small fire*: use dry chemical. *On a large fire*: use water spray, fod, or foam. Do not use water jet. Do not move cargo or vehicle if cargo has been exposed to heat. *Fire involving tanks or car/trailer loads*: fight fire from maximum distance or use unmanned hose holders or monitor nozzles. Do not get water inside containers. Cool containers with flooding quantities of water until well after fire is out. Withdraw immediately in the case of rising sound from venting safety devices or discoloration of tank.

Disposal Method Suggested: Do not discharge into drains or sewers. Dispose of waste material as hazardous waste using a licensed disposal contractor to an approved landfill. Consult with environmental regulatory agencies for guidance on acceptable disposal practices. If allowed, incineration with effluent gas scrubbing is recommended. Containers must be disposed of properly by following package label directions or by contacting your local or federal environmental control agency, or by contacting your regional EPA office.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- USEPA, Office of Pesticide Programs, Pesticide Residue Limits, "Sodium Diacetate," 40 CFR 180.1058. http://www.epa.gov/pesticides/food/viewtols.htm
- USEPA, "Reregistration Eligibility Decision Facts (RED), Sodium Diacetate," Office of Prevention, Pesticides and Toxic Substances, Washington DC (September 1991). http://www.epa.gov/REDs/factsheets/4001fact.pdf

Sodium fluoroacetate S:0480

Use Type: Insecticide, Rodenticide, Wildlife control

CAS Number: 62-74-8

Formula: $C_2H_2FNaO_2$; FCH_2COONa

Synonyms: 1080; Acetic acid, fluoro-, sodium salt; Fluoroacetic acid, sodium salt; Compound 1080;

Fluoacetato sodico (Spanish); NSC 77690; SMFA; Sodium fluoacetate; Sodium fluoacetic acid; Sodium fluoracetate; Sodium monofluoroacetate

Trade Names: AI3-08434®; FLUORAKIL® 3; FRATOL®; FURATOL®; RATBANE 1080®; TEN-EIGHTY®; TL 869®; YASOKNOCK®

Chemical class: Unclassified

EPA/OPP PC Code: 075003

California DPR Chemical Code: 633

HSDB Number: 743

UN/NA & ERG Number: UN2629/151

RTECS® Number: AH9100000

EC Number: 200-548-2 [*Annex I Index No.:* 607-169-00-5]

Uses: A U.S. EPA restricted Use Pesticide (RUP). Not listed for use in EU countries[115]. It is seldom used as an insecticide. Sodium fluoroacetate is primarily used around sewers, ships and warehouses, and in agriculture and by state agricultural departments as bait for rodents and large predators, to control rats, mice, squirrels, prairie dogs, coyotes, rabbits and otherpests. It is seldom used as an insecticide. It is very toxic to birds, domestic animals and wildlife either by consuming the bait or eating poisoned carcasses. It is sometimes used in 1% solutions which are injected into collars which are strapped to the necks of sheep, goats and other livestock that predators are attracted to. Coyotes that puncture the collars are likely to be fatally poisoned by the sodium fluoroacetate as a result.

Regulatory Authority and Advisory Information:
California Proposition 65 Developmental/Reproductive toxin (11/6/1998)
Health Advisory: Mutagen, Developmental/Reproductive Toxin (TRI)
Toxicity (oral) Category 1, DANGER–POISON
EPA Oral reference dose (RfD) = 0.0002 mg/kg/day (UF: 3000, MF: 1)
EPA Hazardous Waste Number (RCRA No.): P058
Superfund/EPCRA 302 Extremely Hazardous Substances: TPQ = 10/10,000 lb (4.54/4,540 kg)
Superfund/EPCRA 40CFR302.4 RQ: CERCLA, 10 lb (4.54 kg)
EPCRA Section 313 Form R *de minimis* concentration reporting level: 1.0%
European/International Regulations: Hazard Symbol: T+, N; risk phrases: R26/27/28; R50; safety phrases: S1/2; S13; S22; S36/37; S45; S61 (see Appendix 1)
WGK (German Aquatic Hazard Class): 3-Severe hazard to waters

Description: Sodium fluoroacetate is a fluffy, colorless or white, hygroscopic solid (sometimes dyed black) or powder. Odorless. Molecular weight = 100.03; Boiling point = (decomposes); Freezing/Melting point = (decomposes) 200 °C. Hazard Identification (based on NFPA-704 M Rating System): Health 4, Flammability 0, Reactivity 0. Soluble in water.

Incompatibilities: Alkaline metals and carbon disulfide. Decomposes at temperature >200 °C.

Permissible Exposure Limits in Air: NIOSH IDLH: 2.5 mg/m^3
OSHA PEL: 0.05 mg/m^3 TWA [skin]
NIOSH REL: 0.05 mg/m^3 TWA; 0.15 mg/m^3 STEL [skin]
ACGIH TLV®[1]: 0.05 mg/m^3 TWA [skin]
Protective Action Criteria (PAC) Ver. 27[89]
PAC-1: 0.15 mg/m^3
PAC-2: 0.5 mg/m^3
PAC-3: 5 mg/m^3

Determination in Air: Filter; Water; Ion chromatography; NIOSH II(5) Method #S30[18]

Permissible Concentration in Water: Federal Drinking Water Standards: EPA 4000 μg[Fl]/L; Federal Drinking Water Guidelines: EPA 2000 μg[Fl]/L; State Drinking Water Standards: California 2000 μg[Fl]/L; Delaware 2000 μg[Fl]/L; State Drinking Water Guidelines: Arizona 4000 μg[Fl]/L; Maine 1680 μg[Fl]/L.

Routes of Entry: Inhalation, skin absorption, ingestion, eye and/or dermal contact.

Harmful Effects and Symptoms

Short Term Exposure: May affect the cardiovascular system and central nervous system, causing cardiac disorders and respiratory failure. Exposure may result in death This material is super toxic. Higher exposures can cause pulmonary edema, a medical emergency that can be delayed for several hours. This can cause death. The probable oral lethal dose in humans is less that 5 mg/kg, or a taste (<7 drops) for a 150 lb person. Symptoms include nausea, vomiting, apprehension, auditory hallucinations, facial paresthesia, twitching face muscle, pulsus altenans, ectopic heartbeat, tacard, ventricular fibrillation. Symptoms are usually seen within one-half hour of exposure, but severe effects may be delayed as long as 20 hours. A rebuttable presumption against registration of sodium fluoroacetate for pesticidal uses was issued on December 1, 1976 by the U.S. EPA. on the basis of reductions in nontarget and endangered species and because there is no human antidote. LD_{50} (oral, rat) = <50 mg/kg; LD_{50} (dermal, rat) = <100 mg/kg.

Long Term Exposure: Fluorides may cause bone disease (pain and tenderness of the bones); mottled teeth in children. May cause liver and kidney damage. May affect the central nervous system, causing epileptiform convulsive seizures that may be followed by severe depression.

Points of Attack: Cardiovascular system, lungs, kidneys, liver and central nervous system, skeletal system, teeth.

Medical Surveillance: In addition to comprehensive initial medical and work histories emphasizing reproductive experience and menstrual history, patient should have physical examination and testing of genito-urinary tract, sperm count, motility and morphology. If required, other tests, such as serum testosterone, serum follicle stimulating hormone (FSH), and serum lutenizing hormone (LH), may be indicated. Consider the points of attack in preplacement and periodic physical examinations. Liver and kidney function tests. Lung function tests. Consider chest x-ray following acute overexposure. Examination of the nervous system.

First Aid: Speed in removing material from eyes and skin is of extreme importance. If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least 15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately. If this chemical contacts the skin, remove contaminated clothing and wash immediately with soap and water. Seek medical attention immediately. If this chemical has been inhaled, remove from exposure, begin rescue breathing (using universal precautions) if breathing has stopped, and CPR if heart action has stopped. Transfer promptly to a medical facility. When this chemical has been swallowed, get medical attention. Give large quantities of water and induce vomiting. Do not make an unconscious person vomit.

Personal Protective Methods: Wear protective gloves and clothing to prevent any reasonable probability of dermal and/or eye contact. Safety equipment suppliers/manufacturers can provide recommendations on the most protective glove/clothing material for your operation. All protective clothing (suits, gloves, footwear, headgear) should be clean, available each day, and put on before work. Contact lenses should not be worn when working with this chemical. Wear dust-proof chemical goggles and face shield unless full facepiece respiratory protection is worn. Employees should wash immediately with soap when skin is wet or contaminated. Provide emergency showers and eyewash.

Respirator Selection: SCBA >0.15 mg/m^3. NIOSH: Up to 0.25 mg/m^3: Qm (APF = 25) (any quarter-mask respirator). *Up to 0.5 mg/m^3:* 95QX [any particulate respirator equipped with an N95, R95, or P95 filter (including N95, R95, and P95 filtering face-pieces) except quarter-mask respirators. The following filters may also be used: N99, R99, P99, N100, R100, P100]; or Sa (APF = 10) (any supplied-air respirator). *Up to 1.25 mg/m^3:* Sa:Cf (APF = 25) (any supplied-air respirator operated in a continuous-flow mode); or PaprHie (APF = 25) (any powered, air-purifying respirator with a high-efficiency particulate filter). *Up to 2.5 mg/m^3:* 100SaT (100 F (APF = 50) (any air-purifying, full facepiece respirator with an N100, R100, or P100 filter); or SaT: Cf (APF = 50) (any supplied-air respirator that has a tight-fitting face-piece and is operated in a continuous-flow mode); or PaprTHie (APF = 50) (any powered, air-purifying respirator with a tight-fitting face-piece and a high-efficiency particulate filter); or SCBAF (APF = 50) (any self-contained breathing apparatus with a full facepiece); or SaF (APF = 50) (any supplied-air respirator with a full facepiece). *Emergency or planned entry into unknown concentrations or IDLH conditions:* SCBAF: Pd,Pp (APF = 10,000) (any NIOSH/MSHA- or European Standard EN 149-approved self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode); or SaF: Pd,Pp: ASCBA (APF = 10,000) (any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary, self-contained breathing apparatus operated in a pressure-demand or other positive-pressure mode). *Escape:* 100 F (APF = 50) 100 F (APF = 50) (any air-purifying, full facepiece respirator with and N100, R100, or P100 filter); or SCBAE (any appropriate escape-type, self-contained breathing apparatus).

Storage: Color Code-Blue: Health Hazard/Poison: Store in a secure poison location. Prior to working with this chemical you should be trained on its proper handling and storage. Where possible, automatically transfer material from drums or other storage containers to process containers. If this material contains a flammable carrier, sources of ignition, such as smoking and open flames, are prohibited where this chemical is handled, used, or stored. Metal containers involving the transfer of this chemical should be grounded and bonded. Wherever this chemical is used, handled, manufactured, or stored, use explosion-proof electrical equipment and fittings. Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: Sodium fluorosilicate requires a shipping label of "poisonous materials." It falls in Hazard Class 6.1.

Spill Handling: Evacuate persons not wearing protective equipment from area of spill or leak until clean up is complete. Collect powdered material in the most convenient and safe manner and deposit in sealed containers. Ventilate area after clean up is complete. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable.

Fire Extinguishing: Hazardous decomposition includes oxides of sodium and carbon and hydrogen fluoride. This chemical is a noncombustible solid. Use dry chemical, carbon dioxide; water spray; or foam extinguishers. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies. From a secure, explosion-proof location, use water spray to cool exposed containers. If cooling streams are ineffective (venting sound increases in volume and pitch, tank discolors, or shows any signs of deforming), withdraw immediately to a secure position. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode.

Disposal Method Suggested: Consult with environmental regulatory agencies for guidance on acceptable disposal practices. Generators of waste containing this contaminant (≥100 kg/mo) must conform with EPA regulations governing storage, transportation, treatment, and waste disposal. In accordance with 40CFR165, follow recommendations for the disposal of pesticides and pesticide containers. Containers must be disposed of properly by following package label directions or by contacting your local or federal environmental control agency, or by contacting your regional EPA office. This compound is unstable at temperatures above 110 °C and decomposes @ 200 °C. Thus, careful incineration has been suggested as a disposal procedure. According to this procedure, the produce should be mixed with large amounts of vermiculite, sodium bicarbonate and sand-soda ash. Slaked lime should also be added to the mixture. Two incineration procedures for this mixture are suggested. The better of these procedures is to burn the mixture in a closed incinerator equipped with an afterburner and an alkali scrubber. The other procedure suggests that the mixture be covered with scrap wood and paper in an open incinerator. (The incinerator should be lighted by means of an excelsior train.)

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- Environmental Protection Agency, "Reregistration Eligibility Decision (RED), Sodium Fluoroacetate," Office of Prevention, Pesticides and Toxic Substances, Washington DC (September 1995), http://www.epa.gov/REDs/3073.pdf
- New Jersey Department of Health and Senior Services, "Hazardous Substance Fact Sheet, Sodium Fluoroacetate," Trenton, NJ (December 1997, rev. April 2000). http://www.state.nj.us/health/eoh/rtkweb/1700.pdf
- USEPA, "Chemical Profile: Sodium Fluoroacetate," Washington DC, Chemical Emergency Preparedness Program (November 30, 1987)

Sodium metaborate S:0513

Use Type: Herbicide, Insecticide, Fungicide, Nematocide

CAS Number: 7775-19-1

Formula: $NaBO_2$

Synonyms: Sodium metaborate; Monosodium metaborate; Boric acid, sodium salt; Sodium borate

Trade Names: ALLPRO BARACIDE®; ATRATOL®[C]; BAREGROUND®; MONOBOR-CHLORATE®; PRAMITOL®; TRI-KILL®; UREABOR®

Chemical class: Inorganic

EPA/OPP PC Code: 011104

California DPR Chemical Code: 689

HSDB Number: 5045

UN/NA & ERG Number: UN3077(solid)/171

RTECS® Number: ED4640000

EC Number: 231-981-6

Uses: Not listed for use in EU countries[115]. Registered for use in the U.S.

U.S. Maximum Allowable Residue Levels for residues of the pesticidal chemical boric acid and its salts, including sodium metaborate [40 CFR 180.1121]: in or on raw agricultural commodities when used as an active ingredient in insecticides, herbicides, or fungicides preharvest or postharvest in accordance with good agricultural practices. **[*40 CFR 180.940(c)*]:** Residues of sodium metaborate are exempted from the requirement of a tolerance when used in accordance with good manufacturing practice as ingredients in an antimicrobial pesticide formulation, provided that the substance is applied on a semi-permanent or permanent food-contact surface (other than being applied on food packaging) with adequate draining before contact with food. Sodium metaborate when used as ingredients in an antimicrobial pesticide formulation may be applied to food-processing equipment and utensils.

Regulatory Authority and Advisory Information:

Carcinogenicity[83]: ACGIH A4, not classified as a human carcinogen

Toxicity (oral) Category 3, CAUTION

WGK (German Aquatic Hazard Class): 3-Severe hazard to waters

Description: White lumpy solid or powder. Soluble in water. Molecular weight = 65.81; Specific gravity (H_2O:1) = 2.463 @ 20 °C; Boiling point = 1425 °C; Freezing/Melting point = 960 °C. Soluble in water.

Incompatibilities: Contact with moisture forms a basic mixture. Keep away from acids and strong oxidizers. Fuses to clear glass @ >965 °C.

Permissible Exposure Limits in Air: *Borate compounds, inorganic (including boric acid)*

OSHA PEL: None

NIOSH REL: None

ACGIH TLV®: 2 mg/m^3 TWA (inhalable fraction); 6 mg/m^3 (inhalable fraction); not classifiable as a human carcinogen.

Determination in Air: Collection on a filter and gravimetric analysis. See NIOSH Method #0500 Particulates NOR (total)[18].

Permissible Concentration in Water: Federal Drinking Water Guidelines: EPA 600 μ[B]g/L; State Drinking Water Guidelines: California 1000 μ[B]g/L; Maine 1400 μ[B]g/L; New Hampshire 630 μ[B]g/L; Minnesota 1000 μ[B]g/L; Wisconsin 960 μ[B]g/L. Runoff from spills or fire control may cause water pollution.

Routes of Entry: Ingestion, dermal exposure, inhalation, eye contact.

Harmful Effects and Symptoms

Short Term Exposure: Corrosive. Severe eye irritant. Irritates the skin and respiratory tract. High levels of ingestion and/or dermal exposures can be associated with weak, rapid pulse, cyanosis and abnormally low blood pressure. Nausea, vomiting, and diarrhea are common. The vomitus and feces may be blue-green in color. Hemorrhagic gastroenteritis can occur. Victim may encounter reduced body temperature, elevated body temperature or normal body temperature. High levels of inhalation can cause nausea, vomiting, weakness, headache, coma, death. The oral mucosa, lips and throat may turn red. Dermal contact may cause erythematous rash with desquamation (cooked lobster syndrome) to develop on the palms, soles, and buttocks along with a generalized rash. LD_{50} (oral, rat) = >2 g/kg.

Long Term Exposure: Repeated or long term exposure may cause headache, lethargy, restlessness, weakness, central nervous system irritation, and/or seizures. Borates are excreted principally by the kidneys. Based on animal studies, they may be fetotoxic, affect reproductive material and fertility, and exhibit teratogenic effects. There is insufficient information concerning the reproductive effects of borates in humans. Adverse testicular effects and infertility have been reported in animals. There have been limited animal studies which suggest decreased ovulation, fetotoxicity and developmental defects may occur with very high exposure levels. Maternal toxicity was present in some studies.

Points of Attack: Eyes, skin, respiratory system.

Medical Surveillance: Preliminary medical exam to detect chronic diseases of central nervous system, liver, heart, kidneys, lung and skin, as well as endocrinological or immunological disturbances, should protect susceptible individuals. Periodical medical exams of internal organs, skin and eyes are important to avoid chronic occupational intoxications. They should include lab and patch tests when necessary[83]. Consider the points of attack in preplacement and periodic physical examinations.

First Aid: If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least 15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately. If this chemical contacts the skin, remove contaminated clothing and wash immediately with soap and water. Seek medical attention immediately. If this chemical has been inhaled, remove from exposure, begin rescue breathing (using universal precautions) if breathing has stopped, and CPR if heart action has stopped. Transfer promptly to a medical facility. When this chemical has been swallowed, get medical attention. If victim is conscious and able to swallow, have victim drink 4 to 8 ounces of water. Do not induce vomiting. *Note to physician or authorized medical personnel*: Medical observation is recommended for 24 to 48 hours following breathing overexposure, as pulmonary edema may be delayed. As first aid for pulmonary edema, a doctor or authorized paramedic might consider administering a corticosteroid spray. Cigarette smoking may exacerbate pulmonary injury and should be discouraged for at least 72 hours following exposure.

Personal Protective Methods: Exposed workers should be educated in the proper use of protective equipment and there should be strict adherence to ventilating provisions in work areas. Workers involved with the manufacture of boric acid should be provided with masks to prevent inhalation of dust and fumes. Wear impervious gloves: recommended gloves include Butyl rubber, Neoprene, Viton™.

Respirator Selection: A respiratory protection program that meets OSHA's Respiratory Protection Standard 29 CFR 1910.134 requirements or European Standard EN 149 must be followed whenever workplace conditions warrant a respirator's use. Oxygen levels below 19.5% are considered IDLH by NIOSH/OSHA and require use of a full facepiece pressure/demand SCBA; or, a full facepiece, supplied-air respirator with auxiliary self-contained air supply is required under 1910.134-1998.

Storage: Color Code-White: Corrosive or Contact Hazard; Store separately in a corrosion-resistant location. Prior to working with this chemical you should be trained on its proper handling and storage. Store in tightly closed containers in a cool, well-ventilated area away from incompatible materials listed above. Metal containers involving the transfer of this chemical should be grounded and bonded. Drums must be equipped with self-closing valves, pressure vacuum bungs, and flame arresters. Use only non-sparking tools and equipment, especially when opening and closing containers of this chemical. If this material contains a flammable carrier, sources of ignition, such as smoking and open flames, are prohibited where this chemical is used, handled, or stored in a manner that could create a potential fire or explosion hazard. Wherever this chemical is used, handled, manufactured, or stored, use explosion-proof electrical equipment and fittings. Store urea in a refrigerator and and protect it from moisture. Keep away from strong oxidizers, chlorine, permanganates, dichromates, nitrites, inorganic chlorides, chlorites, perchlorates; hypochlorites can form explosive compounds. Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: Environmentally hazardous substances, solid or liquid, usually fall in Hazard Class 9. Consult 49CFR, or appropriate Dangerous Goods Regulations, for additional description requirements (e.g., technical name) and mode-specific or quantity-specific shipping requirements.

Spill Handling: Evacuate and restrict persons not wearing protective equipment from area of spill or leak until clean up is complete. The material may be dampened with water to avoid dust and than transferred to a sealed container for disposal. Ventilate area of spill or leak after clean up is complete. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable.

Fire Extinguishing: Hazardous decomposition includes boron and oxides of sodium. As an immediate precautionary measure, isolate spill or leak area in all directions for at least 50 meters/150 feet for liquids and at least 25 meters/75 feet for solids. *Fire involving storage or vehicular tanks:* isolate for 800 meters/0.5 mile in all directions; also, consider initial evacuation for 800 meters /0.5 mile) in all directions. *On a small fire:* use dry chemical, CO_2, water spray or regular foam. *On a large fire:* use water spray, fog or regular foam. Do not scatter spilled material with high-pressure streams of water. Move containers from fire area if you can do it without risk. Dike fire-control water for later disposal. *Fire involving tanks:* from a secure, explosion-proof location, use water spray to cool exposed containers. If cooling streams are ineffective (venting sound increases in volume and pitch, tank discolors, or shows any signs of deforming), withdraw immediately to a secure position. Always stay away from tanks engulfed in fire. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode.

Disposal Method Suggested: Boric acids may be recovered from organic process wastes as an alternative to disposal.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- Sax, N. I., Ed., "*Dangerous Properties of Industrial Materials Report*" 2, No. 6, 76–78 (1982) (Sodium Borate)
- Sittig, Marshall (ed.), Pesticide Manufacturing and Toxic Materials Control Encyclopedia, Noyes Data Corporation, page 672, Park Ridge, NJ (1980)
- Harper, B.; Gervais, J. A.; Buhl, K.; Stone, D., *Boric Acid Technical Fact Sheet*; National Pesticide Information Center, Oregon State University Extension Services, Corvallis, OR (2012)

Sodium methanearsonate S:0516

Use Type: Herbicide, Defoliant

CAS Number: 2163-80-6; 5967-62-4 (hexahydrate)

Formula: CH_4AsNaO_3

Synonyms: Arsonic acid, methyl-, monosodium salt; Disodium methane arsonate; DSMA; Disodium methyl arsonate; Methanearsonic acid, monosodium salt; Methylarsonic acid, monosodium salt; Monosodium acid methanearsonate; Monosodium methane arsonate; MSMA; Monosodium methyl arsonate; Superarsonate

Trade Names: ANSAR®; ARSANOTE® Liquid[C]; ASAZOL BUENO®; DACONATE®; DICONATE 6®; DIUMATE®; DREXAR®-530; EH 1143; FERTI-LOME; HERB-ALL®; HERBAN M®; KACK®; MAGMA®; MERGE®; MESAMATE®; MONATE®; MONATE® Merge 823; NUTGRASS KILLER®; PHYBAN®; PHYBAN H. C. ®; QUADMEC; RED PANTHER®; RIVERDALE®; RIVERSIDE®; SELECT-KIL®; SILVISAR®; SILVISAR-550®; TARGET MSMA®; TRANS-VERT®; VERSAR®; WEED-108®; WEED-BROOM® (DSMA+Bomacil+2,4-D); WEED-E-RAD®; WEED-S-RAD®; WEED HOE®

Chemical class: Organoarsenic

EPA/OPP PC Code: 013803

California DPR Chemical Code: 34

HSDB Number: 754

UN/NA & ERG Number: UN2994 (liquid)/151

RTECS® Number: PA2625000

EC Number: 218-495-9

Uses: MSMA is used extensively as a selective post-emergence herbicide to control grassy weeds in cotton crops, in non-agricultural areas and in industrial applications. Not listed for use in EU countries[115]. Registered for use in the U.S.

U.S. Maximum Allowable Residue Levels for total residues of combined arsenic (calculated as As) [21 CFR 556.60]: in food are established as follows: (a) In edible tissues and in eggs of chickens and turkeys: in uncooked muscle tissue 0.5 ppm; in uncooked edible byproducts 2 ppm; in eggs 0.5 ppm. (b) In edible tissues of swine: in uncooked liver and kidney 2 ppm; in uncooked muscle tissue and byproducts other than liver and kidney 0.5 ppm.

Human toxicity (long-term)[101]: Low–70.00 ppb, Health Advisory

Fish toxicity (threshold)[101]: Very low–1936.86508 ppb, MATC (Maximum Acceptable Toxicant Concentration)

Regulatory Authority and Advisory Information:

Carcinogenicity[83]: EPA, Not likely to be a human carcinogen

Health Advisory: Nerve Toxin (S!); Endocrine disruptor (S!): *as arsenic*, Mutagen, Skin irritant/sensitizer

Acute Oral Category: 3, CAUTION

Clean Air Act: Hazardous Air Pollutants (Title I, Part A, Section 112) as arsenic compounds

Clean Water Act: Toxic Pollutant (Section 401.15) as arsenic and compounds

RCRA Section 261 Hazardous Constituents, waste number D004

EPCRA Section 304 RQ: CERCLA, 1 lb (0.454 kg)

EPCRA (Section 313): Includes any unique chemical substance that contains arsenic as part of that chemical's infrastructure. Form R *de minimis* concentration reporting level: as organic arsenic compounds, 1.0%

Marine pollutant (49CFR, Subchapter 172.101, Appendix B) as arsenates

Description: Colorless crystalline solid. The solution may be yellow or dyed red or green. Odorless. Solid may float or sink in water; solid and solution are highly soluble in water. Molecular weight = 161.95; 162; 292 (hexahydrate); Specific gravity: 1.0 @ 20 °C (solid); 1.4–1.6 @ 20 °C (solutions) Boiling point = (decomposes); Freezing/Melting point = 135 °C; 133–138 °C (hexahydrate);. Hazard Identification (based on NFPA-704 M Rating System): Health Hazards (Blue): 1; Flammability (Red): 1; Reactivity (Yellow): 0.

Permissible Exposure Limits in Air: *arsenic, organic compounds*

OSHA PEL: 0.5 mg[As]/m^3 TWA

ACGIH TLV®[1]: 0.01 mg[As]/m^3 TWA; Confirmed Human Carcinogen; Biological Exposure Index (BEI): Determinant: Inorganic arsenic plus methylated metabolites in urine; Sampling Time: end of workweek; BEI = 35 μg[As]/L. The determinant may be present in biological specimens collected from subjects who have not been occupationally exposed, at a concentration which could affect interpretation of the result. Such background concentrations are incorporated in the BEI value.

NIOSH IDLH: 5 mg[As]/m^3

Determination in Air: Filter; Reagent: Ion chromatography/hydride atomic absorption: NIOSH IV [#5022, Arsenic, organo-][18].

Permissible Concentration in Water: Federal Drinking Water Guidelines: EPA 10 μg/L; State Drinking Water Guidelines: Arizona 10 μg/L; Connecticut 10 μg/L. Runoff from spills or fire control may cause water pollution. Federal Drinking Water Guidelines: EPA 10 μg/L; State Drinking Water Guidelines: Arizona 10 μg/L; Connecticut 10 μg/L.

Determination in Water: See OSHA Method ID-105 for arsenic. Log K_{ow} = negative. Unlikely to bioaccumulate in marine organisms.

Routes of Entry: Inhalation, ingestion, skin and/or eye contact.

Harmful Effects and Symptoms

Short Term Exposure: May cause irritation of the skin, eyes and respiratory tract; pulmonary edema and respiratory failure may develop in severe poisonings from inhalation. Ingestion can cause abdominal pain, severe vomiting and diarrhea, as well as dryness of the oral and nasal cavities. Commons signs of acute arsenic poisoning include abnormally low blood pressure, rapid heart rate and breathing, fever. This may be complicated by altered mental status, seizures, toxic delirium, encephalopathy, and delayed peripheral neuropathy. LD_{50} (oral, rat) = 700–900 mg/kg; LD_{50} (dermal, rabbit) = >2.5 g/kg.

Long Term Exposure: Repeated contact may cause skin sensitivity. Chronic exposure to arsenic compounds can cause dermatitis and digestive disorders, and elevated blood pressure. Renal damage may develop. In animals: kidney damage, muscle tremor, seizure, possible gastrointestinal tract, reproductive effects, possible liver damage.

Points of Attack: Arsenic may cause skin damage or problems with circulatory systems, and may increase the risk of getting cancer. This chemical may attack gastrointestinal tract, particularly the large intestine, and the kidney. Also may affect liver.

Medical Surveillance: Preliminary medical exam to detect chronic diseases of central nervous system, liver, heart, kidneys, lung and skin, as well as endocrinological or immunological disturbances, should protect susceptible individuals. Periodical medical exams of internal organs, skin and eyes are important to avoid chronic occupational intoxications. They should include lab and patch tests when necessary[83]. Kidney function tests. Evaluation by a qualified allergist, including exposure history and testing, may help diagnose allergy. Kidney, liver, lung function tests. Consider chest x-ray following acute overexposure.

First Aid: If artificial respiration is administered, *avoid mouth-to-mouth resuscitation; use bag/mask apparatus*. Solid or solution: Irritating to skin and eyes. If swallowed, will cause nausea, vomiting, or loss of consciousness. Remove contaminated clothing and shoes. Flush affected areas with plenty of water. If in eyes, hold eyelids open and flush with plenty of water. If swallowed and victim is conscious and able to swallow, have victim drink 4 to 8 ounces of water and have victim induce vomiting. If swallowed and victim is unconscious or having convulsions, do nothing except keep victim warm.

Personal Protective Methods: Wear protective gloves and clothing to prevent any reasonable probability of dermal and/or eye contact. Safety equipment suppliers/manufacturers can provide recommendations on the most protective glove/clothing material for your operation. All protective clothing (suits, gloves, footwear, headgear) should be clean, available each day, and put on before work. Contact lenses should not be worn when working with this chemical. Wear dust-proof chemical goggles and face shield unless full facepiece respiratory protection is worn. Employees should wash immediately with soap when skin is wet or contaminated. Provide emergency showers and eyewash. Specific engineering controls are required under OSHA 1910.1018*, Inorganic Arsenic.* See also NIOSH Criteria Document #75–149, *"Inorganic Arsenic."*

Respirator Selection: SCBA >2 mg/m^3 *At concentrations above the NIOSH REL, or where there is no REL, at any detectable concentration:* Sa (APF = 10) (any supplied-air respirator); or SCBAF (APF = 50) (any self-contained breathing apparatus with a full facepiece). *Emergency or planned entry into unknown concentrations or IDLH conditions:* SCBAF: Pd,Pp (APF = 10,000) (any self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode); or SaF: Pd,Pp: ASCBA (APF = 10,000) (any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary, self-contained breathing apparatus operated in a pressure-demand or other positive-pressure mode). *Escape:* GmFAg100 (APF = 50) [any air-purifying, full facepiece respirator (gas mask) with a chin-style, front- or back-mounted acid gas canister having an N100, R100, or P100 filter]; or SCBAE (any appropriate escape-type, self-contained breathing apparatus).

Storage: Color Code-Blue: Health Hazard/Poison: Store in a secure poison location. Prior to working with sodium methane arsenate you should be trained on its proper handling and storage. Store in tightly closed containers in a cool, well-ventilated area. A regulated, marked area should be established where this chemical is handled, used, or stored in compliance with OSHA Standard 1910.1045. Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: Arsenical pesticides, liquid, toxic are labeled "poisonous materials" and fall into Hazard Class 6.1.

Spill Handling: First remove all sources of ignition. Evacuate persons not wearing protective equipment from area of spill or leak until clean up is complete. Collect powdered material in the most convenient and safe manner and deposit in sealed containers. Ventilate area after clean up is complete. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable.

Fire Extinguishing: Hazardous decomposition includes arsine, and oxides of arsenic and carbon. *On a small fire:* use dry chemical, CO_2 or water spray. *On a large fire:* use water spray, fog or regular foam. Move containers from fire area if you can do it without risk. Dike fire-control water for later disposal; do not scatter the material. Use water spray or fog; do not use straight streams. *Fire involving storage or vehicular tanks:* isolate for 800 meters/0.5 mile in all directions; also, consider initial evacuation for 800 meters/0.5 mile in all directions: fight fire from maximum distance or use unmanned hose holders or monitor nozzles. Do not get water inside containers. Cool containers with flooding quantities of water until well after fire is out. Withdraw immediately in the case of rising sound from venting safety devices or discoloration of tank. ALWAYS stay away from tanks engulfed in fire. For massive fire, use unmanned hose holders or monitor nozzles; if this is impossible, withdraw from area and let fire burn. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies.

Disposal Method Suggested: Do not discharge into drains or sewers. Dispose of waste material as hazardous waste using a licensed disposal contractor to an approved landfill. Consult with environmental regulatory agencies for guidance on acceptable disposal practices. If allowed, incineration with effluent gas scrubbing is recommended. Containers must be disposed of properly by following package label directions or by contacting your local or federal environmental control agency, or by contacting your regional EPA office. Chemical Treatability of Arsenic–(1) Concentration Process: Chemical Precipitation; Chemical Classification: Metal; Scale of Study: Pilot Scale; Type of Wastewater Used: Domestic Wastewater + Pure Compound; Results of Study: 5 ppm @ 4 gpm @ pH = 7.0. Iron system–90% reduction; low lime system–80% reduction; high lime system–76% reduction; (three coagulant systems were used; Iron system used 45 ppm as Fe of $Fe_2(SO_4)_3$ @ pH = 6.0. Low lime system used 20 ppm Fe of $Fe_2(SO_4)_3$ and 260 ppm of CaO @ pH = 10.0. High lime system used 600 ppm of CaO @ pH = 11.5. Chemical coagulation was followed by multimedia filtration). (2) Concentration Process: Chemical Precipitation; Chemical Classification: Metal; Scale of Study: Full Scale Continuous Flow; Type of Wastewater Used: Domestic Wastewater; Results of Study: Effluent character (ppb): 2.5, 56% reduction with lime; 3.3, 24% reduction with lime; (lime dose of 350–400 ppm as calcium oxide @ pH = 11.3)[83].

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- International Programme on Chemical Safety (IPCS), "Health and Safety Guide, Dimethyarseinic Acid, Methanearsonic Acid, and Salts," Geneva, Switzerland (1992). http://www.inchem.org/documents/hsg/hsg/hsg69.htm#PartNumber:1
- USEPA, Office of Prevention, and Toxic Substances, *Revised Reregistration Eligibility Decision for MSMA, DSMA, CAMA, and Cacodylic Acid*, EPA 738-R-06–021. Washington DC (August 10, 2006)

Strychnine S:0650

Use Type: Rodenticide, Avicide

CAS Number: 57-24-9; 60-41-3 (sulfate)

Formula: $C_{21}H_{22}N_2O_2$

Synonyms: Estricnina (Spanish); Strychnidin-10-One; Strychnos

Trade Names: BOOMER-RID®; CERTOX®; DOLCO MOUSE CEREAL®; GOPHER BAIT®; GOPHER-GETTER®; GOPHER-GO AG BAIT®; HARE-RID®; KWIK-KIL®; MOLE DEATH®; MOUSE-NOTS®; MOUSE-RID®; MOUSE-TOX®; NUX VOMICA®; PIED PIPER MOUSE SEED® (strychnine); RO-DEX®; SANASEED®

Chemical class: Alkaloid; Botanical

EPA/OPP PC Code: 076901

California DPR Chemical Code: 554

HSDB Number: 2001

UN/NA & ERG Number: UN1692/151

RTECS® Number: WL2275000; WL255000 (sulfate)

EC Number: 200-319-7 [*Annex I Index No.:* 614-003-00-5]; 200-477-7 (sulfate)

Uses: Strychnine products are allowed for use only below ground where exposure to food and feed crops is not expected. It can be used in orchards, feed crop sites, pastures, range land, alfalfa fields, irrigation systems, non-agriculture rights-of-way, forests, and residential sites. Pocket gophers are primary targets. Not listed for use in EU countries[115]. A U.S. EPA restricted Use Pesticide (RUP).

Regulatory Authority and Advisory Information:

Toxicity (oral) Category 1, DANGER–POISON

Health Advisory: Reproductive Toxin

Clean Water Act: Section 311 Hazardous Substances/RQ 40CFR117.3 (same as CERCLA, see below)

EPA Hazardous Waste Number (RCRA No.): P108

Superfund/EPCRA 302 Extremely Hazardous Substances: TPQ = 100/10,000 lb (45.4/4,540 kg)

Superfund/EPCRA 40CFR302.4 RQ: CERCLA, 10 lb (4.54 kg)

EPCRA Section 313 Form R *de minimis* concentration reporting level: 1.0%

U.S. DOT Regulated Marine Pollutant (49CFR172.101, Appendix B)

European/International Regulations *(Strychnine and salts)*: Hazard Symbol: T+, N; risk phrases: R27/28; R50/53; safety phrases: S1/2; S36/37; S45; S60; S61 (see Appendix 1)

Description: White crystalline prisms or white powder. Sprays may be dissolved in xylene or kerosene. Very bitter taste. Molecular weight = 334.41; 383.49 (sulfate); Specific gravity (H_2O:1) = 1.36 @ 20 °C (same for sulfate); Boiling point = (decomposes) 270 °C @ 5 mbar; 560 °C; Freezing/Melting point = 285–287 °C; 200 °C sulfate; Vapor pressure = 1.2×10^{-14} mmHg @ 25 °C; (sulfate) 1×10^{-8} mmHg @ 25 °C;. Hazard Identification (based on NFPA-704 M Rating System): Health 4, Flammability 0, Reactivity 0. Practically insoluble in water; solubility = 140 ppm @ 22 °C. The sulfate is slightly more soluble.

Determination in Water: Log K_{ow} = <2.0. Unlikely to bioaccumulate in marine organisms.

Incompatibilities: Strong oxidizers. Dangerous when heated.

Permissible Exposure Limits in Air: NIOSH IDLH: 3 mg/m^3

OSHA PEL: 0.15 mg/m^3 TWA

NIOSH REL: 0.15 mg/m^3 TWA

ACGIH TLV®[1]: 0.15 mg/m^3 TWA; Excursion Limit Recommendation: Excursions in worker exposure levels may exceed 3 times the TLV-TWA for no more than a total of 30 minutes during a work day, and under no circumstances should they exceed 5 times the TLV-TWA, provided that the TLV-TWA is not exceeded.

Protective Action Criteria (PAC) Ver. 27[89]
PAC-1: 0.15 mg/m^3
PAC-2: 0.3 mg/m^3
PAC-3: 3 mg/m^3

sulfate
PAC-1: 0.45 mg/m^3 Ver. 27[89]
PAC-2: 5 mg/m^3
PAC-3: 40 mg/m^3

Determination in Air: Filter; Reagent; High-pressure liquid chromatography/Ultraviolet detection; NIOSH IV, Method #5016[18].

Permissible Concentration in Water: Runoff from spills or fire control may cause water pollution.

Routes of Entry: Inhalation of dust, ingestion, skin and/or eye contact.

Harmful Effects and Symptoms

Short Term Exposure: Affects the central nervous system, causing convulsions, muscle contractions, and respiratory failure. It causes violent generalized convulsions. Death results from respiratory arrest as the respiratory muscles are in sustained spasm. The lowest lethal oral dose reported for humans if 30 mg/kg. Respiratory paralysis and arrest are likely to occur following severe exposure to strychnine. Signs and symptoms of acute exposure generally involve excitation of all portions of the central nervous system. Convulsions, bilateral horizontal nystagmus (rapid, synchronous, horizontal, oscillations of the eyeballs), agitation, restlessness, apprehension, and abrupt, jerking movements of the extremities may occur. Victims may also experience stiffness, painful muscle cramping (especially in the legs), and opisthotonos (spasm in which the spine and extremities are bent with convexity forward, the body resting on the head and heels). Vomiting and renal failure, as well as cyanosis (blue tint to skin and mucous membranes) and rhabdomyolysis (destruction of skeletal muscle), may be found. LD_{50} (oral, man) = 30 mg/kg; LD_{50} (oral, rat) = >2000 μg/kg[9].

Long Term Exposure: Chronic allergen if inhaled or ingested.

Points of Attack: Central nervous system.

Medical Surveillance: Consider the points of attack in preplacement and periodic physical examinations. Examination by a qualified allergist.

First Aid: Remove victims from exposure. Emergency personnel should avoid self-exposure to strychnine. *Warning:* Any unnecessary sensory input may induce seizures. Isolate the victims from any avoidable distractions. Rush to a health care facility! Evaluate vital signs including pulse and respiratory rate, and note any trauma. If no pulse is detected, provide CPR. If not breathing, provide artificial respiration. If breathing is labored, administer oxygen or other respiratory support. Remove contaminated clothing as soon as possible. If eye exposure has occurred, remove any contact lenses at once; eyes must be flushed with lukewarm water for at least 15 minutes. Wash exposed skin areas thoroughly with soap and water. Obtain authorization and/or further instructions from the local hospital for administration of an antidote or performance of other invasive procedure.

Respirator Selection: Wherever and whenever workplace conditions warrant respirator use, a respiratory protection program must be followed that meets one or more of the following government standards: OSHA's 29 CFR 1910.134, ANSI Z88.2, or European Standard EN 149.

Storage: Color Code-Blue: Health Hazard/Poison. Store in a secure poison location. Prior to working with this chemical you should be trained on its proper handling and storage. Store in tightly closed containers in a cool, well-ventilated area. Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: This material is a toxic pesticide and should be labeled “poisonous materials.” It falls into Hazard Class 6.1. PG I. STN: 49 214 77 (solid); 49 214 78 (salt, solid).

Spill Handling: First remove all sources of ignition.

Evacuate persons not wearing protective equipment from area of spill or leak until clean up is complete. Ventilate area of spill or leak. Use water spray to reduce vapor. Absorb liquids in vermiculite, dry sand, earth, or a similar material and deposit in sealed containers. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable.

Fire Extinguishing: Toxic oxides of nitrogen are released in fire. Use dry chemical, carbon dioxide; or alcohol-resistant foam extinguishers. Vapors are heavier than air and will collect in low areas. Vapors may travel long distances to ignition sources and flashback. Vapors in confined areas may explode when exposed to fire. Storage containers and parts of containers may rocket great distances, in many directions. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies. From a secure, explosion-proof location, use water spray to cool exposed containers. If cooling streams are ineffective (venting sound increases in volume and pitch, tank discolors, or shows any signs of deforming), withdraw immediately to a secure position. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode.

Disposal Method Suggested: Incineration. In accordance with 40CFR165. Do not discharge into drains or sewers. Consult with environmental regulatory agencies for guidance on acceptable disposal practices. Generators of waste containing this contaminant (≥100 kg/mo) must conform with EPA regulations governing storage, transportation, treatment, and waste disposal. Incineration with effluent gas scrubbing is recommended. Containers must be disposed of properly by following package label directions or by contacting your local or federal environmental control agency, or by contacting your regional EPA office.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- USEPA, "Reregistration Eligibility Decision (RED), Strychnine," Office of Prevention, Pesticides and Toxic Substances, Washington DC (July 1996). http://www.epa.gov/REDs/3133.pdf
- New Jersey Department of Health and Senior Services, "Hazardous Substance Fact sheet, Strychnine," Trenton, NJ (April 2002). http://www.state.nj.us/health/eoh/rtkweb/1747.pdf
- Sax, N. I., Ed., "Dangerous Properties of Industrial Materials Report," 2, No. 2, 63–65 (1982) and 8, No. 1, 78-83 (1988)
- USEPA, "Chemical Profile: Strychnine," Washington DC, Chemical Emergency Preparedness Program (November 30, 1987)
- USEPA, "Chemical Profile: Strychnine Sulfate," Washington DC, Chemical Emergency Preparedness Program (November 30, 1987)

Sulfentrazone S:0705

Use Type: Herbicide

CAS Number: 122836-35-5

Formula: $C_{11}H_{10}Cl_2F_2N_4O_3S$

Synonyms: 1-(2,4-Dichloro-5-methylsulfonylamidophenyl)-4-difluoromethyl-4,5-dihydro-3-methyl-1*H*-1,2,4-triazol-5-one; 2-(2,4-Dichloro-5-methylsulfonylamidophenyl)-4-difluoromethyl-2,4-dihydro-5-methyl-3*H*-1,2,4-triazol-3-one; 1-[2,4-Dichloro-5-(N^2-methylsulfonylamino)phenyl]-3-methyl-4-difluoromethyl-Δ^2-1,2,4-triazolin-5-one; Methanesulfonamide, *N*-[2,4-dichloro-5-(4-(difluoromethyl)-4,5-dihydro-3-methyl-5-*oxo*-1*H*-1,2,4-triazol-1-yl) phenyl]-

Trade Names: AUTHORITY® Sulfentrazone; CANOPY XL®; COVER®; F6285®; FMC® 97285; GAUNTLET®; SPARTAN®; SULFENTRAZONE® (F6285) 4F; SULFENTRAZONE® (F6285) 75DF

Chemical class: Triazolone; Aryl Triazolinone

EPA/OPP PC Code: 129081

California DPR Chemical Code: 5923

HSDB Number: 7014

UN/NA & ERG Number: UN3077 (solid)/171; UN3082(liquid)/171

RTECS® Number: PB0475010

EC Number: 602-896-4

Uses: Pre-emergence or pre-plant weed control on various products for the control of broadleaf and grass weed species in sugarcane, soybean, tobacco, and some turfgrass species. Registered for use in the U.S. Not listed for use in EU countries[115].

U.S. Maximum Allowable Residue Levels for Sulfentrazone and its major metabolite 3-hydroxymethyl sulfentrazone N-(2,4-dichloro-5-(4-(difluoromethyl)-4,5-dihydro-3-hydroxymethyl-5-oxo-1H-1,2,4-triazol-1-yl)phenyl)methanesulfonamide [40CFR 180.498(a)]: in or on the following raw agricultural commodity: soybean, seed: 0.05 ppm. ***Tolerances are established for inadvertent and indirect combined residues of sulfentrazone and its metabolites 3-hydroxymethyl sulfentrazone N-[2,4-dichloro-5-(4-(difluoromethyl)-4,5-dihydro-3-hydroxymethyl-5-oxo-1H-1,2,4-triazol-1-yl)phenyl)methanesulfonamide and 3-desmethyl sulfentrazone N-(2,4-dichloro-5-(4-(difluoromethyl)-4,5-dihydro-5-oxo-1H-1,2,4-triazol-1-yl)ph enyl)methanesulfonamide) [40CFR 180.498(d)]:*** in or on the following raw agricultural commodities when present therein as a result of the application of sulfentrazone to growing crops: cereal grains (excluding sweet corn), bran 0.15 ppm; cereal grains (excluding sweet corn), forage 0.2 ppm; cereal grains (excluding sweet corn), grain 0.1 ppm; cereal grains (excluding sweet corn), hay 0.2 ppm; cereal grains (excluding sweet corn), hulls 0.30 ppm; cereal grains (excluding sweet corn), stover 0.1 ppm; and cereal grains (excluding sweet corn), straw 0.6 ppm.

Regulatory Authority and Advisory Information:

Carcinogenicity[83]: EPA Group E, evidence of non-carcinogenicity for human

Toxicity (oral) Category 3, CAUTION

Description: Tan solid or powder. Faint must, sulfur-like odor; Molecular weight = 387.19; Specific gravity (H_2O:1) = 1.33 @ 20 °C; Boiling point = (decomposes) 465 °C; Freezing/Melting point = 121–122 °C; Vapor pressure = 5.5×10^{-9} mmHg @ 25 °C; Flash point = >200 °C. Soluble in water.

Incompatibilities: May react with strong oxidizers such as chlorates, peroxides, nitrates, etc. Dust may form explosive mixture with air.

Permissible Concentration in Water: Federal Drinking Water Standards: EPA 4000 μg[Fl]/L; Federal Drinking Water Guidelines: EPA 2000 μg[Fl]/L; State Drinking Water Standards: California 2000 μg[Fl]/L; Delaware 2000 μg[Fl]/L; State Drinking Water Guidelines: Arizona 4000 μg[Fl]/L; Maine 1680 μg[Fl]/L. Runoff from spills or fire control may cause water pollution.

Determination in Water: Log K_{ow} = ~ 1. Unlikely to bioaccumulate in marine organisms.

Routes of Entry: Inhalation, passing through the skin, ingestion.

Harmful Effects and Symptoms

Short Term Exposure: May cause skin and severe eye irritation. Moderately poisonous if ingested or inhaled. LD_{50} (oral, rat) = >2.5 g/kg; LD_{50} (dermal, rat) = >2 g/kg[83].

Long Term Exposure: Fluorides may cause bone disease (pain and tenderness of the bones); mottled teeth in children. May cause lung irritation and damage. May cause skin allergy. Contact with some triazine compounds may increase risks of tumors known to be associated with hormonal factors. These have been observed in both animals and human beings, and are consistent with the known effects on the hypothalamic pituitary gonadal axis. Repeated exposure may cause weight loss and reduced red blood cell count. May be mutagenic.

Points of Attack: Liver, lungs, skin, blood, skeletal system, teeth. May affect fetus.

Medical Surveillance: Preliminary medical exam to detect chronic diseases of central nervous system, liver, heart, kidneys, lung and skin, as well as endocrinological or immunological disturbances, should protect susceptible individuals. Periodical medical exams of internal organs, skin and eyes are important to avoid chronic occupational intoxications. They should include lab and patch tests when necessary[83]. Before beginning employment and at regular times after that, for those with frequent or potentially high exposures, the following is recommended: Lung function tests. Consider chest x-ray following acute overexposure. Evaluation by a qualified allergist. Examination of the nervous system.

First Aid: If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least 15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately. If this chemical contacts the skin, remove contaminated clothing and wash immediately with soap and water. Seek medical attention immediately. If this chemical has been inhaled, remove from exposure, begin rescue breathing (using universal precautions) if breathing has stopped, and CPR if heart action has stopped. Transfer promptly to a medical facility. When this chemical has been swallowed, get medical attention. Give large quantities of water or milk and induce vomiting. Do not make an unconscious person vomit.

Personal Protective Methods: Applicators and other handlers must wear: Coveralls worn over long-sleeved shirt and long pants; Chemical-resistant gloves such as DuPont™ Tychem® suit fabrics, barrier laminate, or Viton®; Chemical-resistant footwear plus socks; Protective eye wear; Chemical-resistant headgear for overhead exposure; Chemical-resistant apron when cleaning equipment, mixing, or loading[83]. Agricultural Use/Engineering Controls: When handlers use closed systems, enclosed cabs, or aircraft in a manner that meets the requirements listed in the Worker Protection Standard (WPS) for agricultural pesticides, 40 CFR 170.240(d)(4-6), the handler PPE requirements may be reduced or modified as specified in the Worker Protection Standard. Firefighters should wear NIOSH-approved self-contained breathing apparatus and full protective clothing.

Respirator Selection: Wherever and whenever workplace conditions warrant respirator use, a respiratory protection program must be followed that meets one or more of the following government standards: OSHA's 29 CFR 1910.134, ANSI Z88.2, or European Standard EN 149.

Storage: Color Code-Blue: Health Hazard/Poison: Store in a tightly closed container in a dry, well-ventilated and secure poison location. Prior to working with this chemical you should be trained on its proper handling and storage. Where possible, automatically transfer material from other storage containers to process containers.

Shipping: Environmentally hazardous substances, solid or liquid, usually fall in Hazard Class 9.

Spill Handling: Evacuate and restrict persons not wearing protective equipment from area of spill or leak until clean up is complete. Ventilate area of spill or leak. Absorb liquids in vermiculite, dry sand, earth, peat, carbon, or a similar material and deposit in sealed containers. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable.

Fire Extinguishing: Hazardous decomposition includes oxides of nitrogen, carbon and sulfur and hydrogen chloride and hydrogen fluoride gases. This chemical is partially combustible; it may burn but does not easily ignite; may support combustion at high temperatures. Use dry chemical powder extinguishers, foam, carbon dioxide. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies. From a secure, explosion-proof location, use water spray to cool exposed containers. If cooling streams are ineffective (venting sound increases in volume and pitch, tank discolors, or shows any signs of deforming), withdraw immediately to a secure position. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode.

Disposal Method Suggested: Containers must be disposed of properly by following package label directions or by contacting your local or federal environmental control agency, or by contacting your regional EPA office. If this material cannot be disposed of according to label instructions, it may be dissolved or mixed with a combustible solvent and burned in a chemical incinerator equipped with an afterburner and scrubber. In accordance with 40CFR165, follow recommendations for the disposal of pesticides and pesticide containers.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- USEPA, Office of Pesticide Programs, Pesticide Residue Limits, "Sulfentrazone," 40 CFR 180.498. http://www.epa.gov/pesticides/food/viewtols.htm
- USEPA, Office of Pesticide Programs, "Pesticide Fact Sheet, Sulfentrazone" (February 27, 1997). http://www.epa.gov/opprd001/factsheets/sulfentrazone.pdf
- Pohanish, R. P., "Rapid Guide to Hazardous Chemicals in the Environment," Van Nostrand Reinhold, New York, NY (1997)

Sulfluramid S:0708

Use Type: Insecticide, Acaricide, Termiticide

CAS Number: 4151-50-2

Formula: $C_{10}H_6F_{17}NO_2S$

Synonyms: *N*-Ethylperfluorooctanesulfonamide; 1-Octane sulfonamide, *N*-ethyl-1,1,2,2,3,3,4,4,5,5,6,6,7,7,8,8,8-heptadecafluoro-

Trade Names: FINITRON®; FIRSTLINE®; FLUORGUARD®; GX-071®; MICRO-GEN ANT REACTOR®; VOLCANO®

Chemical class: Fluoroaliphatic Sulfonamide

EPA/OPP PC Code: 128992

California DPR Chemical Code: 2314

HSDB Number: 7100

UN/NA & ERG Number: Not regulated

RTECS® Number: RG9701300

EC Number: 223-980-3

Uses: Used as ant, roach and termite trap bait. Not listed for use in EU countries[115]. Actively registered for use in the U.S. According to the Fluoride Action Network, this chemical is not registered for use on food or crops and is scheduled to phased out by 2016.

Regulatory Authority and Advisory Information:

Carcinogenicity[83]: EPA, No data available

Toxicity (oral) Category 3, CAUTION

Description: White to off white crystalline solid or powder. Bland odor. Molecular weight = 527.18; Specific gravity (H_2O:1) = 1.156 @ 20 °C; Boiling point = 196 °C; Freezing/Melting point = 92–94 °C; Vapor pressure = 4×10^{-7} mmHg @ 25 °C; Flash point = 90 °C; Henry's Law constant = 5.37 atm-m^3/mol @ 25 °C (est)[83]. Practically insoluble in water.

Incompatibilities: Slowly hydrolyzes in water, releasing ammonia and forming acetate salt.

Determination in Water: Log K_{ow} = >4.0. Values above 3.0 are likely to bioaccumulate in aquatic organisms.

Routes of Entry: Inhalation and dermal contact.

Harmful Effects and Symptoms

Short Term Exposure: May cause skin burns and respiratory problems. Possible eye contamination. Symptoms of actue exposure include salivation, lethargy, runny nose, decreased appetite. LD_{50} (oral, rat) = >500 mg/kg[83]; LD_{50} (dermal, rat) = >1000 mg/kg[83].

Long Term Exposure: Fluorides may cause bone disease (pain and tenderness of the bones); mottled teeth in children.

Points of Attack: Skin, eyes, lungs, endocrine system: testicles; skeletal system, teeth.

Medical Surveillance: Consider the points of attack in preplacement and periodic physical examinations.

First Aid: If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least 15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately. If this chemical contacts the skin, remove contaminated clothing and wash immediately with soap and water. Seek medical attention immediately. If this chemical has been inhaled, remove from exposure, begin rescue breathing (using universal precautions) if breathing has stopped, and CPR if heart action has stopped. Transfer promptly to a medical facility. When this chemical has been swallowed, get medical attention. Give large quantities of water and induce vomiting. Do not make an unconscious person vomit.

Personal Protective Methods: Applicators and other handlers must wear: Coveralls worn over long-sleeved shirt and long pants; Chemical-resistant gloves such as DuPont™ Tychem® suit fabrics, barrier laminate, or Viton®; Chemical-resistant footwear plus socks; Protective eye wear; Chemical-resistant headgear for overhead exposure; Chemical-resistant apron when cleaning equipment, mixing, or loading[83]. Agricultural Use/Engineering Controls: When handlers use closed systems, enclosed cabs, or aircraft in a manner that meets the requirements listed in the Worker Protection Standard (WPS) for agricultural pesticides, 40 CFR 170.240(d)(4-6), the handler PPE requirements may be reduced or modified as specified in the Worker Protection Standard. Firefighters should wear NIOSH-approved self-contained breathing apparatus and full protective clothing.

Respirator Selection: Wherever and whenever workplace conditions warrant respirator use, a respiratory protection program must be followed that meets one or more of the following government standards: OSHA's 29 CFR 1910.134, ANSI Z88.2, or European Standard EN 149.

Spill Handling: Evacuate and restrict persons not wearing protective equipment from area of spill or leak until clean up is complete. Ventilate area of spill or leak. Absorb liquids in vermiculite, dry sand, earth, peat, carbon, or a similar material and deposit in sealed containers. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable.

Fire Extinguishing: Hazardous decomposition includes oxides of nitrogen, carbon and sulfur and hydrogen fluoride gas. This chemical is partially combustible; it may burn but does not easily ignite; may support combustion at high temperatures. Use dry chemical powder extinguishers, foam, carbon dioxide. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies. From a secure, explosion-proof location, use water spray to cool exposed containers. If cooling streams are ineffective (venting sound increases in volume and pitch, tank discolors, or shows any signs of deforming), withdraw immediately to a secure position. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode.

Disposal Method Suggested: Containers must be disposed of properly by following package label directions or by contacting your local or federal environmental control agency, or by contacting your regional EPA office. If this material cannot be disposed of according to label instructions, it may be dissolved or mixed with a combustible solvent and burned in a chemical incinerator equipped with an afterburner and scrubber. In accordance with 40CFR165, follow recommendations for the disposal of pesticides and pesticide containers.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- Pesticide Management Education Program, "Sulfluramid (GX-071) EPA Pesticide Fact Sheet 3/89," Cornell University, Ithaca, NY (March 1989). http://pmep.cce.cornell.edu/profiles/insect-mite/propetamphos-zetacyperm/sulfluramid/insect-prof-sulfluramid.html
- Fluoride Action Network, Hazardous Substances Data Bank, "Sulfluramid," October 22, 2003. http://www.fluoridealert.org/pesticides/sulfluramid.hsdb.oct.2003.htm

Sulfometuron-methyl S:0715

Use Type: Herbicide

CAS Number: 74222-97-2

Formula: $C_{15}H_{16}N_4O_5S$

Synonyms: Benzoic acid, 2-[((((4,6-dimethyl-2-pyrimidinyl)amino)carbonyl)amino)sulfonyl]-, methyl ester; Benzoic acid, *o*-[(3-(4,6-dimethyl-2-pyrimidinyl)ureido) sulfonyl]-, methyl ester; Methyl 2-[((((4,6-dimethyl-2-pyrimidinyl)amino)carbonyl)amino) sulfonyl]benzoate; Sulfometuron methyl; Methyl 2-[((((4,6-dimethyl-2-pyrimidinyl)amino)carbonyl)amino) sulfonyl]benzoate

Trade Names: DPX-T5648®; KNOCKOUT®; LANDMARK® MP (sulfometuron-methyl + chlorsulfuron); OUST®; OUSTAR®; RIVERDALE®; STAMPRO®

Chemical class: Sulfonylurea

EPA/OPP PC Code:
122001; (122002 old EPA code number)

California DPR Chemical Code: 2149

HSDB Number: 7732

UN/NA & ERG Number:
UN3077 (solid)/171; UN3082(liquid)/171

RTECS® Number: DG9096550

EC Number: 277-780-6

Uses: Used to control annual and perennial grasses and broadleaf weeds on landscapes, rights-of-ways, fence rows, forests, industrial structure areas and non-crop land. Not listed for use in EU countries[115]. Registered for use in the U.S.

Regulatory Authority and Advisory Information:

Carcinogenicity: IARC and NTP have not classified the sulfonylurea herbicides with respect to human carcinogenicity. U.S. EPA considers the sulfonylureas not classifiable, not rated, or noncarcinogenic, *with the exception of* sulfosulfuron (141776-32-1), a likely human carcinogen, and triflusulfuron-methyl (126535-15-7) a Possible human carcinogen[96]

Toxicity (oral) Category 4, Caution

Health Advisory: Skin irritant/sensitizer

Potential Ground Water Pollutant [California FAC Section 13145(d)/12811, active]

Description: White to colorless solid. Odorless. Freezing/Melting point = 202–203 °C. Molecular weight = 364.38;

Specific gravity (H_2O:1) = 1.48 @ 20 °C; Boiling point = (decomposes); Freezing/Melting point = 198–203 °C; Vapor pressure = 6×10^{-15} mmHg @ 25 °C; Henry's Law constant = 5.17×10^{-14} atm-m^3/mol @ 25 °C (est)[83]. Soluble in water.

Determination in Air: Filter; none; Gravimetric; NIOSH IV [Particulates NOR; #0500 (total), #0600 (respirable)].[18].

Determination in Water: Log K_{ow} = negative to ~1. Unlikely to bioaccumulate in marine organisms.

Routes of Entry: Inhalation, dermal contact, ingestion.

Harmful Effects and Symptoms

Human health effects from the sulfonylurea herbicides at low environmental doses or at biomonitored levels from low environmental exposures are unknown. The sulfonylurea herbicides are generally of low toxicity in mammalian studies. Animal studies showed low acute toxicity and little chronic, reproductive, or developmental toxicity or teratogenic effects. Developmental or teratogenic effects tended only to occur at high or maternally toxic doses. At high sublethal, chronic oral doses, such nonspecific effects as weight loss and anemia were observed. Some chemical-specific effects were noted at high doses in animals[96].

Short Term Exposure: Contact with eyes or skin may cause irritation or burns. Inhalation should be avoided; use NIOSH- or CEN (UK)-approved air-purifying respirators for pesticides. May be harmful if swallowed. Dermal contact may cause allergic reaction. LD_{50} (oral, rat) = >5 g/kg; LD_{50} (dermal, rat) = >2 g/kg. LD_{50} (inhalation, rat) >5 ppm/4 hrs[92].

Medical Surveillance: Preliminary medical exam to detect chronic diseases of central nervous system, liver, heart, kidneys, lung and skin, as well as endocrinological or immunological disturbances, should protect susceptible individuals. Periodical medical exams of internal organs, skin and eyes are important to avoid chronic occupational intoxications. They should include lab and patch tests when necessary[83]. Urinary levels of the sulfonylurea herbicides reflect recent exposure. There is very limited information on the biomonitoring of sulfonylurea herbicides or their metabolites. Detection of the metabolites may reflect exposure to more than one particular sulfonylurea herbicide or exposure to environmental degradation products[96].

First Aid: If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least 15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately. If this chemical contacts the skin, remove contaminated clothing and wash immediately with soap and water. Seek medical attention immediately. If this chemical has been inhaled, remove from exposure, begin rescue breathing (using universal precautions) if breathing has stopped, and CPR if heart action has stopped. Transfer promptly to a medical facility. When this chemical has been swallowed, get medical attention. Give large quantities of water and induce vomiting. Do not make an unconscious person vomit.

Personal Protective Methods: Wear protective gloves and clothing to prevent any reasonable probability of dermal and/or eye contact. Safety equipment suppliers/manufacturers can provide recommendations on the most protective glove/clothing material for your operation. All protective clothing (suits, gloves, footwear, headgear) should be clean, available each day, and put on before work. Contact lenses should not be worn when working with this chemical. Wear dust-proof chemical goggles and face shield unless full facepiece respiratory protection is worn. Employees should wash immediately with soap when skin is wet or contaminated. Provide emergency showers and eyewash.

Respirator Selection: Wherever and whenever workplace conditions warrant respirator use, a respiratory protection program must be followed that meets one or more of the following government standards: OSHA's 29 CFR 1910.134, ANSI Z88.2, or European Standard EN 149.

Storage: Color Code-Blue: Health Hazard/Poison. Store in a secure poison location. Store in a refrigerator and protect from exposure to oxidizers or moisture[52]. A regulated, marked area should be established where this chemical is handled, used, or stored in compliance with OSHA Standard 1910.1045. Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: Environmentally hazardous substances, solid or liquid, usually fall in Hazard Class 9.

Spill Handling: Evacuate and restrict persons not wearing protective equipment from area of spill or leak until clean up is complete. Dampen spilled material with alcohol to avoid dust. Collect powdered material in the most convenient and safe manner and deposit in sealed containers. Ventilate area of spill or leak after clean up is complete. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable.

Fire Extinguishing: Hazardous decomposition includes oxides of sulfur and nitrogen. Use dry chemical, carbon dioxide; water spray; or alcohol-resistant foam extinguishers. Prevent water from entering containers. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode.

Disposal Method Suggested: It is the responsibility of chemical waste generators to determine the toxicity and physical properties of a discarded chemical and to properly identify its classification and certification as a hazardous waste and to determine the disposal method. U.S. EPA guidelines for the classification determination are listed in 40 CFR Parts 261.3. Additionally, waste generators must consult and follow all regional, national, state and local hazardous waste laws to ensure complete and accurate classification and disposal methods. Recycle any unused portion of the material for its approved use or return it to the manufacturer or supplier. Ultimate disposal of the chemical must consider: the material's impact on air quality; potential migration in soil or water; effects on animal, aquatic, and plant life; and conformance with environmental and public health regulations[83].

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- EXTOXNET, Extension Toxicology Network, "Pesticide Information Profile, Sulfometuron-methyl," Oregon State University, Corvallis, OR (June 1996). http://extoxnet.orst.edu/pips/sulfomet.htm

Sulfuryl fluoride S:0820

Use Type: Fumigant

CAS Number: 2699-79-8

Formula: F_2O_2S; SO_2F_2

Synonyms: Fluoruro de sulfurilo (Spanish); Sulfonyl fluoride; Sulfur difluoride dioxide; Sulfuric oxyfluoride; Sulphuryl difluoride; Sulphuryl fluoride

Trade Names: TERMAFUME®; VIKANE®; VIKANE FUMIGANT®

Chemical class: Inorganic toxic metals

EPA/OPP PC Code: 078003

California DPR Chemical Code: 618

HSDB Number: 828

UN/NA & ERG Number: UN2191/123

RTECS® Number: WT5075000

EC Number: 220-281-5 [*Annex I Index No.:* 009-015-00-7]

Uses: Sulfuryl fluoride is used to fumigate closed structures and their contents such as domestic dwellings, garages, barns, storage buildings, commercial warehouses, ships in port, and railroad cars. It controls numerous insect pests including termites, powder post beetles, old house borers, bedbugs, carpet beetles, clothes moths and cockroaches, as well as rats and mice. It is also used in organic synthesis of drugs and dyes. Use pending in EU countries[115]. Registered for use in the U.S.

U.S. Maximum Allowable Residue Levels for Sulfuryl Fluoride (40 CFR 180.575): barley, bran, post-harvest 0.05 ppm; barley, flour, post-harvest 0.05 ppm; barley, grain, post-harvest 0.1 ppm; barley, pearled barley 0.05 ppm; corn, field, flour, post-harvest 0.01 ppm; corn, field, grain, post-harvest 0.05 ppm; corn, field, grits, post-harvest 15 ppm; corn, field, meal, post-harvest 0.01 ppm; corn, pop, grain, post-harvest 0.05 ppm; grape, raisin 0.004 ppm; grape, raisin (40 CFR 180.145) 30 ppm; millet, grain, post-harvest 0.1 ppm; nut, tree, group 14, post-harvest 3 ppm; oat, flour, post-harvest 0.05 ppm; oat, grain, post-harvest 0.1 ppm; oat, groats/rolled oats, post-harvest 0.1 ppm; pistachio, post-harvest 3 ppm; rice, bran, post-harvest 0.01 ppm; rice, grain, post-harvest 0.04 ppm; rice, hulls, post-harvest 0.1 ppm; rice, polished rice, post-harvest 0.01 ppm; rice, wild, grain, post-harvest 0.05 ppm; sorghum, grain, grain, post-harvest 0.1 ppm; triticale, grain, post-harvest 0.1 ppm; walnut 2 ppm; walnut (40 CFR 180.145) 12 ppm; wheat, bran, post-harvest 0.05 ppm; wheat, flour, post-harvest 0.05 ppm; wheat, germ, post-harvest 0.02 ppm; wheat, grain, post-harvest 0.1 ppm; wheat, milled byproducts, post-harvest 0.05 ppm; wheat, shorts, post-harvest 0.05 ppm.

Regulatory Authority and Advisory Information:

Carcinogenicity[83]: EPA Not likely to be a human carcinogen

U.S. DOT 49CFR172.101, Inhalation Hazard Chemical

Health Advisory: Developmental/Reproductive Toxin

Toxicity (oral) Category 2, WARNING

EPCRA Section 313 Form R *de minimis* concentration reporting level: 1.0%

European/International Regulations: Hazard Symbol: T, N; risk phrases: R23; R48/20; R50; safety phrases: S1/2; S45; S60; S61; S63 (see Appendix 1)

Description: Sulfuryl fluoride is a colorless gas. Odorless. Usually shipped as a liquefied compressed gas; Molecular weight = 102.055; Specific gravity (H_2O:1) = (liquid) 1.7 G/L; (gas) 3.7 G/L @ –55 °C; Boiling point = –55 °C; Freezing/Melting point = –137 °C; Vapor pressure = 12,000 mmHg @ 21 °C[DOE]. Soluble in water; reaction.

Incompatibilities: Can react with water, steam. Fluorides form explosive gases on contact with strong acids or acid fumes. Stable at temperatures <350 °C.

Permissible Exposure Limits in Air: NIOSH IDLH: 200 ppm

Conversion factor: 1 ppm = 4.18 mg/m^3 @ 25 °C & 1 atm

OSHA PEL: 5 ppm/20 mg/m^3 TWA; Vacated 1989 5 ppm/20 mg/m^3 TWA; STEL 10 ppm/40 mg/m^3 is still enforced in some states.

NIOSH REL: 5 ppm/20 mg/m^3 TWA; 10 ppm/42 mg/m^3 STEL

ACGIH TLV®[1]: 5 ppm/21 mg/m^3 TWA; 10 ppm/40 mg/m^3 STEL

Protective Action Criteria (PAC)

PAC-1: 10 ppm

PAC-2: 21_A ppm

PAC-3: 64_A ppm

Subscript "**A**" signifies 60-minute AEGL (Acute Emergency Guideline Level) values.

Determination in Air: Charcoal tube; Sodium hydroxide; Ion chromatography; NIOSH IV, Method #6012[18].

Permissible Concentration in Water: Runoff from spills or fire control may cause water pollution.

Determination in Water: Log K_{ow} = <1. Unlikely to bioaccumulate in marine organisms.

Routes of Entry: Inhalation, eye and/or dermal contact (liquid).

Harmful Effects and Symptoms

Short Term Exposure: May cause conjunctivitis, rhinitis, pharyngitis, paresthesia. Contact with the liquid may cause frostbite. High exposures can cause pulmonary edema, a medical emergency that can be delayed for several hours. This can cause death. Overexposure can cause nausea, vomiting, itching, muscle twitching, tremors and seizures. LD_{50} (oral, rat) = 100 mg/kg.

Long Term Exposure: May cause kidney damage. Repeated high exposures can cause deposits of fluorides in the bones (fluorosis) that may cause pain, disability and mottling of the teeth. May cause reproductive and fetal effects. Fluorides may cause bone disease (pain and tenderness of the bones); mottled teeth in children.

Points of Attack: Eyes, skin, respiratory system, central nervous system and kidneys. Reproductive cells. Skeletal system, teeth.

Medical Surveillance: In addition to comprehensive initial medical and work histories emphasizing reproductive experience and menstrual history, patient should have physical examination and testing of genito-urinary tract, sperm count, motility and morphology. If required, other tests, such as serum testosterone, serum follicle stimulating hormone (FSH), and serum lutenizing hormone (LH), may be indicated. Consider the points of attack in preplacement and periodic physical examinations. Fluoride level in urine (for fluoride in urine use NIOSH #8308). Levels higher than 4 mg/L may indicate overexposure. If symptoms develop or overexposure is suspected, the following may be useful: Consider chest x-ray after acute overexposure. Kidney function tests. Examination of the nervous system. Kidney function tests.

First Aid: If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least 15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately. If this chemical contacts the skin, remove contaminated clothing and wash immediately with soap and water. Seek medical attention immediately. If this chemical has been inhaled, remove from exposure, begin rescue breathing (using universal precautions) if breathing has stopped, and CPR if heart action has stopped. Transfer promptly to a medical facility. Medical observation is recommended for 24 to 48 hours following breathing overexposure, as pulmonary edema may be delayed. As first aid for pulmonary edema, a doctor or authorized paramedic may consider administering a corticosteroid spray. If frostbite has occurred, seek medical attention immediately; do *NOT* rub the affected areas or flush them with water. In order to prevent further tissue damage, do *NOT* attempt to remove frozen clothing from frostbitten areas. If frostbite has *NOT* occurred, immediately and thoroughly wash contaminated skin with soap and water.

Personal Protective Methods: Safety equipment suppliers/manufacturers can provide recommendations on the most protective glove/clothing material for your operation. All protective clothing (suits, gloves, footwear, headgear) should be clean, available each day, and put on before work. Contact lenses should not be worn when working with this chemical. Wear gas-proof chemical goggles and face shield unless full facepiece respiratory protection is worn. Employees should wash immediately with soap when skin is wet or contaminated. Provide emergency showers and eyewash.

Respirator Selection: SCBA >10 ppm. NIOSH: *Up to 50 ppm:* Sa* (APF = 10) (any supplied-air respirator). *Up to 125 ppm:* Sa:Cf* (APF = 25) (any supplied-air respirator operated in a continuous-flow mode). *Up to 200 ppm:* SCBAF (APF = 50) (any self-contained breathing apparatus with a full facepiece); or SaF (APF = 50) (any supplied-air respirator with a full facepiece). *Emergency or planned entry into unknown concentrations or IDLH conditions:* SCBAF: Pd,Pp (APF = 10,000) (any self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode); or SaF: Pd,Pp: ASCBA (APF = 10,000) (any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary self-contained breathing apparatus operated in a pressure-demand or other positive-pressure mode. *Escape:* GmFS100 (APF = 50) [any air-purifying, full facepiece respirator (gas mask) with a chin-style, front- or back-mounted canister providing protection against the compound of concern and having an N100, R100, or P100 filter]; or SCBAE (any appropriate escape-type, self-contained breathing apparatus).

Storage: Poison gas. Color Code-Blue: Health Hazard/Poison: Store in a secure poison location. Prior to working with this chemical you should be trained on its proper handling and storage. Store in tightly closed containers in a cool, well-ventilated area away from water, steam and strong acids. Procedures for the handling, use and storage of cylinders should be in compliance with OSHA 1910.101 and 1910.169, as with the recommendations of the Compressed Gas Association. Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: Sulfuryl fluoride requires a shipping label of "POISON GAS." It falls in Hazard Class 2.3. It is a violation of transportation regulations to refill compressed gas cylinders without the express written permission of the owner.

Spill Handling: If in a building, evacuate building and confine vapors by closing doors and shutting down HVAC systems. Restrict persons not wearing protective equipment from area of spill or leak until clean up is complete. Ventilate area of spill or leak to disperse the gas. Wear chemical protective suit with self-contained breathing apparatus to combat spills. Stay upwind and use water spray to "knock down" vapor; contain runoff. Stop the flow of gas, if it can be done safely from a distance. If source is a cylinder and the leak cannot be stopped in place, remove the leaking cylinder to a safe place; and repair leak or allow cylinder to empty. Keep this chemical out of confined spaces, such as a sewer, because of the possibility of explosion, unless the sewer is designed to prevent the buildup of explosive concentrations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable.

Initial isolation and protective action distances
Distances shown are likely to be affected during the first 30 minutes after materials are spilled and could increase with time. If more than one tank car, cargo tank, portable tank, or large cylinder is involved in the incident is leaking, the protective action distance may need to be increased. You may need to seek emergency information from CHEMTREC at (800) 424-9300 or seek professional environmental engineering assistance from the U.S. EPA Environmental Response Team at (908) 548-8730 (24-hour response line).

Small Spills (from a small package or a small leak from a large package)
First: isolate in all directions (feet/meters) 100/30
Then: Protect persons downwind (miles/kilometers)
Day 0.1/0.2
Night 0.3/0.5

Large spills (from a large package or from many small packages)
First: isolate in all directions (feet/meters) 1000/300
Then: Protect persons downwind (miles/kilometers)
Day 1.1/1.8
Night 3.1/4.9

Fire Extinguishing: This chemical is a nonflammable gas. Hazardous decomposition includes sulfur dioxide and hydrogen fluoride. For small fires use dry chemical or carbon dioxide extinguishers. Gas is heavier than air and will collect in low areas. Containers may explode in fire. Storage containers and parts of containers may rocket great distances, in many directions. Notify local health and fire officials and pollution control agencies. From a secure, explosion-proof location, use water spray to cool exposed containers. If cooling streams are ineffective (venting sound increases in volume and pitch, tank discolors, or shows any signs of deforming), withdraw immediately to a secure position. If cylinders are exposed to excessive heat from fire or flame contact, withdraw immediately to a secure location. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156

Disposal Method Suggested: Addition of soda ash-slaked lime solution to form the corresponding sodium and calcium salt solution. This solution can be safely discharged after dilution. The precipated calcium fluoride may be buried or added to a landfill. Small amounts could also be released directly to the atmosphere without serious harm.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- USEPA, Office of Pesticide Programs, Pesticide Residue Limits, "Sulfuryl Fluoride," 40 CFR 180.575. http://www.epa.gov/pesticides/food/viewtols.htm
- Environmental Protection Agency, "Reregistration Eligibility Decision (RED) Fact Sheet, Sulfuryl Fluoride," Office of Prevention, Pesticides and Toxic Substances, Washington DC (September 1993). http://www.epa.gov/REDs/factsheets/0176fact.pdf
- New Jersey Department of Health and Senior Services, "Hazardous Substance Fact Sheet, Sulfuryl Fluoride," Trenton, NJ (March 1989, rev. May 2000). http://www.state.nj.us/health/eoh/rtkweb/1769.pdf
- EXTOXNET, Extension Toxicology Network, "Pesticide Information Profile, Sulfuryl Fluoride," Oregon State University, Corvallis, OR (June 1996). http://extoxnet.orst.edu/pips/sulfuryl.htm
- *Sulfuryl Fluoride Technical Fact Sheet*; National Pesticide Information Center, Oregon State University Extension Services, Corvallis, OR (2000)

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* Substance reported to cause eye irritation or damage; may require eye protection.
\+ May need acid gas sorbent.
* Substance reported to cause eye irritation or damage; may require eye protection.

T

Tebuconazole T:0133

Use Type: Fungicide, Plant growth regulator
CAS Number: 107534-96-3
Formula: $C_{16}H_{23}ClN_3O$
Synonyms: (RS)-1-(4-Chlorophenyl)-4,4-dimethyl-3-(1*H*-1,2,4-triazol-1-ylmethyl)pentan-3-ol; (RS)-1-*p*-Chlorophenyl-4,4-dimethyl-3-(1*H*-1,2,4-triazol-1-ylmethyl) pentan-3-ol; (±)-α-[2-(4-Chlorophenyl)ethyl]-α-(1,1-dimethylethyl)-1*H*-1,2,4-triazole-1-ethanol; Ethyltrianol; Fenetrazole; Terbutrazole; 1*H*-1,2,4-Triazole-1-ethanol, α-[2-(4-chlorophenyl)ethyl]-α-(1,1-dimethylethyl)-, (±)-
Trade Names: BAY®-HWG 1608; BAYER®-HWG-1608 CORAIL®; ELITE®; FOLICUR®; FOLITRAZOLE®; GAUCHO®; HORIZON®; HWG 1608®; LYNX-1.2®; PREVENTOL® RAXIL (tebuconazole+metalaxyl); SILVACUR®; TEBUJECT®; WOLMAN®; WOODLIFE®
Chemical class: Azole; Triazole
EPA/OPP PC Code: 128997
California DPR Chemical Code: 3850
HSDB Number: 7448
UN/NA & ERG Number: UN3082 (liquid)/171
RTECS® Number: XZ4803270
EC Number: 403-640-2 [Annex I Index No.: 603-197-00-7]
Uses: Used as a seed treatment against smuts and bunts of cereals; as a foliar spray against diseases of cereal, peanuts, oilseed rape, grapes, bananas, stone fruit, and pome fruit. Registered for use in EU countries[115]. Registered for use in the U.S.
U.S. Maximum Allowable Residue Levels for the fungicide Tebuconazole [40 CFR 180.474(a)(1)]: in or on the following raw agricultural commodities: banana 0.05 ppm; barley, grain 0.05 ppm; barley, hay 0.10 ppm; barley, straw 0.10 ppm; cherry 4.0 ppm; grape 5.0 ppm; grass, forage 8.0 ppm; grass, hay 25.0 ppm; grass, seed screenings 55.0 ppm; grass, straw 30.0 ppm; oat, forage 0.10 ppm; oat, grain 0.05 oat, hay 0.10 ppm; oat, straw 0.10 ppm; peach (includes nectarine) 1.0 ppm; peanut 0.1 ppm; wheat, forage 0.10 ppm; wheat, grain 0.05 ppm; wheat, hay 0.10 ppm; wheat, straw 0.10 ppm. *Tebuconazole and its metabolite 1-(4-chlorophenyl)-4,4-dimethyl-3-(1H-1,2,4-triazole-1-yl-methyl)-pentane-3,5-diol metabolite* ***[40 CFR 180.474(a)(2)]:*** cattle, meat byproducts 0.2 ppm; goat, meat byproducts 0.2 ppm; horse, meat byproducts 0.2 ppm; milk 0.1 ppm; sheep, meat byproducts 0.2 ppm.
Regulatory Authority and Advisory Information:
Carcinogenicity[83]: EPA Group C, Possible human carcinogen
Poison Category: 3, CAUTION
European/International Regulations: Hazard Symbol: Xi, N; risk phrases: R22; R51/R53; R63; safety phrases: S2; S22; S36/37; S61 (see Appendix 1)
Description: Clear, crystalline solid. Slightly soluble in water. Molecular weight = 307.87; Specific gravity (H_2O:1) = 1.25 @ 20 °C; Boiling point = (decomposes) 350 °C; Freezing/Melting point = 105–106 °C; Vapor pressure = 1×10^{-7} mmHg @ 25 °C. Low solubility in water.
Permissible Concentration in Water: Runoff from spills or fire control may cause water pollution.
Determination in Water: Log K_{ow} = >3.5. Values above 3.0 are likely to bioaccumulate in aquatic organisms.
Routes of Entry: Ingestion, dermal and/or eye contact.
Harmful Effects and Symptoms
Short Term Exposure: Poisonous if swallowed. Contact may irritate skin and cause eye irritation and possible severe injury. Avoid inhalation. LD_{50} (oral, rat) = >2.5 g/kg; LD_{50} (dermal, rat) = >5 g/kg.
Long Term Exposure: Possible carcinogen.
Points of Attack: Liver, blood system.
Medical Surveillance: This chemical is a suspected or known human carcinogen. Exposed persons should contact a physician for advice regarding the possible long term health effects and advice for medical monitoring. Liver function tests, Complete blood count.
First Aid: If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least 15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately. If this chemical contacts the skin, remove contaminated clothing and wash immediately with soap and water. If this chemical has been inhaled, remove from exposure, begin rescue breathing (using universal precautions) if breathing has stopped, and CPR if heart action has stopped. Transfer promptly to a medical facility. When this chemical has been swallowed, get medical attention. Give large quantities of water and induce vomiting. Do not make an unconscious person vomit.
Personal Protective Methods: Applicators and other handlers must wear: Coveralls worn over long-sleeved shirt and long pants; Chemical-resistant gloves such as DuPont™ Tychem® suit fabrics, barrier laminate, or Viton®; Chemical-resistant footwear plus socks; Protective eye wear; Chemical-resistant headgear for overhead exposure; Chemical-resistant apron when cleaning equipment, mixing, or loading[83]. Agricultural Use/Engineering Controls: When handlers use closed systems, enclosed cabs, or aircraft in a manner that meets the requirements listed in the Worker Protection Standard (WPS) for agricultural pesticides, ***40 CFR 170.240(d)(4-6),*** the handler PPE requirements may be reduced or modified as specified in the Worker Protection Standard. Firefighters should wear NIOSH-approved self-contained breathing apparatus and full protective clothing.
Respirator Selection: *At any detectable concentration:* SCBAF: Pd,Pp (APF = 10,000) (any NIOSH/MSHA- or

European Standard EN 149-approved self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode); or SaF: Pd,Pp: ASCBA (APF = 10,000) (any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary, self-contained breathing apparatus operated in a pressure-demand or other positive-pressure mode). *Escape:* 100F (APF = 50) (any air-purifying, full facepiece respirator with an N100, R100, or P100 filter k-mounted organic vapor canister having a high-efficiency particulate filter); or SCBAE (any appropriate escape-type, self-contained breathing apparatus).

Storage: Color Code-Blue: Health Hazard/Poison. Store in a secure poison location. Prior to working with this chemical you should be trained on its proper handling and storage. Store in tightly closed containers in a cool, well-ventilated area. If this material contains a flammable carrier, sources of ignition, such as smoking and open flames, are prohibited where this chemical is used, handled, or stored in a manner that could create a potential fire or explosion hazard. Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: Environmentally hazardous substances, solid or liquid, usually fall in Hazard Class 9.

Spill Handling: First, remove all sources of ignition. Evacuate persons not wearing protective equipment from area of spill or leak until clean up is complete. Collect powdered material in the most convenient and safe manner and deposit in sealed containers. Ventilate area after clean up is complete. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable.

Fire Extinguishing: Hazardous decomposition includes oxides of nitrogen and carbon and hydrogen chloride. As an immediate precautionary measure, isolate spill or leak area in all directions for at least 50 meters/150 feet for liquids and at least 25 meters/75 feet for solids. *Fire involving storage or vehicular tanks:* isolate for 800 meters/0.5 mile in all directions; also, consider initial evacuation for 800 meters/0.5 mile in all directions. *On a small fire:* use dry chemical, CO_2, water spray or regular foam. *On a large fire:* use water spray, fog or regular foam. Do not scatter spilled material with high-pressure streams of water. Move containers from fire area if you can do it without risk. Dike fire-control water for later disposal. *Fire involving tanks:* from a secure, explosion-proof location, use water spray to cool exposed containers. If cooling streams are ineffective (venting sound increases in volume and pitch, tank discolors, or shows any signs of deforming), withdraw immediately to a secure position. Always stay away from tanks engulfed in fire. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode.

Disposal Method Suggested: Consult with environmental regulatory agencies for guidance on acceptable disposal practices. Contact a licensed disposal facility about surplus and non-recyclable solutions. Burn in a chemical incinerator equipped with an afterburner and scrubber. Extra care must be exercised as the material in an organic solvent is highly flammable. In accordance with 40CFR165, follow recommendations for the disposal of pesticides and pesticide containers. Containers must be disposed of properly by following package label directions or by contacting your local or federal environmental control agency, or by contacting your regional EPA office. Incineration or permanganate oxidation.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- USEPA, Office of Pesticide Programs, Pesticide Residue Limits, "Tebuconazole," 40 CFR 180.474. http://www.epa.gov/pesticides/food/viewtols.htm

Tebufenozide T:0135

Use Type: Insecticide, Insect growth regulator

CAS Number: 112410-23-8

Formula: $C_{22}H_{28}N_2O_2$

Synonyms: Benzoic acid, 3,5-dimethyl-, 1-(1,1-dimethylethyl)-2-(4-ethylbenzoyl)hydrazide; *N-tert*-Butyl-*N'*-(4-ethylbenzoyl)-3,5-dimethylbenzoylhydrazide; 3,5-Dimethylbenzoic acid 1-(1,1-dimethylethyl)-2-(4-ethylbenzoyl)hydrazine

Trade Names: CONFIRM®; MIMIC®; RH-5992®

Chemical class: Diacylhydrazine

EPA/OPP PC Code: 129026

California DPR Chemical Code: 3957

HSDB Number: 7050

UN/NA & ERG Number: UN3077(solid)/171

EC Number: 412-850-3 [*Annex I Index No.:* 616-076-00-9]

Uses: Tebufenozide is an insect growth regulator that interferes with molting of Lepidopteran larvae. It is used on fruitworm, fireworms, false armyworm, gypsy moth, and spanworms, and is applied pre-harvest. Registered for use in EU countries[115]. Registered for use in the U.S.

U.S. Maximum Allowable Residue Levels for Tebufenozide [40 CFR 180.482(a)(1)]: in or on the following raw agricultural commodities almond, hulls: 25 ppm; apple, pomace 3.0 ppm; apple 1.0 ppm; berry (crop group 13) 3.0 ppm; canola, refined oil 4.0 ppm; canola, seed 2.0 ppm; cotton 1.5 ppm; cotton, gin byproducts 30 ppm; cranberry 1.0 ppm; fruiting vegetables (except cucurbits) 1.0 ppm; head and stem Brassica crop subgroup 5.0 ppm; kiwifruit 0.5 ppm; leafy Brassica green crop subgroup 10.0 ppm: leafy greens crop subgroup 10.0 ppm; leafy petioles crop subgroup 2.0 ppm; peppermint, tops 10.0 ppm; pome fruit 1.5 ppm; spearmint, tops 10.0 ppm; tree nut crop group including pistachios 0.1 ppm; turnip, roots 0.3 ppm; turnip, tops 9.0 ppm; walnut 0.1 ppm.

Tebufenozide and its metabolites benzoic acid, 3,5-dimethyl-1-[1,1-dimethylethyl)-2-((4-carboxymethyl) benzoyl)hydrazide), benzoic acid, 3-hydroxymethyl,5-methyl-1-(1,1-dimethylethyl)-2-(4-ethylbenzoyl) hydrazide, the stearic acid conjugate of benzoic acid, 3-hydroxymethyl-5-methyl-1-(1,1-dimethylethyl)-2-(4-(1-hydroxyethyl)benzoyl)hydrazide [40 CFR 180.482(a)(2)]: in or on the following raw agricultural commodities: fat of cattle, goats, hogs, horses, and sheep 0.1 ppm; meat of cattle, goats, hogs, horses, and sheep 0.08 ppm; meat byproducts of cattle, goats, hogs, horses, and sheep 0.08 ppm; milk 0.04 ppm.

Regulatory Authority and Advisory Information:
Carcinogenicity[83]: EPA Group E, evidence of non-carcinogenicity for humans
Acute Oral Category: 3, CAUTION
Health Advisory: Ground water pollutant (S!)
EPA Acceptable Daily Intake (ADI): Oral reference dose (RfD) = 0.018 mg/kg/day. This RfD is based on a chronic toxicity study in dogs which found growth retardation, alterations in hematology parameters, changes in organ weights, and histopathological lesions in the bone, spleen and liver at 8.7 mg/kg/day [64 FR 16850][83].
European/International Regulations: Hazard Symbol: N; risk phrases: R50/53; safety phrases: S2; S61 (see Appendix 1)

Description: An off-white powder. Commercial product can be a soluble concentrate that may be mixed with water and used as a spray. Molecular weight = 352.47; Specific gravity (H_2O:1) = 1.04 @ 20 °C; Boiling point = (decomposes); Freezing/Melting point = 189 °C; Vapor pressure = mmHg @ 25 °C; Vapor pressure = 3×10^{-7} mmHg @ 25 °C. Practically insoluble in water.

Incompatibilities: Decomposes in temperatures >200 °C. Keep away from strong oxidizers and alkalies.

Permissible Concentration in Water: Federal Drinking Water Guidelines: 100 ppb[14].

Determination in Water: Log K_{ow} = >3.5. Likely to bioaccumulate in marine organisms.

Incompatibilities: Contact with flammable material may cause fire and explosions. Contact with combustible or oxidizable materials may form heat-, shock-, and friction-sensitive explosive mixtures. Static electricity may also cause explosions. Keep away from all acids, especially dibasic organic acids, ammonium compounds, antimony sulfide, arsenic trioxide, metal sulfides, powdered metals, calcium aluminum hydride, cyanides, manganese dioxide, phosphorus, selenium, sulfur, thiocyanates, zinc

Permissible Concentration in Water: State Drinking Water Guidelines: Maine 140 μg/L. Environmental hazard; runoff from spills or fire control may cause water pollution.

Determination in Water: Log K_{ow} = >4.0. Values above 3.0 are likely to bioaccumulate in aquatic organisms.

Routes of Entry: Inhalation of dust, dermal contact, ingestion.

Harmful Effects and Symptoms

Short Term Exposure: May be toxic if ingested, inhaled or on contact with skin or eyes. LD_{50} (oral, rat) = >5 g/kg; LD_{50} (dermal, rat) = >2 g/kg.

Long Term Exposure: Possible liver, kidney and blood effects. Animal studies suggest growth retardation.

Points of Attack: Bone, spleen, liver, kidney, cardiovascular system.

Medical Surveillance: Consider the points of attack in preplacement and periodic physical examinations. Liver and kidney function tests.

First Aid: If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least 15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately. If this chemical contacts the skin, remove contaminated clothing and wash immediately with soap and water. Seek medical attention immediately. If this chemical has been inhaled, remove from exposure, begin rescue breathing (using universal precautions) if breathing has stopped, and CPR if heart action has stopped. Transfer promptly to a medical facility. When this chemical has been swallowed, get medical attention. Give large quantities of water and induce vomiting. Do not make an unconscious person vomit.

Personal Protective Methods: Wear protective gloves and clothing to prevent any reasonable probability of dermal and/or eye contact. Safety equipment suppliers/manufacturers can provide recommendations on the most protective glove/clothing material for your operation. All protective clothing (suits, gloves, footwear, headgear) should be clean, available each day, and put on before work. Contact lenses should not be worn when working with this chemical. Wear dust-proof chemical goggles and face shield unless full facepiece respiratory protection is worn. Employees should wash immediately with soap when skin is wet or contaminated. Provide emergency showers and eyewash.

Respirator Selection: Follow regulations in OSHA 29CFR1910.134 or European Standard EN149. Use a NIOSH/MSHA- or European Standard EN149-approved respirator; or use an approved supplied-air respirator with a full facepiece operated in the positive-pressure mode, or with a full facepiece, hood, or helmet in the continuous-flow mode; or use a NIOSH/MSHA- or European Standard EN149-approved self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive-pressure mode.

Storage: Color Code-Blue: Health Hazard/Poison. Store in a secure poison location. Prior to working with this chemical you should be trained on its proper handling and storage. Store in tightly closed containers in a cool, well-ventilated area. If this material contains a flammable carrier, sources of ignition, such as smoking and open flames, are prohibited where this chemical is used, handled, or stored in a manner that could create a potential fire or explosion hazard. Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: Environmentally hazardous substances, solid or liquid, usually fall in Hazard Class 9 and Packing Group III.

Spill Handling: Evacuate persons not wearing protective equipment from area of spill or leak until clean up is complete. Remove all sources of ignition, ventilate the spill area, and use absorbent to pick up spilled material. Follow by washing surfaces well, first with 60 to 70% ethanol and water, then with soap and water. Collect powdered material in the most convenient and safe manner and deposit in sealed containers. Ventilate area after clean up is complete. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable.

Fire Extinguishing: Hazardous decomposition includes oxides of nitrogen and carbon. As an immediate precautionary measure, isolate spill or leak area in all directions for at least 50 meters/150 feet for liquids and at least 25 meters/75 feet for solids. *Fire involving storage or vehicular tanks:* isolate for 800 meters/0.5 mile in all directions; also, consider initial evacuation for 800 meters/0.5 mile in all directions. *On a small fire:* use dry chemical, CO_2, water spray or regular foam. *On a large fire:* use water spray, fog or regular foam. Do not scatter spilled material with high-pressure streams of water. Move containers from fire area if you can do it without risk. Dike fire-control water for later disposal. *Fire involving tanks:* from a secure, explosion-proof location, use water spray to cool exposed containers. If cooling streams are ineffective (venting sound increases in volume and pitch, tank discolors, or shows any signs of deforming), withdraw immediately to a secure position. Always stay away from tanks engulfed in fire. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode.

Disposal Method Suggested: Consult with environmental regulatory agencies for guidance on acceptable disposal practices. In accordance with 40CFR165, follow recommendations for the disposal of pesticides and pesticide containers. Containers must be disposed of properly by following package label directions or by contacting your local or federal environmental control agency, or by contacting your regional EPA office.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- USEPA, Office of Pesticide Programs, Pesticide Residue Limits, “Tebufenozide,” 40 CFR 180.482. http://www.epa.gov/pesticides/food/viewtols.htm

Tebuthiuron T:0137

Use Type: Herbicide

CAS Number: 34014-18-1

Formula: $C_9H_{16}N_4OS$

Synonyms: Caswell No. 366AA; *N*-[5-(1,1-Dimethylethyl)-1,3,4-thiadiazol-2-yl]-*N,N*'-dimethylurea; *N*-[5-(1,1-Dimethylethyl)-1,3,4-thiadiazol-2-yl]-*N,N*'-dimethylurea; 1-(5-*tert*-Butyl-1,3,4-thiadiazol-2-yl)-1,3-dimethylurea; Urea, *N*-(5-(1,1-dimethylethyl)-1,3,4-thiadiazol-2-yl)-*N,N*'-dimethyl-; Urea, 2-(5-*tert*-butyl-1,3,4-thiadiazol-2-yl)-1,3-dimethyl-; Urea, 1-(5-*tert*-butyl-1,3,4-thiadiazol-2-yl)-1,3-dimethyl-; Urea, *N*-[5-(1,1-dimethylethyl)-1,3,4-thiadiazol-2-yl]-*N,N*'-dimethyl-

Trade Names: BRULAN®; BRUSH-BULLET®; E-103®; GRASLAN®; HERBEC®; HERBIC®; PERFLAN®; RECLAIM; SHA-105501®; SPIKE®; SPRAKIL®; TEBULAN®; TIUROLAN®

Chemical class: Urea

EPA/OPP PC Code: 105501

California DPR Chemical Code: 1810

HSDB Number: 6863

UN/NA & ERG Number: UN3077(solid)/171

RTECS® Number: YS4250000

EC Number: 251-793-7 [*Annex I Index No.:* 616-020-00-3]

Uses: Tebuthiuron is a broad-spectrum herbicide that is used to control weeds in non-cropland areas, range lands, rights-of-way and industrial sites. In grasslands and sugar cane it controls woody and herbaceous plants and weeds such as alfalfa, bluegrasses, chickweed, clover, dock, goldenrod and mullein. Not approved for use in EU countries[115]. Registered for use in the U.S.

U.S. Maximum Allowable Residue Levels for Tebuthiuron and its metabolites [40 CFR 180.390(a)(1)]: in or on the following raw agricultural commodities: grass, forage 10.0 ppm; grass, hay 10.0 ppm. ***[40 CFR 180.390(a)(2)]:*** cattle, fat 1.0 ppm; cattle, meat 1.0 ppm; cattle, meat byproducts 5.0 ppm; goat, fat 1.0 ppm; goat, meat 1.0 ppm; goat, meat byproducts 5.0 ppm; horse, fat 1.0 ppm; horse, meat 1.0 ppm; horse, meat byproducts 5.0 ppm; sheep, fat 1.0 ppm; sheep, meat 1.0 ppm; sheep, meat byproducts 5.0 ppm. ***[40 CFR 180.390(a)(3)]:*** milk, 0.8 ppm.

Regulatory Authority and Advisory Information:

Health Advisory: Developmental Toxin (TRI)
Toxicity (oral) Category (depending on formulation) 2, WARNING; Category: 3, CAUTION
Potential Ground Water Pollutant [California FAC Section 13145(d)/12811, active]
EPCRA Section 313 Form R *de minimis* concentration reporting level: 1.0%
European/International Regulations: Hazard Symbol: Xn, N; risk phrases: R22; R50/53; safety phrases: S2; S37; S60; S61 (see Appendix 1)

Description: Grayish to dark-brown pellets, granules, or powder; Technical grade is colorless. Musty odor. Molecular weight = 228.33; Specific gravity (H_2O:1) = 1.19 @ 20 °C; Boiling point = (decomposes); Freezing/Melting point = 163 °C; Vapor pressure = 2.2×10^{-6} mmHg @ 20 °C; 0.27 mmHg @ 25 °C. Henry's Law constant = 1.2×10^{-10} atm-m^3/mol @ 25 °C[83,USDA]. Soluble in water: solubility: >2000 ppm @ 25 °C (powder).

Incompatibilities: Keep away from strong oxidizers and alkalies.

Permissible Concentration in Water: Federal Drinking Water Guidelines: EPA 500 μg/L; State Drinking Water Guidelines: Arizona 35 μg/L; Florida 490 μg/L. Runoff from spills or fire control may cause water pollution.

Determination in Water: Log K_{ow} = <2.0. Unlikely to bioaccumulate in marine organisms.

Routes of Entry: Inhalation, dermal contact, ingestion.

Harmful Effects and Symptoms

Short Term Exposure: Contact with eyes or skin may cause irritation or burns. May cause corneal damage. Inhalation should be avoided; use NIOSH- or CEN (UK)-approved air-purifying respirators for pesticides. May be harmful if swallowed causing nausea, vomiting and diarrhea. Dermal contact may cause allergic reaction. LD_{50} (oral, rat) = 640 mg/kg; LD_{50} (dermal, rat) = >5 g/kg[83].

Medical Surveillance: Preliminary medical exam to detect chronic diseases of central nervous system, liver, heart, kidneys, lung and skin, as well as endocrinological or immunological disturbances, should protect susceptible individuals. Periodical medical exams of internal organs, skin and eyes are important to avoid chronic occupational intoxications. They should include lab and patch tests when necessary[83]. Urinary levels of the sulfonylurea herbicides reflect recent exposure. There is very limited information on the biomonitoring of sulfonylurea herbicides or their metabolites. Detection of the metabolites may reflect exposure to more than one particular sulfonylurea herbicide or exposure to environmental degradation products[96]. Evaluation by a qualified allergist, including exposure history and testing, may help diagnose allergy. Eye examination by an ophthalmologist.

First Aid: If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least 15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately. If this chemical contacts the skin, remove contaminated clothing and wash immediately with soap and water. Seek medical attention immediately. If this chemical has been inhaled, remove from exposure, begin rescue breathing (using universal precautions) if breathing has stopped, and CPR if heart action has stopped. Transfer promptly to a medical facility. When this chemical has been swallowed, get medical attention. Give large quantities of water and induce vomiting. Do not make an unconscious person vomit.

Personal Protective Methods: Wear protective gloves and clothing to prevent any reasonable probability of dermal and/or eye contact. Safety equipment suppliers/manufacturers can provide recommendations on the most protective glove/clothing material for your operation. All protective clothing (suits, gloves, footwear, headgear) should be clean, available each day, and put on before work. Contact lenses should not be worn when working with this chemical. Wear dust-proof chemical goggles and face shield unless full facepiece respiratory protection is worn. Employees should wash immediately with soap when skin is wet or contaminated. Provide emergency showers and eyewash.

Respirator Selection: Wherever and whenever workplace conditions warrant respirator use, a respiratory protection program must be followed that meets one or more of the following government standards: OSHA's 29 CFR 1910.134, ANSI Z88.2, or European Standard EN 149.

Storage: Color Code-Blue: Health Hazard/Poison. Store in a secure poison location. Store in a refrigerator and protect from exposure to oxidizers or moisture[52]. A regulated, marked area should be established where this chemical is handled, used, or stored in compliance with OSHA Standard 1910.1045. Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: Environmentally hazardous substances, solid or liquid, usually fall in Hazard Class 9.

Spill Handling: Evacuate and restrict persons not wearing protective equipment from area of spill or leak until clean up is complete. Dampen spilled material with alcohol to avoid dust. Collect powdered material in the most convenient and safe manner and deposit in sealed containers. Ventilate area of spill or leak after clean up is complete. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable.

Fire Extinguishing: Hazardous decomposition includes oxides of sulfur and nitrogen. As an immediate precautionary measure, isolate spill or leak area in all directions for at least 50 meters/150 feet for liquids and at least 25 meters/75 feet for solids. *Fire involving storage or vehicular tanks:* isolate for 800 meters/0.5 mile in all directions; also, consider initial evacuation for 800 meters/0.5 mile in all directions. *On a small fire:* use dry chemical, CO_2, water spray or regular foam. *On a large fire:* use water spray, fog or regular foam.

Do not scatter spilled material with high-pressure streams of water. Move containers from fire area if you can do it without risk. Dike fire-control water for later disposal. *Fire involving tanks:* from a secure, explosion-proof location, use water spray to cool exposed containers. If cooling streams are ineffective (venting sound increases in volume and pitch, tank discolors, or shows any signs of deforming), withdraw immediately to a secure position. Always stay away from tanks engulfed in fire. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode.

Disposal Method Suggested: It is the responsibility of chemical waste generators to determine the toxicity and physical properties of a discarded chemical and to properly identify its classification and certification as a hazardous waste and to determine the disposal method. U.S. EPA guidelines for the classification determination are listed in ***40 CFR*** Parts 261.3. Additionally, waste generators must consult and follow all regional, national, state and local hazardous waste laws to ensure complete and accurate classification and disposal methods. Recycle any unused portion of the material for its approved use or return it to the manufacturer or supplier. Ultimate disposal of the chemical must consider: the material's impact on air quality; potential migration in soil or water; effects on animal, aquatic, and plant life; and conformance with environmental and public health regulations[83].

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- USEPA, Office of Pesticide Programs, Pesticide Residue Limits, "Tebuthiuron," 40 CFR 180.390. http://www.epa.gov/pesticides/food/viewtols.htm
- EXTOXNET, Extension Toxicology Network, "Pesticide Information Profile, Tebuthiuron," Oregon State University, Corvallis, OR (September 1993). http://pmep.cce.cornell.edu/profiles/extoxnet/pyrethrins-ziram/tebuthiuron-ext.html
- USEPA, "Reregistration Eligibility Decision Fact Sheet (RED), Tebuthiuron," Office of Prevention, Pesticides and Toxic Substances, Washington DC (April 1994). http://www.epa.gov/REDs/factsheets/0054fact.pdf

Tefluthrin T:0144

Use Type: Insecticide, Miticide

CAS Number: 79538-32-2

Formula: $C_{17}H_{14}ClF_7O_2$

Synonyms: Cyclopropanecarboxylic acid, 3-(2-chloro-3,3,3-trifluoro-1-propenyl)-2,2-dimethyl-, (2,3,5,6-tetrafluoro-4-methylphenyl)methyl ester, (1α,3α*(Z)*)-(±)-; (2,3,5,6-Tetrafluoro-4-methylphenyl)methyl *cis*-3-(2-chloro-3,3,3-trifluoro-1-propenyl)-2,2-dimethylcyclopropane carboxylate; Tefluthrine

Trade Names: FORCE®; FORCE® ST; FORZA®; JF 6064®; KOMET-RP®; PP 993®; R 151993®

Chemical class: Pyrethroid

EPA/OPP PC Code: 128912

California DPR Chemical Code: 3839

HSDB Number: 7135

UN/NA & ERG Number: UN3349 (solid)/151; UN3352 (liquid)/151; UN3082 (liquid)/171; UN3077(solid)/171

RTECS® Number: GZ1227850

Uses: A U.S. EPA restricted use Pesticide (RUP). Registered in the U.S. for use on corn. Elsewhere it is registered for use on a variety of crops, e.g., peanuts, sweet potato, sugarcane, cabbage, radish, Brussels sprouts, and strawberries. Registered for use in EU countries[115].

U.S. Maximum Allowable Residue Levels (combined) for Tefluthrin and its metabolite (Z)-3- (2-chloro-3,3,3-trifluroro-1-propenyl)-2,2-dimethylcyclopropanecarboxylic acid [40 CFR 180.440]: corn, field, forage 0.06 ppm; corn, field, grain 0.06 ppm; corn, field, stover 0.06 ppm; corn, pop, forage 0.06 ppm; corn, pop, grain 0.06 ppm; corn, pop, stover 0.06 ppm; corn, sweet, forage 0.06 ppm; corn, sweet, kernel plus 0.06 ppm; cob with husks removed ppm; corn, sweet, stover 0.06 ppm.

Regulatory Authority and Advisory Information:

Carcingenicity: EPA, Not yet evaluated

Toxicity (oral) Category 1, DANGER–POISON

Health Advisory: Endocrine disruptor (S!)

Marine pollutant (IMDG)

European/International Regulations: Hazard Symbol: T+, N; risk phrases: R23/24; R28; R50/53; safety phrases: S1/2; S22; S23; S28; S36/37/39; S45; S60; S61 (see Appendix 1)

Description: Tan crystalline solid or powder. Musty odor. Commercial product is available as an emulsifiable concentrate. Molecular weight = 418.71; Specific gravity (H_2O:1) = 1.23 @ 20 °C; Boiling point = 156 °C; Freezing/Melting point = 46 °C; Vapor pressure = $6.5\ \ 10^{-5}$ mmHg @ 25 °C. Henry's Law constant = 1.6×10^{-3} atm-m^3/mol @ 25 °C (est)[83]. Practically insoluble in water; solubility = <0.002 ppm. Physical and toxicological properties may be affected by carrier solvents in commercial formulations.

Incompatibilities: May react violently with strong oxidizers, bromine, 90% hydrogen peroxide, phosphorus trichloride, silver powders or dust. Incompatible with silver compounds. Mixture with some silver compounds forms explosive salts of silver oxalate. Store at temperature <35 °C and away from alkaline materials.

Permissible Exposure Limits in Air:

NIOSH[2] IDLH = 5,000 ppm

OSHA PEL: 5 mg/m^3 TWA

NIOSH REL: 5 mg/m^3 TWA

ACGIH TLV®[1]: 5 mg/m^3 TWA

STEL set by HSE[33] = 10 mg/m^3.

Determination in Air: Collection by impinger or fritted bubbler, analysis by gas liquid chromatography/ultraviolet. See NIOSH IV, Method #5008[18]. (pyrethrum).

Determination in Water: Log K_{ow} = <6.0. Values above 3.0 are likely to bioaccumulate in aquatic organisms.

Routes of Entry: Inhalation, dermal contact (may be poisonous), ingestion.

Harmful Effects and Symptoms

Short Term Exposure: Toxic by inhalation and dermal and/or eye contact. Highly toxic if swallowed; nausea, vomiting, abdominal pain, and diarrhea may develop within 10 to 60 minutes following ingestion. Inhalation may cause skin, eye, and respiratory tract irritation. Stuffiness, runny nose and scratchy throat following inhalation exposure may be noted. Hypersensitivity reactions characterized by pneumonitis, cough, dyspnea, wheezing, chest pain, and bronchospasm may occur. High exposures may cause respiratory failure, including cardiopulmonary arrest; death may occur. Mild skin sensitizer. LD_{50} (oral, rat) = <50 mg/kg; LD_{50} (dermal, rabbit) = <200 mg/kg.

Long Term Exposure: Redness or rash of the skin (erythema), a skin condition that mimics sunburn, may occur following prolonged repeated exposure.

Points of Attack: Skin, lungs.

Medical Surveillance: Before beginning employment and at regular times after that, the following are recommended: Employees should be screened for history of certain medical conditions which might place the employee at increased risk from pyrethroid exposure. Chronic respiratory disease: In persons with chronic respiratory disease, especially asthma, the inhalation of pyrethroids might cause exacerbation of symptoms due to its sensitizing properties. Lung function tests. These may be normal if the person is not having an attack at the time of the test. Consider chest x-ray if lung symptoms are present. Skin disease: Pyrethroids can cause dermatitis which may be allergic in nature. Persons with pre-existing skin disorders may be more susceptible to the effects of this agent. Evaluation by a qualified allergist, including exposure history and testing, may help diagnose allergy. Any employee developing the above-listed conditions should be referred for further medical examination[9].

First Aid: If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least 15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately. If this chemical contacts the skin, remove contaminated clothing and wash immediately with soap and water. Seek medical attention immediately. If this chemical has been inhaled, remove from exposure, begin rescue breathing (using universal precautions) if breathing has stopped, and CPR if heart action has stopped. Transfer promptly to a medical facility. When this chemical has been swallowed, get medical attention. Give large quantities of water and induce vomiting. Do not make an unconscious person vomit. Do not induce vomiting when formulations containing petroleum solvents are ingested.

Respirator Selection: NIOSH/OSHA *for pyrethrum*: *50 mg/m³:* CcrOv95 (APF = 10) [any air-purifying half-mask respirator equipped with an organic vapor cartridge(s) in combination with an N95, R95, or P95 filter. The following filters may also be used: N99, R99, P99, N100, R100, P100]; or Sa (APF = 10) (any supplied-air respirator). *125 mg/m³:* Sa:Cf (APF = 25) (any supplied-air respirator operated in a continuous-flow mode); or PaprOvHie (APF = 25) (any air-purifying ful facepiece respirator equipped with an organic vapor cartridge in combination with a high-efficiency particulate filter). *250 mg/m³:* CcrFOv100 (APF = 50) [any air-purifying full facepiece respirator equipped with organic vapor cartridge(s) in combination with an N100, R100, or P100 filter]; or PaprTOvHie (APF = 50) [any powered, air-purifying respirator with a tight-fitting face-piece and organic vapor cartridge(s) in combination with a high-efficiency particulate filter]; or SCBAF (APF = 50) (any self-contained breathing apparatus with full facepiece); or SaF (APF = 50) (any supplied-air respirator with a full facepiece). *5000 mg/m³:* SaF:Pd,Pp (APF = 2000) (any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode). *Emergency or planned entry into unknown concentrations or IDLH conditions:* SCBAF:Pd,Pp (APF = 10,000) (any self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode); or SaF:Pd,Pp:ASCBA (APF = 10,000) (any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary self-contained breathing apparatus operated in a pressure-demand or other positive-pressure mode). *Escape:* GmFOv100 (APF = 50) [any air-purifying, full facepiece respirator (gas mask) with a chin-style, front- or back-mounted organic vapor canister having an N100, R100, or P100 filter]; or SCBAE (any appropriate escape-type, self-contained breathing apparatus). *Note:* Substance reported to cause eye irritation or damage; may require eye protection.

Storage: Color Code-Blue: Health Hazard/Poison. Store in a secure poison location at temperature <35 °C and away from alkaline materials. Prior to working with this chemical you should be trained on its proper handling and storage. Store in tightly closed containers in a cool, well-ventilated area. Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: This material is a toxic pesticide and should be labeled "poisonous materials." It falls into Hazard Class 6.1. PG I.

Spill Handling: First remove all sources of ignition. Evacuate persons not wearing protective equipment from area of spill or leak until clean up is complete. Ventilate area of spill or leak. Use water spray to reduce vapor. Absorb liquids in vermiculite, dry sand, earth, or a similar material and deposit in sealed containers. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations.

If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable.

Fire Extinguishing: Hazardous decomposition includes hydrogen chloride, hydrogen fluoride, and oxides of carbon. *On a small fire:* use dry chemical, CO_2 or water spray. *On a large fire:* use water spray, fog or regular foam. Move containers from fire area if you can do it without risk. Dike fire-control water for later disposal; do not scatter the material. Use water spray or fog; do not use straight streams. *Fire involving storage or vehicular tanks:* isolate for 800 meters/0.5 mile in all directions; also, consider initial evacuation for 800 meters/0.5 mile in all directions. Fight fire from maximum distance or use unmanned hose holders or monitor nozzles. Do not get water inside containers. Cool containers with flooding quantities of water until well after fire is out. Withdraw immediately in the case of rising sound from venting safety devices or discoloration of tank. ALWAYS stay away from tanks engulfed in fire. For massive fire, use unmanned hose holders or monitor nozzles; if this is impossible, withdraw from area and let fire burn. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies.

Disposal Method Suggested: Incineration would be an effective disposal procedure where permitted. If an efficient incinerator is not available, the product should be mixed with large amounts of combustible material and contact with the smoke should be avoided. In accordance with 40CFR165, follow recommendations for the disposal of pesticides and pesticide containers.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- USEPA, Office of Pesticide Programs, Pesticide Residue Limits, "Tefluthrin," 40 CFR 180.440. http://www.epa.gov/pesticides/food/viewtols.htm

Temephos T:0170

Use Type: Insecticide, Larvicide

CAS Number: 3383-96-8

Formula: $C_{16}H_{20}O_6P_2S_3$

Synonyms: Bis-*p*-(*O,O*-dimethyl *O*-phenyl phosphorothioate)sulfide; *O,O*-Dimethylphosphorothioate *O,O*-diester with 4,4'-thiodiphenol; ENT 27,165; Phenol,4,4'-thiodi-, *O,O*-diester with *O,O*-dimethyl phosphorothioate; Phosphorothioic acid, *O,O'*-dimethyl ester, *O,O*-diester with 4,4'-thiodiphenol; Phosphorothioic acid, *O,O'*-(thiodi-4,1-phenylene)*O,O,O',O'*-tetramethyl ester; Phosphorothioic acid, *O,O'*-(thiodi-*p*-phenylene)*O,O,O',O'*-tetramethyl ester; Swebate; Temefos (Spanish); Temophos; Tetrafenphos; Tetramethyl-*O,O'*-thiodi-*p*-phenylene phosphorothioate; *O,O,O',O'*-Tetramethyl *O,O'*-thiodi-*p*-phenylene bis(phosphorothioate); *O,O,O',O'*-Tetramethyl *O,O'*-thiodi-*p*-phenylenephosphorothioate; *O,O'*-(Thiodi-4,1-phenylene)bis(*O,O*-dimethylphosphorothioate); *O,O'*-(Thiodi-4,1-phenylene)phosphorothioic acid *O,O,O',O'*-tetramethyl ester; *O,O'*-(Thiodi-*p*-phenylene)*O,O,O',O'*-tetra methylbis(phosphorothioate)

Trade Names: 27165®; ABAT®; ABATE®; ABATE® 1-SG; ABATE® 2-CG; ABATE® 4-E; ABATE® 5CG; ABATHION®; AI3-27165®; AC 52160®; AMERICAN CYANAMID AC-52,160®; AMERICAN CYANAMID CL-52160®; AMERICAN CYANAMID E. I.52,160®; BIOTHION®; BITHION®; CL 52160®; DIFENPHOS®; DIFENTHOS®; DIFOS®; DIPHOS®; ECOPRO®; ECOPRO® 1707; EI 52160®; NEPHIS®; NEPHIS® 1G; NIMITEX®; NIMITOX®

Chemical class: Organophosphate

EPA/OPP PC Code: 059001

California DPR Chemical Code: 1

HSDB Number: 956

UN/NA & ERG Number: UN2783 (solid)/152

RTECS® Number: TF6890000

EC Number: 222-191-1

Uses: Temephos is one of the few organophosphates that is registered to control mosquito larvae. It is a non-systemic insecticide for use on wetlands, ponds, lakes and other moist areas to control mosquito, gnat, black fly, midge, pinkie and sandfly larvae. Banned for use in EU countries[115]. Registered for use in the U.S.

Regulatory Authority and Advisory Information:

Carcinognicity: EPA, Not yet determined

Health Advisory: Nerve Toxin, Developmental/Reproductive Toxin

Toxicity (oral) Category (depending on formulation) 2, WARNING; Category: 3, CAUTION

EPCRA Section 313 Form R *de minimis* concentration reporting level: 1.0%

U.S. DOT 49CFR172.101, Inhalation Hazard Chemical as organophosphates

U.S. DOT Regulated Marine Pollutant (49CFR172.101, Appendix B)

Description: Temephos is a crystalline solid, powder, or liquid (>30.5 °C). The technical product is a brown viscous liquid. Commercial product is available as an emulsifiable concentrate. Molecular weight = 466.48; Boiling point = 120–125 °C; Freezing/Melting point = 30.6 °C; Vapor pressure = 7.9×10^{-8} mmHg @ 25 °C (sest.)[83]; Flash point = 43–92 °C (based on formulation, NFPA). Henry's Law constant = 1.2×10^{-9} atm-m^3/mol @ 25 °C (est)[83]. Practically insoluble in water. Physical and toxicological properties may be affected by carrier solvents in commercial formulations.

Incompatibilities: Strong acids and bases. In the presence of strong reducing agents such as hydrides, organophosphates form highly toxic and flammable phosphine gas. Contact with oxidizers can cause the release of toxic oxides of phosphorus.

Permissible Exposure Limits in Air: OSHA PEL: 15 mg/m^3 TWA, total dust; 5 mg/m^3 TWA respirable fraction.

NIOSH REL: 10 mg/m^3 TWA, total dust; 5 mg/m^3 TWA respirable fraction.

ACGIH TLV®[1]: 1 mg/m^3 TWA, inhalable fraction and vapors [skin]; Not Classifiable as a human Carcinogen; BEI$_A$ issued for Acetylcholinesterase inhibiting pesticides.

No Protective Action Criteria (PAC) available.

Determination in Air: Collection on a filter and gravimetric analysis.

Permissible Concentration in Water: No criteria set. Experience in the field for a period of more than one year has shown, however, that 1 mg/L in drinking water is without effect.

Determination in Water: NIOSH Method 1657. The determination of organophosphorus pesticides in municipal and industrial wastewater by gas chromatography. Detection limit = 6.0 ng/L. Log K_{ow} = >6.0 Values above 3.0 are likely to bioaccumulate in aquatic organisms.

Routes of Entry: Inhalation, skin absorption, ingestion, skin and/or eye contact.

Harmful Effects and Symptoms: Organophosphates are highly toxic. Symptoms may develop rapidly, or there may be a delay of several hours following exposure before they become noticeable. The delay tends to be longer in the case of some compounds that dissolve fats, lipids, oils and non-polar solvents such as toluene. Symptoms may increase in severity for more than a single day and last for several days. In severe cases of organophosphate intoxication, respiratory failure may occur.

Short Term Exposure: Temephos can affect you when breathed in and quickly enters the body by passing through the skin. Severe poisoning can occur from dermal and/or eye contact. It is a moderately toxic organophosphate chemical. Exposure can cause rapid severe poisoning with headache, sweating, nausea and vomiting, diarrhea, loss of coordination, and death. Delayed pulmonary edema may occur after inhalation. LD_{50} (oral, rat) = 444[14]–> 1 g/kg[83]; LD_{50} (dermal, rat) = 1–> 3 g/kg.

Long Term Exposure: Cholinesterase inhibitor; cumulative effect is possible. This chemical may damage the nervous system with repeated exposure, resulting in convulsions, respiratory failure. May cause liver damage.

Points of Attack: Respiratory system, lungs, central nervous system, cardiovascular system, skin, eyes, plasma and red blood cell cholinesterase.

Medical Surveillance: Medical observation is recommended for 24 to 48 hours following breathing overexposure, as pulmonary edema may be delayed.Routine biological monitoring of pesticide applicators and field workers includes testing of plasma and red blood cell acetylcholinesterase levels (for enzyme poisoned by this chemical). These tests are normally accurate only if done within about two hours of exposure. If exposure stops, plasma levels return to normal in 1-2 weeks while red blood cell levels may be reduced for 1-3 months. When acetylcholinesterase enzyme levels are reduced by 25% or more below preemployment levels, risk of poisoning is increased, even if results are in lower ranges of "normal." Reassignment to work not involving organophosphate pesticides is recommended until enzyme levels recover. Do not drink any alcoholic beverages before or during use as it promotes absorption of organophosphates.

First Aid: **Treatment for organophosphate poisoning consists of thorough decontamination, cardiorespiratory support, and administration of the antidotes atropine and pralidoxime. In cases of severe poisoning, diazepam, an anticonvulsant, should also be administered. Antidotes should be administered as prevention even if the diagnosis is in doubt**. Speed in removing material from eyes and skin is of extreme importance. *Eyes:* Eye contact can cause dangerous amounts of these chemicals to be quickly absorbed through the mucous membrane into the bloodstream. Immediately and gently flush eyes with plenty of warm or cold water (NO hot water) for at least 15 minutes, occasionally lifting the upper and lower eyelids. Get medical aid immediately. *Skin:* Get medical aid. Dermal contact can cause dangerous amounts of these chemicals to be absorbed into the bloodstream. Wearing the appropriate PPE equipment and respirator for organophosphate pesticides, immediately flush skin with plenty of soap and water for at least 15 minutes while removing contaminated clothing and shoes. Shampoo hair promptly if contaminated. The removed, contaminated clothing and shoes should be double-bagged and left in Hot Zone for later disposal by hazardous materials experts. Skin may also be decontaminated with diluted hypochlorite solution. *Inhalation:* Get medical aid. Do not contaminate yourself. Wearing the appropriate PPE equipment and respirator for organophosphate pesticides, immediately remove the victim from the contaminated area to fresh air. If the victim is not breathing, administer artificial respiration. Do not use mouth-to-mouth method if victim ingested or inhaled the substance; give artificial respiration with the aid of a pocket mask equipped with a one-way valve or other proper respiratory medical device. If breathing is difficult, administer oxygen through bag/mask apparatus until medical help arrives. Do not leave victim unattended. *Ingestion:* Call poison control. Loosen all clothing. Never give anything by mouth to an unconscious person. If victim is *unconscious or having convulsions,* do nothing except keep victim warm. Get medical aid. Transfer promptly to a medical facility. In cases of ingestion, **do not induce vomiting**. If the victim is alert and asymptomatic, administer a slurry of activated charcoal at a dose of 1 g/kg (infant, child, and adult dose). A soda can and straw may be of assistance when offering charcoal to a child. *In some cases you may be specifically instructed by poison control to induce vomiting by way of 2 tablespoons of syrup of ipecac (adult) washed down with a cup of water*. Do NOT give activated charcoal before or with ipecac syrup

Note to physician or authorized medical personnel: Treat cases of respiratory compromise, coma, or excessive pulmonary secretions with respiratory support using protocols and techniques available and within the scope of training. Some cases may necessitate procedures such as endotracheal intubation or cricothyrotomy by properly trained and equipped personnel. When possible, atropine (see *Antidotes*, below) should be given under medical supervision. Patients who are comatose, hypotensive, or having seizures or cardiac arrhythmias should be treated according to advanced life support protocols. *Antidotes:* Two antidotes are administered to treat organophosphate poisoning. Atropine is a competitive antagonist of acetylcholine at muscarinic receptors and is used to control the excessive bronchial secretions which are often responsible for death. Pralidoxime relieves both the nicotinic and muscarine effects of organophosphate poisoning by regenerating acetylcholinesterase and can reduce both the bronchial secretions and the muscle weakness associated with poisoning. The initial intravenous dose of atropine in adults should be determined by the severity of symptoms: An initial adult dose of 1.0 to 2.0 mg or pediatric dose of 0.01 mg/kg (minimum 0.01 mg) should be administered intravenously. If intravenous access cannot be established, atropine may also be given intramuscularly, subcutaneously or via endotracheal tube. Doses should be repeated every 15 minutes until excessive secretions and sweating have been controlled. Once bronchial secretion has been controlled, atropine administration should be repeated whenever the secretions begin to recur. In seriously poisoned patients, very large doses may be required. Alterations of pulse rate and pupillary size should not be used as indicators of treatment adequacy. Pralidoxime should be administered as early in poisoning as possible as its efficacy may diminish when given more than 24 to 36 hours after exposure. Doses are as follows: adult 1.0 g; pediatric 25 to 50 mg/kg. The drug should be administered intravenously over 30 to 60 minutes, but in a life-threatening situation one-half of the total dose can be given per minute for a total administration time of 2 minutes. Treatment should begin to take effect within 40 minutes with a reduction in symptoms and the amount of atropine necessary to control bronchial secretion. The initial dose can be repeated in 1 hour and then every 8 to 12 hours until the patient is clinically well and no longer requires atropine. If intravenous access cannot be established, pralidoxime may also be given intramuscularly. Early administration of diazepam in addition to the combined atropine and pralidoxime treatment may help prevent the onset of seizures and potential brain and cardiac morphologic damage following high-level organophosphate poisoning.

Respirator Selection: Wherever and whenever workplace conditions warrant respirator use, a respiratory protection program must be followed that meets one or more of the following government standards: OSHA's 29 CFR 1910.134, ANSI Z88.2, or European Standard EN 149.

Storage: Color Code-Blue: Health Hazard/Poison. Store in a secure poison location. Prior to working with this chemical, you should be trained on its proper handling and storage. Store in tightly closed containers in a cool, well-ventilated area away from strong bases. Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: Organophosphorus pesticides, solid or liquid (nonflammable), require a label of "poisonous materials." This chemical falls in Hazard Class 6.1.

Spill Handling: First remove all sources of ignition. Evacuate persons not wearing protective equipment from area of spill or leak until clean up is complete. Stay upwind; keep out of low areas. Ventilate area of spill or leak. Remove and isolate contaminated clothing at the site. Do not touch spilled material; stop leak if you can do so without risk. Use water spray to reduce vapors. *Small spills:* absorb with sand or other noncombustible absorbent material and place into containers for later disposal. *Large spills:* dike far ahead of spill for later disposal. Collect powdered material in the most convenient and safe manner and deposit in sealed containers. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable. Seek professional environmental engineering assistance from the U.S. EPA Environmental Response Team at (908) 548-8730 (24-hour response line).

Fire Extinguishing: Hazardous decomposition includes of phosphorus, sulfur, and nitrogen. May be fatal if inhaled, ingested or absorbed through skin. Inhalation or contact with some of these materials will irritate or burn skin and eyes. Vapors may cause dizziness or suffocation. *Small fires:* dry chemical, carbon dioxide; water spray; or foam. *Large fires:* water spray, fog, or foam. Stay upwind; keep out of low areas. Ventilate closed spaces before entering them. Firefighting gear (including SCBA) may not provide adequate protection. If exposure occurs, remove and isolate gear immediately and thoroughly decontaminate personnel. Wear positive-pressure breathing apparatus and special protective clothing. Remove and isolate contaminated clothing at the site. Move container from fire area if you can do so without risk. Fight fire from maximum distance. Dike fire-control water for later disposal; do not scatter the material. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies. From a secure, explosion-proof location, use water spray to cool exposed containers. If cooling streams are ineffective (venting sound increases in volume and pitch, tank discolors, or shows any signs of deforming), withdraw immediately to a secure position. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode.

Disposal Method Suggested: Destruction by alkali hydrolysis or incineration. Containers must be disposed of properly by following package label directions or by contacting your local or federal environmental control agency, or by contacting your regional EPA office.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- EXTOXNET, Extension Toxicology Network, "Pesticide Information Profile, Temephos," Oregon State University, Corvallis, OR (June 1996). http://extoxnet.orst.edu/pips/temephos.htm
- New Jersey Department of Health and Senior Services, "Hazardous Substance Fact Sheet: Temephos," Trenton, NJ (April 1986, rev. May 2000). http://www.state.nj.us/health/eoh/rtkweb/1780.pdf
- Pohanish, R. P., "Rapid Guide to Hazardous Chemicals in the Environment," Van Nostrand Reinhold, New York, NY (1997)
- Agency for Toxic Substances and Disease Registry, U.S. Department of Health and Human Services, Public Health Service, "Managing Hazardous Materials Incidents," Atlanta, GA (June 2003)

Terbacil T:0185

Use Type: Herbicide

CAS Number: 5902-51-2

Formula: $C_9H_{13}ClN_2O_2$

Synonyms: 3-*tert*-Butyl-5-chloro-6-methyluracil; 5-Chloro-3-*tert*-butyl-6-methyluracil; 5-Chloro-3-(1,1-dimethylethyl)-6-methyl-2,4(1*H*,3*H*)-pyrimidinedione;5-Chloro-3-(1,1-dimethyl)-6-methyl-2,4(1*H*,3*H*)-pyrimidinedione; 5-Chloro-3-(1,1-dimethylethyl)-6-methyl-2,4(1H,3H)-pyrimidinedione; 5-Chloro-3-*tert*-butyl-6-methyluracil; 2,4(1*H*,3*H*)-Pyrimidinedione, 5-chloro-3-(1,1-dimethylethy)-6-methyl-; Uracil, 3-*tert*-butyl-5-chloro-6-methyl-

Trade Names: COMPOUND® 732; DuPont™® 732; EXPERIMENTAL HERBICIDE 732; GEONTER®; SINBAR®; TURBSVIL®; ZOBAR®[C]

Chemical class: Uracil

EPA/OPP PC Code: 012701

California DPR Chemical Code: 532

HSDB Number: 1418

UN/NA & ERG Number: None assigned

RTECS® Number: YQ9360000

EC Number: 227-595-2

Uses: Terbacil is a selective herbicide that treats a broad spectrum of broadleaf weeds and grasses. It is formulated as a wettable powder and is applied by aircraft or ground equipment on terrestrial food and feed crops (e.g., apples, mint/peppermint/spearmint, sugarcane, and ornamentals), forestry [e.g., cottonwood (forest/shelterbelt)], terrestrial food (e.g., asparagus, blackberry, boysenberry, dewberry, loganberry, peach, raspberry, youngberry and strawberry), and terrestrial feed (e.g., alfalfa, sainfoin (hay and fodder), and forage). Not approved for use in EU countries[115]. Registered for use in the U.S.

U.S. Maximum Allowable Residue Levels for Terbacil [40 CFR 180.209]: alfalfa, forage 1.0 ppm; alfalfa, hay 2.0 ppm; apple 0.3 ppm; asparagus 0.4 ppm; blueberry 0.2 ppm; caneberry subgroup 13a, 0.2 ppm; peach 0.2 ppm; peppermint, tops 2.0 ppm; spearmint, tops 2.0 ppm; strawberry 0.1 ppm; sugarcane, cane 0.4 ppm; watermelon 0.4 ppm.

Regulatory Authority and Advisory Information:

Carcinogenicity[83]: EPA Group E, evidence of non-carcinogenicity for humans

California Proposition 65 Chemical: Developmental/Reproductive toxin (5/18/1999)

Health Advisory: Developmental & Reproductive toxin (TRI)

Toxicity (oral) Category 4, Caution.

EPCRA Section 313 Form R *de minimis* concentration reporting level: 1.0%

Description: White crystalline powder; colorless crystalline solid or powder. Odorless. Molecular weight = 216.65; Specific gravity (H_2O:1) = 1.35 @ 20 °C; Boiling point = (decomposes) <175 °C; Freezing/Melting point = 176 °C; Vapor pressure = 4.5×10^{-7} mmHg @ 29.5 °C. Henry's Law constant = 1.9×10^{-10} atm-m^3/mol @ 25 °C (est)[83]. High solubility in water; solubility = 712 ppm @ 25 °C.

Incompatibilities: Incompatible with strong oxidizers. Decomposes in temperatures >173 °C. Dust may form explosive mixture with air.

Determination in Air: Filter; none; Gravimetric; NIOSH IV [Particulates NOR; #0500 (total), #0600 (respirable)][18].

Permissible Concentration in Water: Federal Drinking Water Guidelines: EPA 90 μg/L; State Drinking Water Guidelines: Florida 91 μg/L Groundwater: Using the maximum groundwater concentration of 0.0089 mg/L an estimated daily intake, assuming 2 L/day of water, is 0.00025 mg[terbacil]/kg body wt/day for an adult, assuming 1 L/day of water, is 0.00089 mg[terbacil]/kg body wt/day for a 10 kg child; Surface water: Using the maximum concentration of 0.105 ∝g/L found near sugar cane fields an estimated daily intake, assuming 2 L/day of water, is 0.003 mg[terbacil]/kg body wt/day for an adult, assuming 1 L/day of water, is 0.00105 mg[terbacil]/kg body wt/day for a 10 kg child[83].

Determination in Water: Log K_{ow} = <2.0. Unlikely to bioaccumulate in marine organisms.

Routes of Entry: Inhalation, skin and eye contact.

Harmful Effects and Symptoms

Short Term Exposure: Contact or inhalation may cause irritation to the skin, eyes and respiratory tract. Ingestion may be followed by dizziness, elevated temperature, nausea, vomiting, and diarrhea. Overexposure may produce pulmonary edema, cyanosis and methemoglobinemia. LD_{50} (oral, rat) = >5 g/kg; LD_{50} (dermal, rat) = >2 g/kg.

Long Term Exposure: May cause damage of the liver, kidneys, central nervous system.

Medical Surveillance: Preliminary medical exam to detect chronic diseases of central nervous system, liver, heart, kidneys, lung and skin, as well as endocrinological or immunological disturbances, should protect susceptible individuals. Periodical medical exams of internal organs, skin and eyes are important to avoid chronic occupational intoxications. They should include lab and patch tests when necessary[83]. Comprehensive physical examination with emphasis on the genito-urinary tract analysis to include sperm count, motility and morphology. Other tests, such as serum testosterone, serum follicle stimulating hormone (FSH), and serum lutenizing hormone (LH), may be carried out if, in the opinion of a physician, they are indicated. Medical observation is recommended for 24 to 48 hours following breathing overexposure, as pulmonary edema may be delayed. Before beginning employment and at regular times after that, for those with frequent or potentially high exposures, the following are recommended: Lung function tests. If symptoms develop or overexposure is suspected, the following may be useful: Complete blood count. Test for methemoglobin if skin is blue.

First Aid: If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least 15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately. If this chemical contacts the skin, remove contaminated clothing and wash immediately with soap and water. Seek medical attention immediately. If this chemical has been inhaled, remove from exposure, begin rescue breathing (using universal precautions) if breathing has stopped, and CPR if heart action has stopped. Transfer promptly to a medical facility. When this chemical has been swallowed, get medical attention. Give large quantities of water and induce vomiting. Do not make an unconscious person vomit. Do not induce vomiting when formulations containing petroleum solvents are ingested

Personal Protective Methods: Wear protective gloves and clothing to prevent any reasonable probability of dermal and/or eye contact. Safety equipment suppliers/manufacturers can provide recommendations on the most protective glove/clothing material for your operation. All protective clothing (suits, gloves, footwear, headgear) should be clean, available each day, and put on before work. Contact lenses should not be worn when working with this chemical. Wear splash- or dust-proof chemical goggles (depending on physical state of material) and face shield unless full facepiece respiratory protection is worn. Employees should wash immediately with soap when skin is wet or contaminated. Provide emergency showers and eyewash.

Respirator Selection: Where potential exists for exposures *over 1ppm*, use a NIOSH/MSHA- or European Standard EN149-approved respirator equipped with particulate (dust/fume/mist) filters. Particulate filters must be checked every day before work for physical damage, such as rips or tears, and replaced as needed. *Where potential for high exposures exists*, use a NIOSH/MSHA- or European Standard EN149-approved supplied-air respirator with a full facepiece operated in the positive-pressure mode, or with a full facepiece, hood, or helmet in the continuous-flow mode; or use a NIOSH/MSHA- or European Standard EN149-approved self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive-pressure mode.

Storage: Color Code-Blue: Health Hazard/Poison. Store in a secure poison location. Color Code-Green: General storage may be used. Prior to working with this chemical you should be trained on its proper handling and storage. Store in tightly closed containers in a cool, well-ventilated area away from strong acids; oxidizers, heat and open flame. Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: No information found.

Spill Handling: Evacuate and restrict persons not wearing protective equipment from area of spill or leak until clean up is complete. Absorb liquid in vermiculite, dry sand, earth, or similar material. Collect powdered material in the most convenient and safe manner and deposit in sealed containers. Ventilate area of spill or leak after clean up is complete. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable. Soil Adsorption Index K_{oc} = 32.

Fire Extinguishing: Hazardous decomposition includes hydrogen chloride and oxides of nitrogen and oxygen. Terbacil may burn, but does not readily ignite; may be ignited by heat or open flame. Dust may cause an explosion. Use dry chemical, carbon dioxide; water spray; or foam extinguishers. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies. From a secure, explosion-proof location, use water spray to cool exposed containers. If cooling streams are ineffective (venting sound increases in volume and pitch, tank discolors, or shows any signs of deforming), withdraw immediately to a secure position. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode.

Disposal Method Suggested: Do not discharge into drains or sewers. Dispose of waste material as hazardous waste using a licensed disposal contractor to an approved landfill. Consult with environmental regulatory agencies for guidance on acceptable disposal practices. If allowed, incineration with effluent gas scrubbing is recommended.

Containers must be disposed of properly by following package label directions or by contacting your local or federal environmental control agency, or by contacting your regional EPA office.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- USEPA, Office of Pesticide Programs, Pesticide Residue Limits, "Terbacil," 40 CFR 180.209. http://www.epa.gov/pesticides/food/viewtols.htm
- USEPA, "Reregistration Eligibility Decision (RED), Terbacil," Office of Prevention, Pesticides and Toxic Substances, Washington DC (January 1998). http://www.epa.gov/REDs/0039red.pdf
- EXTOXNET, Extension Toxicology Network, "Pesticide Information Profile, Terbacil," Oregon State University, Corvallis, OR (June 1996). http://extoxnet.orst.edu/pips/terbacil.htm

Terbufos T:0190

Use Type: Insecticide, Nematicide

CAS Number: 13071-79-9

Formula: $C_9H_{21}O_2PS_3$; $(C_2H_5O)_2PSSCH_2SC(CH_3)_3$

Synonyms: *S*-[(Tert-butylthio)methyl]-*O,O*-diethylphosphorodithioate; *S*-[((1,1-Dimethylethyl)thio) methyl]-*O,O*-diethylphosphorodithioate; Phosphorodithioic acid *S*-[(tert-butylthio)methyl]-*O,O*-diethylester; Phosphorodithioic acid *S*-[((1,1-dimethylethyl)thio)methyl]-*O,O*-diethyl ester

Trade Names: AC 921000®; ARAGRAN®; CONTRAVEN®; COUNTER®; COUNTER 15G SYSTEMIC INSECTICIDE®; PLYDOX®; TERBUROX®

Chemical class: Organophosphate

EPA/OPP PC Code: 105001

California DPR Chemical Code: 2925

HSDB Number: 6444

UN/NA & ERG Number: UN2783 (solid)/152; UN3018 (liquid)/152

RTECS® Number: TD7200000

EC Number: 235-963-8 [*Annex I Index No.:* 015-139-00-2]

Uses: This insecticide and nematicide is applied at planting time to corn, sugar beets, sorghum, maize, cotton, bananas and cabbage. It controls corn rootworms, wireworms, white grubs, maggots, billbugs and nematodes. Some above-ground pests can be controlled when soil has been treated with terbufos. Terbufos has no residential use. Not approved for use in EU countries[115]. A U.S. EPA restricted use Pesticide (RUP).

U.S. Maximum Allowable Residue Levels for Terbufos and its cholinesterase-inhibiting metabolites [40 CFR 180.352(a)]: in or on the following raw commodities: bananas 0.025 ppm; beet, sugar, roots 0.05 ppm (negligible residues); beet, sugar, tops 0.1 ppm; corn, field, fodder 0.5 ppm; corn, field, forage 0.5 ppm; corn, pop, fodder 0.5 ppm; corn, pop, forage 0.5 ppm; corn, grain 0.05 ppm (negligible residue); corn, sweet, kernel plus cob with husks removed 0.05 ppm (negligible residue); corn, sweet, forage 0.5 ppm; corn, sweet, fodder 0.5 ppm; sorghum, fodder 0.5 ppm; sorghum, forage 0.5 ppm; and sorghum, grain 0.05 ppm.

Regulatory Authority and Advisory Information:

Carcinogenicity[83]: EPA Group E, evidence of non-carcinogenicity for humans

Toxicity (oral) Category 1, DANGER–POISON

Health Advisory: Nerve Toxin

Superfund/EPCRA 302 Extremely Hazardous Substances: TPQ = 100 lb (45.4 kg)

Superfund/EPCRA 40CFR302.4 RQ: EHS, 1 lb (0.454 kg)

U.S. DOT 49CFR172.101, Inhalation Hazard Chemical as organophosphates

U.S. DOT Regulated Marine Pollutant (49CFR172.101, Appendix B), severe pollutant

European/International Regulations: Hazard Symbol: T+, N; risk phrases: R27/28; R50/53; safety phrases: S1/2; S36/37; S45; S60. S61 (see Appendix 1)

WGK (German Aquatic Hazard Class): 3-Severe hazard to waters

Description: Terbufos is a clear, colorless to pale yellow or reddish-brown liquid. Mercaptan-like odor. Some commercial products are granular solids. Molecular weight = 288.45[9]; Specific gravity (H_2O:1) = 1.105 @ 24 °C; Boiling point = 315 °C; 68.9 °C @ 0.01 mm; Freezing/Melting point = –29 °C; Vapor pressure = 3×10^{-4} mmHg @ 25 °C; Flash point = 88 °C (oc). Hazard Identification (based on NFPA-704 M Rating System): Health 4, Flammability 3, Reactivity 0. Slightly soluble in water; solubility = <1 mg/mL.

Incompatibilities: Incompatible with alkaline conditions (hydrolyzes) and strong oxidizers. In the presence of strong reducing agents such as hydrides, organophosphates form highly toxic and flammable phosphine gas. Contact with oxidizers can cause the release of toxic oxides of phosphorus.

Permissible Exposure Limits in Air: ACGIH TLV®[1]: 0.01 mg/m^3 TWA, inhalable fraction and vapor [skin]; not classifiable as a human carcinogen; BEI issued (1999)

Protective Action Criteria (PAC) Ver. 27[89]

PAC-1: 0.091 mg/m^3
PAC-2: 1 mg/m^3
PAC-3: 1 mg/m^3

Determination in Air: OSHA versatile sampler-2; Toluene/Acetone; Gas chromatography/Flame photometric detection for sulfur, nitrogen, or phosphorus; NIOSH Method IV Method #5600, Organophosphorus pesticides[18].

Permissible Concentration in Water: Federal Drinking Water Guidelines: EPA 0.2 μg/L[107]; EPA Health Advisory: zero; State Drinking Water Guidelines: Maine 0.35 μg/L; Florida 0.18 μg/L. Canadian Drinking Water Standards: IMAC 0.001 mg/L.

Determination in Water: NIOSH Method 1657. The determination of organophosphorus pesticides in municipal and industrial wastewater by gas chromatography.

Detection limit = 6.0 ng/L. Analysis of terbufos is by a gas chromatographic (GC) method applicable to the determination of certain nitrogen-phosphorus-containing pesticides in water samples. In this method, approximately 1 liter of sample is extracted with methylene chloride. The extract is concentrated and the compounds are separated using capillary column GC. Measurement is made using a nitrogen-phosphorus detector. Log K_{ow} = >4.5. Values above 3.0 are likely to bioaccumulate in aquatic organisms.

Routes of Entry: Inhalation, ingestion and dermal contact.

Harmful Effects and Symptoms: Organophosphates are highly toxic. Symptoms may develop rapidly, or there may be a delay of several hours following exposure before they become noticeable. The delay tends to be longer in the case of some compounds that dissolve fats, lipids, oils and non-polar solvents such as toluene. Symptoms may increase in severity for more than a single day and last for several days. In severe cases of organophosphate intoxication, respiratory failure may occur.

Short Term Exposure: This material may be fatal if swallowed, inhaled, or absorbed through the skin. Repeated inhalation or dermal contact may progressively increase susceptibility to poisoning. Acute exposure to terbufos may produce the following signs and symptoms: pinpoint pupils, blurred vision, headache, dizziness, muscle spasms, and profound weakness. Vomiting, diarrhea, abdominal pain, seizures, and coma may also occur. The heart rate may decrease following oral exposure or increase following dermal exposure. Chest pain may be noted. Hypotension (low blood pressure) may be noted, although hypertension (high blood pressure) is not uncommon. Respiratory symptoms include dyspnea (shortness of breath), respiratory depression, and respiratory paralysis. Psychosis may occur. Delayed pulmonary edema may occur after inhalation. LD_{50} (oral, rat) = wide variation reported from more than 1000 μg/kg to >2 g/kg.

Long Term Exposure: Cholinesterase inhibitor; cumulative effect is possible. This chemical may damage the nervous system with repeated exposure, resulting in convulsions, respiratory failure. May cause liver damage.

Points of Attack: Respiratory system, lungs, central nervous system, cardiovascular system, skin, eyes, plasma and red blood cell cholinesterase.

Medical Surveillance: Medical observation is recommended for 24 to 48 hours following breathing overexposure, as pulmonary edema may be delayed. Routine biological monitoring of pesticide applicators and field workers includes testing of plasma and red blood cell acetylcholinesterase levels (for enzyme poisoned by this chemical). These tests are normally accurate only if done within about two hours of exposure. If exposure stops, plasma levels return to normal in 1-2 weeks while red blood cell levels may be reduced for 1-3 months. When acetylcholinesterase enzyme levels are reduced by 25% or more below preemployment levels, risk of poisoning is increased, even if results are in lower ranges of "normal." Reassignment to work not involving organophosphate pesticides is recommended until enzyme levels recover. Do not drink any alcoholic beverages before or during use as it promotes absorption of organophosphates.

First Aid: **Treatment for organophosphate poisoning consists of thorough decontamination, cardiorespiratory support, and administration of the antidotes atropine and pralidoxime. In cases of severe poisoning, diazepam, an anticonvulsant, should also be administered. Antidotes should be administered as prevention even if the diagnosis is in doubt**. Speed in removing material from eyes and skin is of extreme importance. *Eyes:* Eye contact can cause dangerous amounts of these chemicals to be quickly absorbed through the mucous membrane into the bloodstream. Immediately and gently flush eyes with plenty of warm or cold water (NO hot water) for at least 15 minutes, occasionally lifting the upper and lower eyelids. Get medical aid immediately. *Skin:* Get medical aid. Dermal contact can cause dangerous amounts of these chemicals to be absorbed into the bloodstream. Wearing the appropriate PPE equipment and respirator for organophosphate pesticides, immediately flush skin with plenty of soap and water for at least 15 minutes while removing contaminated clothing and shoes. Shampoo hair promptly if contaminated. The removed, contaminated clothing and shoes should be double-bagged and left in Hot Zone for later disposal by hazardous materials experts. Skin may also be decontaminated with diluted hypochlorite solution. *Inhalation:* Get medical aid. Do not contaminate yourself. Wearing the appropriate PPE equipment and respirator for organophosphate pesticides, immediately remove the victim from the contaminated area to fresh air. If the victim is not breathing, administer artificial respiration. Do not use mouth-to-mouth method if victim ingested or inhaled the substance; give artificial respiration with the aid of a pocket mask equipped with a one-way valve or other proper respiratory medical device. If breathing is difficult, administer oxygen through bag/mask apparatus until medical help arrives. Do not leave victim unattended. *Ingestion:* Call poison control. Loosen all clothing. Never give anything by mouth to an unconscious person. If victim is *unconscious or having convulsions,* do nothing except keep victim warm. Get medical aid. Transfer promptly to a medical facility. In cases of ingestion, **do not induce vomiting**. If the victim is alert and asymptomatic, administer a slurry of activated charcoal at a dose of 1 g/kg (infant, child, and adult dose). A soda can and straw may be of assistance when offering charcoal to a child. *In some cases you may be specifically instructed by poison control to induce vomiting by way of 2 tablespoons of syrup of ipecac (adult) washed down with a cup of water*. Do NOT give activated charcoal before or with ipecac syrup

Note to physician or authorized medical personnel: Treat cases of respiratory compromise, coma, or excessive pulmonary secretions with respiratory support using protocols and techniques available and within the scope of training. Some cases may necessitate procedures such as endotracheal intubation or cricothyrotomy by properly trained and equipped personnel. When possible, atropine (see *Antidotes*, below) should be given under medical supervision. Patients who are comatose, hypotensive, or having seizures or cardiac arrhythmias should be treated according to advanced life support protocols. *Antidotes:* Two antidotes are administered to treat organophosphate poisoning. Atropine is a competitive antagonist of acetylcholine at muscarinic receptors and is used to control the excessive bronchial secretions which are often responsible for death. Pralidoxime relieves both the nicotinic and muscarine effects of organophosphate poisoning by regenerating acetylcholinesterase and can reduce both the bronchial secretions and the muscle weakness associated with poisoning. The initial intravenous dose of atropine in adults should be determined by the severity of symptoms: An initial adult dose of 1.0 to 2.0 mg or pediatric dose of 0.01 mg/kg (minimum 0.01 mg) should be administered intravenously. If intravenous access cannot be established, atropine may also be given intramuscularly, subcutaneously or via endotracheal tube. Doses should be repeated every 15 minutes until excessive secretions and sweating have been controlled. Once bronchial secretion has been controlled, atropine administration should be repeated whenever the secretions begin to recur. In seriously poisoned patients, very large doses may be required. Alterations of pulse rate and pupillary size should not be used as indicators of treatment adequacy. Pralidoxime should be administered as early in poisoning as possible as its efficacy may diminish when given more than 24 to 36 hours after exposure. Doses are as follows: adult 1.0 g; pediatric 25 to 50 mg/kg. The drug should be administered intravenously over 30 to 60 minutes, but in a life-threatening situation one-half of the total dose can be given per minute for a total administration time of 2 minutes. Treatment should begin to take effect within 40 minutes with a reduction in symptoms and the amount of atropine necessary to control bronchial secretion. The initial dose can be repeated in 1 hour and then every 8 to 12 hours until the patient is clinically well and no longer requires atropine. If intravenous access cannot be established, pralidoxime may also be given intramuscularly. Early administration of diazepam in addition to the combined atropine and pralidoxime treatment may help prevent the onset of seizures and potential brain and cardiac morphologic damage following high-level organophosphate poisoning.

Personal Protective Methods: Wear protective gloves and clothing to prevent any reasonable probability of dermal and/or eye contact. Safety equipment suppliers/manufacturers can provide recommendations on the most protective glove/clothing material for your operation. One recommendation is the use of DuPont™ Tychem® suit fabrics[88]. All protective clothing (suits, gloves, footwear, headgear) should be clean, available each day, and put on before work. Contact lenses should not be worn when working with this chemical. Wear splash-proof chemical goggles and face shield unless full facepiece respiratory protection is worn. Employees should wash immediately with soap when skin is wet or contaminated. Provide emergency showers and eyewash.

Respirator Selection: Engineering controls should be used wherever feasible to maintain airborne concentrations of this chemical below the prescribed exposure limit. Respirators and protective equipment are less effective than engineering controls, and should be used only in non-routine or emergency situations which may result in exposure concentrations in excess of the TWA environmental limit. *At any concentrations above the NIOSH REL, or where there is no REL, at any detectable concentration:* SCBAF: Pd,Pp (APF = 10,000) (any NIOSH/MSHA- or European Standard EN 149-approved self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode); or SaF: Pd,Pp: ASCBA (APF = 10,000) (any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary, self-contained breathing apparatus operated in a pressure-demand or other positive-pressure mode).

Storage: Color Code-Blue: Health Hazard/Poison. Store in a secure poison location. Prior to working with this chemical you should be trained on its proper handling and storage. Where possible, automatically transfer material from other storage containers to process containers. Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: Organophosphorus pesticides, solid or liquid (nonflammable), require a "poisonous materials" label. This chemical falls in Hazard Class 6.1. **STN:** 49 216 74.

Spill Handling: First remove all sources of ignition. Evacuate persons not wearing protective equipment from area of spill or leak until clean up is complete. Stay upwind; keep out of low areas. Ventilate area of spill or leak. Remove and isolate contaminated clothing at the site. Do not touch spilled material; stop leak if you can do so without risk. Use water spray to reduce vapors. *Small spills:* absorb with sand or other noncombustible absorbent material and place into containers for later disposal. *Large spills:* dike far ahead of spill for later disposal. Collect powdered material in the most convenient and safe manner and deposit in sealed containers. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable. Seek professional environmental engineering assistance from the U.S. EPA Environmental Response Team at (908) 548-8730 (24-hour response line).

Fire Extinguishing: Hazardous decomposition includes oxides of phosphorus, sulfur, and nitrogen. May be fatal if inhaled, ingested or absorbed through skin. Inhalation or contact with some of these materials will irritate or burn skin and eyes. Vapors may cause dizziness or suffocation. *Small fires:* dry chemical, carbon dioxide; water spray; or foam. *Large fires:* water spray, fog, or foam. Stay upwind; keep out of low areas. Ventilate closed spaces before entering them. Firefighting gear (including SCBA) may not provide adequate protection. If exposure occurs, remove and isolate gear immediately and thoroughly decontaminate personnel. Wear positive-pressure breathing apparatus and special protective clothing. Remove and isolate contaminated clothing at the site. Move container from fire area if you can do so without risk. Fight fire from maximum distance. Dike fire-control water for later disposal; do not scatter the material. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies. From a secure, explosion-proof location, use water spray to cool exposed containers. If cooling streams are ineffective (venting sound increases in volume and pitch, tank discolors, or shows any signs of deforming), withdraw immediately to a secure position. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode.

Disposal Method Suggested: Destruction by alkali hydrolysis or incineration. Containers must be disposed of properly by following package label directions or by contacting your local or federal environmental control agency, or by contacting your regional EPA office.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- USEPA, Office of Pesticide Programs, Pesticide Residue Limits, "Terbufos," 40 CFR 180.352. http://www.epa.gov/pesticides/food/viewtols.htm
- EXTOXNET, Extension Toxicology Network, "Pesticide Information Profile, Terbufos," Oregon State University, Corvallis, OR (June 1996). http://extoxnet.orst.edu/pips/terbufos.htm
- USEPA, "Interim Reregistration Eligibility Decision (IRED) Fact Sheet, Terbufos," Washington DC (October 2001). http://www.epa.gov/REDs/factsheets/terbufos_ired_fs.htm
- New Jersey Department of Health and Senior Services, "Hazardous Substance Fact Sheet, Terbufos," Trenton, NJ (May 2002). http://www.state.nj.us/health/eoh/rtkweb/2801.pdf
- USEPA, "Health Advisory: Terbufos," Washington DC, Office of Drinking Water (August 1987)
- Pohanish, R. P., "Rapid Guide to Hazardous Chemicals in the Environment," Van Nostrand Reinhold, New York, NY (1997)
- Agency for Toxic Substances and Disease Registry, U.S. Department of Health and Human Services, Public Health Service, "Managing Hazardous Materials Incidents," Atlanta, GA (June 2003)
- USEPA, "Chemical Profile: Terbufos," Washington DC, Chemical Emergency Preparedness Program (November 30, 1987)

Tetrachlorvinphos T:0275

Use Type: Insecticide

CAS Number: 961-11-5 (mixture of E- and Z-isomer); 22248-79-9 (Z-isomer)

Formula: $C_{10}H_9Cl_4O_4P$

Synonyms: Benzyl alcohol, 2,4,5-trichloro-α-(chloromethylene)-, dimethyl phosphate; 2-Chloro-1-(2,4,5-trichlorophenyl)ethenyl dimethyl phosphate; 2-Chloro-1-(2,4,5-trichlorophenyl)vinyl dimethyl phosphate; 2-Chloro-1-(2,4,5-trichlorophenyl)vinyl phosphoric acid dimethyl ester; CVMP; *O,O*-Dimethyl-*O*-2-chloro-1-(2,4,5-trichlorophenyl)vinyl phosphate; Dimethyl 2,4,5-trichloro-α-(chloromethylene)benzyl phosphate; ENT 25841; NCI-C00168; OMS 595; Phosphoric acid, 2-chloro-1-(2,3,5-trichlorophenyl)ethenyl dimethyl ester; Phosphoric acid, 2-chloro-1-(2,4,5-trichlorophenyl)vinyl dimethyl ester; Phosphoric acid, 2-chloro-1-(2,4,5-trichlorophenyl) ethenyldimethyl ester; Phosphoric acid, 2-chloro-1-(2,3,5-trichlorophenyl)ethenyl dimethyl ester; Tetraclorvinfos (Spanish); 2,4,5-Trichloro-α-(chloromethylene)benzyl phosphate

Trade Names: AMERICARE RABON®; CLEAN CROP®; EQUI-FLY® ORAL LARVICIDE; EQUITROL®; FLY PATROL®; GARDONA®; IPO 8®; RABON®; RABOND®; SD 8447®; STIROFOS®

Chemical class: Organophosphate

EPA/OPP PC Code: 083702 (E-isomer); 083701 (Z-isomer)

California DPR Chemical Code: 305

HSDB Number: 4066

UN/NA & ERG Number: UN2783 (solid)/152; UN3018 (liquid)/152

RTECS® Number: TB9100000

EC Number: 203-506-3 (E-isomer); 244-865-4 (Z-isomer)

Uses: Tetrachlorvinphos is applied dermally to livestock to control flies and mites. It is used as an oral larvicide in cattle, hog, goats and horses; in cattle ear tags to control flies; in cattle feedlots; in poultry dust boxes to control poultry mites; and in poultry houses. Tetrachlorvinphos also is used in pet sleeping areas and pet flea collars and to control flies around refuse sites, recreational areas, and for general outdoor treatment. Not approved for use in EU countries[115] (isomer unspecified). Registered for use in the U.S. (both isomers).

U.S. Maximum Allowable Residue Levels for Tetrachlorvinphos [40 CFR 180.252(a) (1)]: cattle, fat 1.5 ppm; egg 0.1 ppm; goat, fat 0.5 ppm; hog, fat 1.5 ppm; horse, fat 0.5 ppm; milk, fat (reflecting negligible residues in whole milk) 0.5 Poultry, fat. ***[40 CFR 180.252(a) (2)]*** this pesticide may be safely used in accordance with the following prescribed conditions: (i) It is used in the feed of beef, dairy cattle, and horse at a rate of 0.00015 pound (0.07 gram) and swine at the rate of 0.00011 pound (0.05 gram) per 100 pounds of body weight per day. (ii) It is used for control of fecal flies in manure of treated cattle, horse, and swine. (iii) To assure safe use of the pesticide, the label and labeling of the pesticide formulation shall conform to the label and labeling registered by the U.S. EPA.

Human toxicity (long-term)[101]: Very low–875.00 ppb, Health Advisory

Fish toxicity (threshold)[101]: Intermediate–49.75254 ppb, MATC (Maximum Acceptable Toxicant Concentration)

Regulatory Authority and Advisory Information:

Carcinogenicity[83]: IARC: Group 3, unclassifiable as to human carcinogenicity

Health Advisory: Nerve Toxin, Tumorigen

Toxicity (oral) (depending on formulation) Category: 2, WARNING Category 3, CAUTION

EPCRA Section 313 Form R *de minimis* concentration reporting level: 1.0%

U.S. DOT Regulated Marine Pollutant (49CFR172.101, Appendix B), severe pollutant

DOT Inhalation Hazard Chemicals as organophosphates

Description: Tan, brown or off-white crystalline solid or powder. Slight chemical odor. Molecular weight = 365.96; Specific gravity (H_2O:1) = 1.52 @ 20 °C; Boiling point = (decomposes); Freezing/Melting point = 94–98 °C; Vapor pressure = 4.2×10^{-8} mmHg @ 20 °C. Henry's Law constant = 2×10^{-9} atm-m^3/mol @ 25 °C (est)[83]. Practically insoluble in water.

Incompatibilities: May react violently with antimony(V) pentafluoride. Incompatible with lead diacetate, magnesium, silver nitrate. In the presence of strong reducing agents such as hydrides, organophosphates form highly toxic and flammable phosphine gas. Contact with oxidizers can cause the release of toxic oxides of phosphorus.

Determination in Air: OSHA versatile sampler-2; Toluene/Acetone; Gas chromatography/Flame ionization detection; NIOSH IV, Method #5600, Organophosphorus Pesticides[18].

Permissible Concentration in Water: State Drinking Water Guidelines: Florida 1.5 μg/L. Runoff from spills or fire control may cause water pollution.

Determination in Water: NIOSH Method 1657. The determination of organophosphorus pesticides in municipal and industrial wastewater by gas chromatography. Detection limit = 6.0 ng/L. Log K_{ow} = >3.5. Values above 3.0 are likely to bioaccumulate in aquatic organisms.

Routes of Entry: Inhalation, ingestion, skin and eye contact. May be absorbed through the unbroken skin.

Harmful Effects and Symptoms: Organophosphates are highly toxic. Symptoms may develop rapidly, or there may be a delay of several hours following exposure before they become noticeable. The delay tends to be longer in the case of some compounds that dissolve fats, lipids, oils and non-polar solvents such as toluene. Symptoms may increase in severity for more than a single day and last for several days. In severe cases of organophosphate intoxication, respiratory failure may occur.

Short Term Exposure: Eye pupils are small, blurred vision, eye watering, runny nose, cough, shortness of breath, salivation, dizziness, nausea, stomach cramps, diarrhea, and vomiting, increased blood pressure, profuse sweating, hypermotility, hallucinations, irritability, tingling of the skin, drowsiness, slow heartbeat, convulsions, fluid in lungs, loss of consciousness, incontinence, breathing stops, death. Organophosphates inhibit the action of acetylcholinesterase enzymes, and alter the way in which nervous impulses are transmitted. The effects can last for hours, days, or much longer. The action of the enzymes is reestablished after new enzymes are formed. LD_{50} (oral, rat, male) = 1480 mg/kg[83]; (oral, rat, female) = 465–985 mg/kg[83]; LD_{50} (dermal, rat) = >10 g/kg[IARC].

Long Term Exposure: Cholinesterase inhibitor; cumulative effect is possible. Neurotoxic. Organophosphates may damage the nervous system with repeated exposure, resulting in convulsions, respiratory failure. May cause liver damage. Liver and kidney toxin.

Points of Attack: Respiratory system, central nervous system, cardiovascular system, blood cholinesterase, kidneys.

Medical Surveillance: Medical observation is recommended for 24 to 48 hours following breathing overexposure, as pulmonary edema may be delayed. Cigarette smoking may exacerbate pulmonary injury and should be discouraged for at least 72 hours following exposure. Routine biological monitoring of pesticide applicators and field workers includes testing of plasma and red blood cell acetylcholinesterase levels (for enzyme poisoned by this chemical). These tests are normally accurate only if done within about two hours of exposure. If exposure stops, plasma levels return to normal in 1-2 weeks while red blood cell levels may be reduced for 1-3 months. When acetylcholinesterase enzyme levels are reduced by 25% or more below preemployment levels, risk of poisoning is increased, even if results are in lower ranges of “normal.” Reassignment to work not involving organophosphate pesticides is recommended until enzyme levels recover. Do not drink any alcoholic beverages before or during use as it promotes absorption of organophosphates.

First Aid: Speed in removing material from eyes and skin is of extreme importance. Eye contact can cause dangerous amounts of these chemicals to be quickly absorbed through the mucous membrane into the bloodstream. Immediately and gently flush eyes with plenty of warm or cold water (NO hot water) for at least 15 minutes, occasionally lifting the upper and lower eyelids. Get medical aid immediately. *Skin:* Get medical aid. Dermal contact can cause dangerous amounts of these chemicals to be absorbed into the bloodstream. Wearing the appropriate PPE equipment and respirator for organophosphate pesticides, immediately flush skin with plenty of soap and water for at least 15 minutes while removing contaminated clothing and shoes. Shampoo hair promptly if contaminated. *Ingestion:* Call poison control. Loosen all clothing. Never give anything by mouth to an unconscious person. Get medical aid. Do NOT induce vomiting. * If conscious, alert, and able to swallow, rinse mouth and have victim drink 4 to 8 ounces of water do NOT induce vomiting but immediately administer slurry of activated charcoal (2 oz in 8 oz of water). If victim is *unconscious or having convulsions,* do nothing except keep victim warm. **In some cases you may be specifically instructed by poison control to induce vomiting by way of 2 tablespoons of syrup of ipecac (adult) washed down with a cup of water*. Do NOT give activated charcoal before or with ipecac syrup. *Inhalation:* Get medical aid. Do not contaminate yourself. Wearing the appropriate PPE equipment and respirator for organophosphate pesticides, immediately remove the victim from the contaminated area to fresh air. If the victim is not breathing, administer artificial respiration. Do not use mouth-to-mouth method if victim ingested or inhaled the substance; give artificial respiration with the aid of a pocket mask equipped with a one-way valve or other proper respiratory medical device. If breathing is difficult, administer oxygen through bag/mask apparatus until medical help arrives. Do not leave victim unattended. *Note to physician or authorized medical personnel.* Administer atropine, 2 mg (1/30 gr) intramuscularly or intravenously as soon as any local or systemic signs or symptoms of an intoxication are noted; repeat the administration of atropine every 3 to 8 minutes until signs of atropinization (mydriasis, dry mouth, rapid pulse, hot and dry skin) occur; initiate treatment in children with 0.05 mg/kg of atropine; repeat at 5 to 10 minute intervals. Watch respiration, and remove bronchial secretions if they appear to be obstructing the airway; intubate if necessary. *Notes to physician or authorized medical personnel*: *N*-methylpyridinium-2-aldoxime (2-PAMCI) when used in conjunction with atropine reacts with the phosphorylated cholinesterase, thereby restoring normal activity by removing the phosphorylating group. The combination of these two chemicals is synergistic and must be administered within minutes to a few hours following exposure (depending on the specific agent) to be effective. Give 2-PAMCI (Pralidoxime; Protopam), 2.5 g in 100 ml of sterile water or in 5% dextrose and water, intravenously, slowly, in 15-30 minutes; if sufficient fluid is not available, give 1 g of 2-PAMCI in 3 ml of distilled water by deep intramuscular injection; repeat this every half hour if respiration weakens or if muscle fasciculation or convulsions recur. Also diazepam, an anticonvulsant, might be considered. As first aid for pulmonary edema, a doctor or authorized paramedic might consider administering a corticosteroid spray.

Personal Protective Methods: Wear protective gloves and clothing to prevent any reasonable probability of dermal and/or eye contact. Safety equipment suppliers/manufacturers can provide recommendations on the most protective glove/clothing material for your operation. One recommendation is the use of DuPont™ Tychem® suit fabrics[88]. All protective clothing (suits, gloves, footwear, headgear) should be clean, available each day, and put on before work. Contact lenses should not be worn when working with this chemical. Wear splash-proof chemical goggles and face shield unless full facepiece respiratory protection is worn. Employees should wash immediately with soap when skin is wet or contaminated. Provide emergency showers and eyewash.

Respirator Selection: Engineering controls should be used wherever feasible to maintain airborne concentrations of this chemical below the prescribed exposure limit. Respirators and protective equipment are less effective than engineering controls, and should be used only in non-routine or emergency situations which may result in exposure concentrations in excess of the TWA environmental limit. *At any concentrations above the NIOSH REL, or where there is no REL, at any detectable concentration:* SCBAF: Pd,Pp (APF = 10,000) (any NIOSH/MSHA- or European Standard EN 149-approved self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode); or SaF: Pd,Pp: ASCBA (APF = 10,000) (any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary, self-contained breathing apparatus operated in a pressure-demand or other positive-pressure mode).

Storage: Color Code-Blue: Health Hazard/Poison. Store in a secure poison location. Prior to working with this chemical you should be trained on its proper handling and storage. Where possible, automatically transfer material from other storage containers to process containers. Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: Organophosphorus pesticides, solid or liquid (nonflammable), require a "poisonous materials" label. This chemical falls in Hazard Class 6.1.

Spill Handling: First remove all sources of ignition. Evacuate persons not wearing protective equipment from area of spill or leak until clean up is complete. Stay upwind; keep out of low areas. Ventilate area of spill or leak. Remove and isolate contaminated clothing at the site. Do not touch spilled material; stop leak if you can do so without risk. Use water spray to reduce vapors. *Small spills:* absorb with sand or other noncombustible absorbent material and place into containers for later disposal. *Large spills:* dike far ahead of spill for later disposal. Collect powdered material in the most convenient and safe manner and deposit in sealed containers. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable. Seek professional environmental engineering assistance from the U.S. EPA Environmental Response Team at (908) 548-8730 (24-hour response line).

Fire Extinguishing: Hazardous decomposition includes hydrogen chloride and oxides of phosphorus, sulfur, nitrogen, and carbon. May be fatal if inhaled, ingested or absorbed through skin. Inhalation or contact with some of these materials will irritate or burn skin and eyes. Vapors may cause dizziness or suffocation. *Small fires:* dry chemical, carbon dioxide; water spray; or foam. *Large fires:* water spray, fog, or foam. Stay upwind; keep out of low areas. Ventilate closed spaces before entering them. Firefighting gear (including SCBA) may not provide adequate protection. If exposure occurs, remove and isolate gear immediately and thoroughly decontaminate personnel. Wear positive-pressure breathing apparatus and special protective clothing. Remove and isolate contaminated clothing at the site. Move container from fire area if you can do so without risk. Fight fire from maximum distance. Dike fire-control water for later disposal; do not scatter the material. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies. From a secure, explosion-proof location, use water spray to cool exposed containers. If cooling streams are ineffective (venting sound increases in volume and pitch, tank discolors, or shows any signs of deforming), withdraw immediately to a secure position. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode.

Disposal Method Suggested: Destruction by alkali hydrolysis or incineration. Containers must be disposed of properly by following package label directions or by contacting your local or federal environmental control agency, or by contacting your regional EPA office.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- USEPA, Office of Pesticide Programs, Pesticide Residue Limits, "Tetrachlorvinphos," 40 CFR 180. http://www.epa.gov/pesticides/food/viewtols.htm
- USEPA, "Reregistration Eligibility Decision (RED), Tetrachlorvinphos," Office of Prevention, Pesticides and Toxic Substances, Washington DC (September 1995). http://www.epa.gov/REDs/0321red.pdf

Tetramethrin T:0350

Use Type: Insecticide

CAS Number: 7696-12-0

Formula: $C_{19}H_{25}NO_4$

Synonyms: AI3-27339; Bioneopynamin; Caswell No. 844; (1-Cyclohexane-1,2-dicarboximido)methyl chrysanthemumate; Cyclohex-1-ene-1,2-dicarboximidomethyl (±)-*cis-trans*-chrysanthemate; (1-Cyclohexene-1,2-dicarboximido)methyl 2,2-dimethyl-3-(2-methylpropenyl) cyclopropanecarboxylate; Cyclopropanecarboxylic acid, 2,2-dimethyl-3-(2-methyl-1-propenyl)-, (1,3,4,5,6,7-hexahydro-1,3-dioxo-2*H*-isoindol-2-yl)methyl ester; 2,2-Dimethyl-3-(2-methyl-1-propenyl)cyclopropanecarboxylic acid (1,3,4,5,6,7-hexahydro-1,3-dioxo-2*H*-isoindol-2-yl) methyl ester; ENT 27339; NSC 190939; *d*-Phthalthrin; 2,3,4,5-Tetrahydrophthalimidomethylchrysanthemate; 3,4,5,6-Tetrahydrophthalimidomethyl (±)-*cis-trans*-chrysanthemate; 3,4,5,6-Tetrahydrophthalimidomethyl (±)-*(Z)*-*(E)*-chrysanthemate; 3,4,5,6-Tetrahydrophthalimidomethyl *cis and trans dl*-chrysanthemummonocarboxylic acid; *N*-(3,4,5,6-Tetra hydrophthalimido)-methyl *dl-cis-,trans*-chrysanthemate; *N*-(3,4,5,6-Tetrahydrophthalimido)-methyl *dl-(Z)*,*(E)*-chrysanthemate; Tetramethrin, (±)-; Tetramethrine; Tetramethrin, racemic; (±)-*cis/trans*-Phthalthrin

Trade Names: FMC 9260®; ENT-27339; EVERCIDE INTERMEDIATE® 2265 (tetramethrin+fenvalerate); MULTICIDE®; NEO-PYNAMIN®; NEOPYNAMINE®; NEOPYNAMIN FORTE®; NIAGARA®-9260; NIA®-9260; PHTHALTHRIN®; SP-1103; SUMITOMO® SP-1103

Chemical class: Pyrethroid

EPA/OPP PC Code: 069003

California DPR Chemical Code: 1695

HSDB Number: 6738

UN/NA & ERG Number: UN3352 (liquid)/151; UN3349 (solid)/151

RTECS® Number: GZ1730000

EC Number: 231-711-6

Uses: Tetramethrin is often formulated as an aerosol and used primarily for indoor pest control or in mosquito coils. It is also used in shampoos to control fleas and ticks on pets. It is often formulated with other insecticides and synergists. Not approved for use in EU countries[115]. Registered for use in the U.S.

Human toxicity (long-term)[101]: Very low–8750.00 ppb, Health Advisory

Fish toxicity (threshold)[101]: Extra high–0.26608 ppb, MATC (Maximum Acceptable Toxicant Concentration)

Regulatory Authority and Advisory Information:

Carcinogenicity[83]: EPA Group C, Possible human carcinogen

Toxicity (oral) Category 4, Caution

Health Advisory: Mutagen, Skin irritant/sensitizer, Endocrine disruptor (?)

EPCRA Section 313 Form R *de minimis* concentration reporting level: 1.0%

Marine pollutant

Description: White to colorless crystalline solid. Commercial products are available in various forms including as emulsifiable concentrates. Molecular weight = 331.40; Specific gravity (H_2O:1) = 1.11 @ 20 °C; Boiling point = 140 @ 12 mmHg @ 25 °C; Freezing/Melting point = 69-74 °C; Vapor pressure = 10 Pa @ 20 °C. Henry's Law constant = $1.69\sigma10^{-6}$ atm-m^3/mol @ 25 °C (est)[83]. Practically insoluble in water. Physical and toxicological properties may be affected by carrier solvents in commercial formulations.

Incompatibilities: Keep away from alkaline materials. May react violently with strong oxidizers, bromine, 90% hydrogen peroxide, phosphorus trichloride, silver powders or dust. Incompatible with silver compounds. Mixture with some silver compounds forms explosive salts of silver oxalate.

Permissible Exposure Limits in Air:

NIOSH[2] IDLH = 5,000 ppm
OSHA PEL: 5 mg/m^3 TWA
NIOSH REL: 5 mg/m^3 TWA
ACGIH TLV®[1]: 5 mg/m^3 TWA
STEL set by HSE[33] = 10 mg/m^3.

Determination in Air: Collection by impinger or fritted bubbler, analysis by gas liquid chromatography/ultraviolet. See NIOSH IV, Method #5008[18]. (pyrethrum).

Permissible Concentration in Water: Acceptable Daily Intake (ADI) =0.02 mg/kg as pyrethroid

Determination in Water: Log K_{ow} = >4.5. Values above 3.0 are likely to bioaccumulate in aquatic organisms.

Routes of Entry: Inhalation, ingestion, dermal contact.

Harmful Effects and Symptoms

Short Term Exposure: Irritates the eyes and respiratory tract. Toxic by inhalation and dermal and/or eye contact. Highly toxic if swallowed; nausea, vomiting, abdominal pain, and diarrhea may develop within 10 to 60 minutes following ingestion. Inhalation may cause skin, eye, and respiratory tract irritation. Inhalation can cause stuffiness, runny nose and scratchy throat. Hypersensitivity reaction characterized by pneumonitis, cough, dyspnea, wheezing, chest pain, and bronchospasm may occur. Mild skin sensitizer. High exposures may cause respiratory failure, including cardiopulmonary arrest; death may occur. High exposure can affect the nervous system causing headache, nausea, vomiting, fatigue, and restlessness, rhinorrhea (discharge of thin nasal mucous). LD_{50} (oral, rat) = >5 g/kg; LD_{50} (dermal, rat) = >2 g/kg.

Long Term Exposure: High or repeated exposure can cause lung allergy (with cough, wheezing and/or shortness of breath) or hay fever symptoms (sneezing, runny or stuffy nose). Allergic "pneumonia" can also occur with cough, chest pain, breathing difficulty and abnormal chest x-ray. Repeated attacks may lead to permanent scarring. Skin allergy may also develop with rash and itching, even with lower exposures. Dermal contact can cause rash with redness, blisters and intense itching. A severe generalized allergy can occur with weakness and collapse. Possible liver toxin.

Points of Attack: Respiratory system, skin, central nervous system.

Medical Surveillance: This chemical is a suspected or known human carcinogen. Exposed persons should contact a physician for advice regarding the possible long term health effects and advice for medical monitoring., the following are recommended: Employees should be screened for history of certain medical conditions which might place the employee at increased risk from pyrethroid exposure. Chronic respiratory disease: In persons with chronic respiratory disease, especially asthma, the inhalation of pyrethroids might cause exacerbation of symptoms due to its sensitizing properties. Lung function tests. These may be normal if the person is not having an attack at the time of the test. Consider chest x-ray if lung symptoms are present. Skin disease: Pyrethroids can cause dermatitis which may be allergic in nature. Persons with pre-existing skin disorders may be more susceptible to the effects of this agent. Evaluation by a qualified allergist, including exposure history and testing, may help diagnose allergy. Any employee developing the above-listed conditions should be referred for further medical examination[9].

First Aid: If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least 15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately. If this chemical contacts the skin, remove contaminated clothing and wash immediately with soap and water. Seek medical attention immediately. If this chemical has been inhaled, remove from exposure, begin rescue breathing (using universal precautions) if breathing has stopped, and CPR if heart action has stopped. Transfer promptly to a medical facility. When this chemical has been swallowed, get medical attention. Give large quantities of water and induce vomiting. Do not make an unconscious person vomit.

Personal Protective Methods: Applicators and other handlers must wear: Coveralls worn over long-sleeved shirt and long pants; Chemical-resistant gloves such as DuPont™ Tychem® suit fabrics, barrier laminate, or Viton®; Chemical-resistant footwear plus socks; Protective eye wear; Chemical-resistant headgear for overhead exposure; Chemical-resistant apron when cleaning equipment, mixing, or loading[83]. Agricultural Use/Engineering Controls: When handlers use closed systems, enclosed cabs, or aircraft in a manner that meets the requirements listed in the Worker Protection Standard (WPS) for agricultural pesticides, ***40 CFR 170.240(d)(4-6),*** the handler PPE requirements may be reduced or modified as specified in the Worker Protection Standard. Firefighters should wear NIOSH-approved self-contained breathing apparatus and full protective clothing.

Respirator Selection: NIOSH/OSHA *for pyrethrum*: *50 mg/m^3:* CcrOv95 (APF = 10) [any air-purifying half-mask respirator equipped with an organic vapor cartridge(s) in combination with an N95, R95, or P95 filter. The following filters may also be used: N99, R99, P99, N100, R100, P100]; or Sa (APF = 10) (any supplied-air respirator). *125 mg/m^3:* Sa:Cf (APF = 25) (any supplied-air respirator operated in a continuous-flow mode); or PaprOvHie (APF = 25) (any air-purifying full facepiece respirator equipped with an organic vapor cartridge in combination with a high-efficiency particulate filter). *250 mg/m^3:* CcrFOv100 (APF = 50) [any air-purifying full facepiece respirator equipped with organic vapor cartridge(s) in combination with an N100, R100, or P100 filter]; or PaprTOvHie (APF = 50) [any powered, air-purifying respirator with a tight-fitting face-piece and organic vapor cartridge(s) in combination with a high-efficiency particulate filter]; or SCBAF (APF = 50) (any self-contained breathing apparatus with full facepiece);

or SaF (APF = 50) (any supplied-air respirator with a full facepiece). *5000 mg/m³:* SaF:Pd,Pp (APF = 2000) (any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode). *Emergency or planned entry into unknown concentrations or IDLH conditions:* SCBAF:Pd,Pp (APF = 10,000) (any self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode); or SaF:Pd,Pp:ASCBA (APF = 10,000) (any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary self-contained breathing apparatus operated in a pressure-demand or other positive-pressure mode). *Escape:* GmFOv100 (APF = 50) [any air-purifying, full facepiece respirator (gas mask) with a chin-style, front- or back-mounted organic vapor canister having an N100, R100, or P100 filter]; or SCBAE (any appropriate escape-type, self-contained breathing apparatus). *Note:* Substance reported to cause eye irritation or damage; may require eye protection.

Storage: Color Code-Blue: Health Hazard/Poison. Store in a secure poison location at temperature <35 °C and away from alkaline materials. Prior to working with this chemical you should be trained on its proper handling and storage. Store in tightly closed containers in a cool, well-ventilated area. Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: This material is a toxic pesticide and should be labeled "poisonous materials." It falls into Hazard Class 6.1. PG III.

Spill Handling: First remove all sources of ignition. Evacuate persons not wearing protective equipment from area of spill or leak until clean up is complete. Ventilate area of spill or leak. Use water spray to reduce vapor. Absorb liquids in vermiculite, dry sand, earth, or a similar material and deposit in sealed containers. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable.

Fire Extinguishing: Hazardous decomposition includes oxides of nitrogen and carbon. *On a small fire:* use dry chemical, CO_2 or water spray. *On a large fire:* use water spray, fog or regular foam. Move containers from fire area if you can do it without risk. Dike fire-control water for later disposal; do not scatter the material. Use water spray or fog; do not use straight streams. *Fire involving storage or vehicular tanks:* isolate for 800 meters/0.5 mile in all directions; also, consider initial evacuation for 800 meters/0.5 mile in all directions. Fight fire from maximum distance or use unmanned hose holders or monitor nozzles. Do not get water inside containers. Cool containers with flooding quantities of water until well after fire is out. Withdraw immediately in the case of rising sound from venting safety devices or discoloration of tank. ALWAYS stay away from tanks engulfed in fire. For massive fire, use unmanned hose holders or monitor nozzles; if this is impossible, withdraw from area and let fire burn. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies.

Disposal Method Suggested: Incineration would be an effective disposal procedure where permitted. If an efficient incinerator is not available, the product should be mixed with large amounts of combustible material and contact with the smoke should be avoided. In accordance with 40CFR165, follow recommendations for the disposal of pesticides and pesticide containers.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- International Programme on Chemical Safety (IPCS), "Environmental Health Criteria, Tetramethrin," Geneva, Switzerland (1990). http://www.inchem.org/documents/ehc/ehc/ehc98.htm

Thiabendazole T:0423

Use Type: Fungicide

CAS Number: 148-79-8; 28558-32-9 (hypophosphite salt)

Formula: $C_{10}H_7N_3S$

Synonyms: AI3-50598; 1*H*-Benzimidazole, 2-(4-thiazolyl)-; Benzimidazole, 2-(4-thiazolyl)-; 4-(2-Benzimidazolyl)thiazole; Caswell No. 849A; TBDZ; TBZ; 2-Thiazole-4-ylbenzimidazole; 2-(Thiazol-4-yl) benzimidazole; 2-(1,3-Thiazol-4-yl)benzimidazole; 2-(4'-Thiazolyl)benzimidazole; 2-(4-Thiazolyl)benzimidazole; 2-(4-Thiazolyl)-1*H*-benzimidazole; Tiabendazol (Spanish)

Trade Names: AGROSOL®; AGROSOL®-T, (with thiram); APL-LUSTER®; ARBOTECT®; BOVIZOLE®; BRODEX®; CHEM-TEK®; CITRUS LUSTR®; DECCO SALT NO.19®; E-Z-EX®; EPROFIL®; EQUIVET TZ®; EQUIZOLE®; FRESHGARD®; FUNGICIDE 4T®; GRANOX®; IRGAGUARD®; LOMBRISTOP®; MERTEC®; MERTECT 160®; METASOL TK-100®; MINTEZOL®; MINZOLUM®; MK-360®; MYCOZOL®; NEMAPAN®; NSC 525040®; OMNIZOLE®; POLIVAL®; RIVAL®, (captan+PCNB+thiabendazole); RPH®; RTU-VITAVAX-EXTRA®; STA-FRESH®; TBZ 6®; TECTO®; TECTO RPH®; TECTO 10P®; TECTO

40 F®; TESTO®; THIABEN®; THIABENDAZOLUM®; THIABENZAZOLE®; THIABENZOLE®; THIBENZOL®; THIBENZOLE®; THIBENZOLE 200®; THIBENZOLE ATT®; TIABENDAZOLE®; TOBAZ®; TOP FORM WORMER®; VITAVAX® Thiabendazole

Chemical class: Benzimidazole

EPA/OPP PC Code: 060101

California DPR Chemical Code: 587

HSDB Number: 2027

UN/NA & ERG Number: UN3077 (solid)/171; UN3082 (liquid)/171

RTECS® Number: DE0700000

EC Number: 205-725-8 [*Annex I Index No.:* 613-054-00-0]

Uses: Thiabendazole is a fungicide used to control blight, mold, stain and rot that are found on fruit and vegetables; Dutch elm disease; and diseases found in food storage and other diseases. It is also used to treat roundworms and similar conditions in livestock and humans. Registered for use in EU countries[115]. A U.S. EPA restricted use Pesticide (RUP).

U.S. Maximum Allowable Residue Levels for Thiabendazole and its metabolite benzimidazole (free and conjugated) in or on the following food commodities:[*40CFR 180.242(a)(1)*]: apple, wet pomace 12.0 ppm; Avocado (There are no U.S. registrations on the indicated commodity) 10.0 ppm; banana, post harvest 3.0 ppm; bean, dry, seed 0.1 ppm; beet, sugar, dried pulp 3.5 ppm; beet, sugar, roots 0.25 ppm; beet, sugar, tops 10.0 ppm; cantaloupe (There are no U.S. registrations on the indicated commodity) 15.0 ppm; carrot, roots, postharvest 10.0 ppm; citrus, oil 15.0 ppm; fruit, citrus, group 10, postharvest 10.0 ppm; fruit, pome, group 11, postharvest 5.0 ppm; mango 10.0 ppm; mushroom 40.0 ppm; papaya, postharvest 5.0 ppm; potato, postharvest 10.0 ppm; soybean 0.1 ppm; strawberry (There are no U.S. registrations on the indicated commodity) 5.0 ppm; sweet potato (postharvest to sweet potato intended only for use as seed) 0.05 ppm; wheat, grain 1.0 ppm; wheat, straw 1.0 ppm. **[*40CFR 180.242(a)(2)*]:** cattle, meat 0.1 ppm; cattle, meat byproducts 0.4 ppm; goat, meat byproducts 0.4 ppm; Hog, meat byproducts 0.3 ppm; horse, meat byproducts 0.4 ppm; milk 0.1 ppm; sheep, meat byproducts 0.4 ppm. **[*40CFR 180.2010*]:** Use/Limits: As a seed treatment for dry pea (including field pea, pigeon pea, chickpea or lentil), using a maximum application rate of 0.075 pounds of active ingredient per 100 pounds of seed. Vines or hay grown from treated seed may not be fed to livestock.

Human toxicity (long-term)[101]: Very low–700.00 ppb, Health Advisory

Fish toxicity (threshold)[101]: Intermediate–18.65477 ppb, MATC (Maximum Acceptable Toxicant Concentration)

Regulatory Authority and Advisory Information:

U.S. EPA Carcinogens: Likely to be a carcinogen in high doses; Unlikely to be a carcinogen in low doses

Health Advisory: Mutagen, Developmental/Reproductive Toxin (TRI)

Toxicity (oral) Category 3, CAUTION

EPCRA Section 313 Form R *de minimis* concentration reporting level: 1.0%

European/International Regulations: Hazard Symbol: N; risk phrases: R52; R53; safety phrases: S2; S60; S61 (see Appendix 1)

WGK (German Aquatic Hazard Class): 2-Water polluting

Description: White to tan crystalline solid or powder. Odorless. There are various formulation types registered with the EPA, including ready-to-use, dusts, flowable concentrates, emulsifiable concentrates, wettable powders, granules, and water dispersable granules. Molecular weight = 201.26; Specific gravity (H_2O:1) = 1.4 @ 20 °C; Freezing/Melting point = 304 °C. Vapor pressure = 4.1×10^{-8} mmHg @ 20 °C. Henry's Law constant = 2.12×10^{-11} atm-m^3/mol @ 25 °C (est)[83]. Low solubility in water. Physical and toxicological properties may be affected by carrier solvents in commercial formulations.

Incompatibilities: Incompatible with alkaline materials and copper-containing products. When heated to decomposition this material forms toxic oxides of nitrogen and sulfur.

Determination in Air: Filter; none; Gravimetric; NIOSH IV [Particulates NOR; #0500 (total), #0600 (respirable)][18].

Determination in Water: Log K_{ow} = <2.0. Unlikely to bioaccumulate in marine organisms.

Routes of Entry: Ingestion, dermal and/or eye contact.

Harmful Effects and Symptoms

Short Term Exposure: Symptoms and signs that sometimes follow ingestion include dizziness, nausea, vomiting, diarrhea, epigastric distress, lethargy, fever, flushing, chills, rash and local edema, headache, tinnitus, paresthesia, and hypotension. Blood enzyme tests may indicate liver injury[83]. LD_{50} (oral, rat) = >3 g/kg; LD_{50} (dermal, rat) = >2 g/kg.

Long Term Exposure: May cause thyroid, liver, spleen and kidney problems. May affect testes. May cause tumors.

Points of Attack: Liver, kidney, spleen, thyroid. May cause tumors and affect reproductive system.

Medical Surveillance: In addition to comprehensive initial medical and work histories emphasizing reproductive experience and menstrual history, patient should have physical examination and testing of genito-urinary tract, sperm count, motility and morphology. If required, other tests, such as serum testosterone, serum follicle stimulating hormone (FSH), and serum lutenizing hormone (LH), may be indicated. Mahor organ tests.

First Aid: If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least 15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately. If this chemical contacts the skin, remove contaminated clothing and wash immediately with soap and water. Seek medical attention immediately. If this chemical has been inhaled, remove from exposure, begin rescue breathing (using universal precautions) if breathing has stopped, and CPR if heart action has stopped. Transfer promptly to a medical facility. When this chemical has been swallowed, get medical attention. Give large quantities of water and induce vomiting. Do not make an unconscious person vomit.

Personal Protective Methods: Wear protective gloves and clothing to prevent any reasonable probability of dermal and/or eye contact. Safety equipment suppliers/manufacturers can provide recommendations on the most protective glove/clothing material for your operation. One recommendation is the use of DuPont™ Tychem® suit fabrics[88]. All protective clothing (suits, gloves, footwear, headgear) should be clean, available each day, and put on before work. Contact lenses should not be worn when working with this chemical. Wear splash-proof chemical goggles and face shield unless full facepiece respiratory protection is worn. Employees should wash immediately with soap when skin is wet or contaminated. Provide emergency showers and eyewash.

Respirator Selection: Engineering controls should be used wherever feasible to maintain airborne concentrations of this chemical below the prescribed exposure limit. Respirators and protective equipment are less effective than engineering controls, and should be used only in non-routine or emergency situations which may result in exposure concentrations in excess of the TWA environmental limit. *At any concentrations above the NIOSH REL, or where there is no REL, at any detectable concentration:* SCBAF: Pd,Pp (APF = 10,000) (any NIOSH/MSHA- or European Standard EN 149-approved self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode); or SaF: Pd,Pp: ASCBA (APF = 10,000) (any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary, self-contained breathing apparatus operated in a pressure-demand or other positive-pressure mode).

Storage: Color Code-Blue: Health Hazard/Poison. Store in a secure poison location in tightly closed container @ 15-30 °C. Prior to working with this chemical you should be trained on its proper handling and storage. Where possible, automatically transfer material from other storage containers to process containers. Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: Organophosphorus pesticides, solid or liquid (nonflammable), require a “poisonous materials” label. This chemical falls in Hazard Class 6.1.

Spill Handling: First remove all sources of ignition. Evacuate persons not wearing protective equipment from area of spill or leak until clean up is complete. Stay upwind; keep out of low areas. Ventilate area of spill or leak. Remove and isolate contaminated clothing at the site. Do not touch spilled material; stop leak if you can do so without risk. Use water spray to reduce vapors. *Small spills:* absorb with sand or other noncombustible absorbent material and place into containers for later disposal. *Large spills:* dike far ahead of spill for later disposal. Collect powdered material in the most convenient and safe manner and deposit in sealed containers. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable. Seek professional environmental engineering assistance from the U.S. EPA Environmental Response Team at (908) 548-8730 (24-hour response line).

Fire Extinguishing: Hazardous decomposition includes oxides of phosphorus, sulfur, and nitrogen. Containers may explode in high temperatures. May be fatal if inhaled, ingested or absorbed through skin. Inhalation or contact with some of these materials will irritate or burn skin and eyes. Vapors may cause dizziness or suffocation. As an immediate precautionary measure, isolate spill or leak area in all directions for at least 50 meters/150 feet for liquids and at least 25 meters/75 feet for solids. *Fire involving storage or vehicular tanks:* isolate for 800 meters/0.5 mile in all directions; also, consider initial evacuation for 800 meters/0.5 mile in all directions. *On a small fire:* use dry chemical, CO_2, water spray or regular foam. *On a large fire:* use water spray, fog or regular foam. Do not scatter spilled material with high-pressure streams of water. Move containers from fire area if you can do it without risk. Dike fire-control water for later disposal. *Fire involving tanks:* from a secure, explosion-proof location, use water spray to cool exposed containers. If cooling streams are ineffective (venting sound increases in volume and pitch, tank discolors, or shows any signs of deforming), withdraw immediately to a secure position. Always stay away from tanks engulfed in fire. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode.

Disposal Method Suggested: Destruction by alkali hydrolysis or incineration. Containers must be disposed of properly by following package label directions or by contacting your local or federal environmental control agency, or by contacting your regional EPA office.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- EXTOXNET, Extension Toxicology Network, “Pesticide Information Profile, Thiabendazole,” Oregon State University, Corvallis, OR (June 1996). http://extoxnet.orst.edu/pips/thiabend.htm
- USEPA, Office of Pesticide Programs, Pesticide Residue Limits, “Thiabendazole,” 40 CFR 180.242. http://www.epa.gov/pesticides/food/viewtols.htm
- Pohanish, R. P., “Rapid Guide to Hazardous Chemicals in the Environment,” Van Nostrand Reinhold, New York, NY (1997)

- American Society of Health System Pharmacists; AHFS Drug Information 2009, p.65. Bethesda, MD (2009)

Thiafluamide T:0424

Use Type: Herbicide
CAS Number: 142459-58-3
Formula: $C_{14}H_{12}O_2N_3SF_4$
Synonyms: Acetamide, *N*-(4-fluorophenyl)-*N*-(1-methylethyl)-2-[(5-(trifluoromethyl)-1,3,4-thiadiazol-2-yl)oxy]-; Flufenacet; *N*-(4-Fluorophenyl)-*N*-(1-methylethyl)-2[(5-(trifluoromethyl)-1,3,4-thiadiazol-2-yl)oxy]acetamide benzoate
Trade Names: AXIOM® Thiafluamide; DOMAIN®; EPIC®; FOE 5043® technical
Chemical class: Anilide; Thiadiazole[83]
EPA/OPP PC Code: 121903
California DPR Chemical Code: 5293
HSDB Number: 7011
UN/NA & ERG Number: UN3077./171
RTECS® Number: AC2845000
EC Number: [*Annex I Index No.:* 613-164-00-9]
Uses: Flufenacet is applied to the soil surface or incorporated pre-emergence in field corn, corn grown for silage, or soybeans to control certain annual grasses and broadleaf weeds. Not listed for use in EU countries[115]. Registered for use in the U.S.
U.S. Maximum Allowable Residue Levels for flufenacet and its metabolites containing the 4-fluoro-N-methylethyl benzenamine moiety [40 CFR 180.527(a)]: in or on the following commodities: cattle, kidney 0.05 ppm; corn, field, forage 0.4 ppm; corn, field, grain 0.05 ppm; corn, field, stover 0.4 corn, sweet, forage 0.45 ppm; corn, sweet, kernel plus cob with husks removed 0.05 ppm; corn, sweet, stover 0.30 ppm; goat, kidney 0.05 ppm; hog, kidney 0.05 ppm; horse, kidney 0.05 ppm; sheep, kidney 0.05 ppm; soybean, seed 0.1 ppm; wheat, bran 0.80 ppm; wheat, forage 6.0 ppm; wheat, grain 0.60 ppm; wheat, hay 1.2 ppm; wheat, straw 0.35 ppm. ***Tolerances with regional registration, as defined in part 180.1(l) [40CFR 180.527(c)]:*** grass, forage 7.0 ppm; grass, hay 0.4 ppm; ***[40CFR 180.527(d)]:*** alfalfa, forage 0.1 ppm; alfalfa, hay 0.1 ppm; alfalfa, seed 0.1 ppm; clover, forage 0.1 ppm; clover, hay 0.1 ppm; grain, cereal, group 15, except rice 0.1 ppm; grain, cereal, forage, fodder, and straw, group 16, except rice 0.1 ppm; grass, forage, fodder, and hay, group 17, 0.1 ppm.
Human toxicity (long-term)[101]: Intermediate–28.00 ppb, Health Advisory
Fish toxicity (threshold)[101]: Low–245.00 ppb, MATC (Maximum Acceptable Toxicant Concentration)
Regulatory Authority and Advisory Information:
Carcinogenicity[83]: EPA, Not likely to be a carcinogen
Toxicity (oral) (depending on formulation) Category 2, WARNING; Category: 3, CAUTION
European/International Regulations: Hazard Symbol: Xi, Xn, N; risk phrases: R22; R43; R48/22; R50/53; safety phrases: S2; S13; S24; S37; S60, S61 (see Appendix 1)
Description: Tan solid. Mercaptan-like odor. There are various formulation types registered with the EPA, including ready-to-use, dusts, flowable concentrates, emulsifiable concentrates, wettable powders, granules, and water dispersable granules. Molecular weight = 363.31; Specific gravity (H_2O:1) = 1.3 @ 20 °C; Boiling point = (decomposes); Freezing/Melting point = 75.5–78 °C; Vapor pressure = 1.4×10^{-6} mmHg @ 25 °C. Henry's Law constant = 5.76×10^{-9} atm-m^3/mol @ 25 °C (est)[83]. Soluble in water. Physical and toxicological properties may be affected by carrier solvents in commercial formulations.
Determination in Water: Log K_{ow} = >3.0. Values above 3.0 are likely to bioaccumulate in aquatic organisms.
Routes of Entry: Inhalation of dust, ingestion, dermal and/or eye contact.
Harmful Effects and Symptoms
Short Term Exposure: Contact with eyes or skin may cause irritation or injury. May cause skin sensitization May be harmful if swallowed. LD_{50} (oral, rat) = 371-2347 mg/kg[83]; LD_{50} (dermal, rat) = >2 g/kg[83].
Long Term Exposure: May cause damage of the liver, spleen and thyroid. Enzyme inhibition. May be a skin sensitizer. Fluorides may cause bone disease (pain and tenderness of the bones); mottled teeth in children.
Points of Attack: Skin, liver, blood, spleen, thyroid, skeletal system, teeth.
Medical Surveillance: Preliminary medical exam to detect chronic diseases of central nervous system, liver, heart, kidneys, lung and skin, as well as endocrinological or immunological disturbances, should protect susceptible individuals. Periodical medical exams of internal organs, skin and eyes are important to avoid chronic occupational intoxications. They should include lab and patch tests when necessary[83]. Evaluation by a qualified allergist, including exposure history and testing, may help diagnose allergy.
First Aid: If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least 15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately. If this chemical contacts the skin, remove contaminated clothing and wash immediately with soap and water. Seek medical attention immediately. If this chemical has been inhaled, remove from exposure, begin rescue breathing (using universal precautions) if breathing has stopped, and CPR if heart action has stopped. Transfer promptly to a medical facility. When this chemical has been swallowed, get medical attention. Give large quantities of water and induce vomiting. Do not make an unconscious person vomit. Do not induce vomiting when formulations containing petroleum solvents are ingested
Personal Protective Methods: A restricted entry interval of 12 hours following application is suggested by one manufacturer[Bayer]. To enter treated area, wear protective gloves and clothing to prevent any reasonable probability of dermal and/or eye contact. Safety equipment suppliers/manufacturers can provide recommendations on the most protective glove/clothing material for your operation. All protective clothing (suits, gloves, footwear, headgear)

should be clean, available each day, and put on before work. Contact lenses should not be worn when working with this chemical. Wear dust-proof chemical goggles and face shield unless full facepiece respiratory protection is worn. Employees should wash immediately with soap when skin is wet or contaminated. Provide emergency showers and eyewash.

Respirator Selection: Engineering controls should be used wherever feasible to maintain airborne concentrations of this chemical below the prescribed exposure limit. Respirators and protective equipment are less effective than engineering controls, and should be used only in non-routine or emergency situations which may result in exposure concentrations in excess of the TWA environmental limit. *At any concentrations above the NIOSH REL, or where there is no REL, at any detectable concentration:* SCBAF: Pd,Pp (APF = 10,000) (any NIOSH/MSHA- or European Standard EN 149-approved self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode); or SaF: Pd,Pp: ASCBA (APF = 10,000) (any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary, self-contained breathing apparatus operated in a pressure-demand or other positive-pressure mode).

Storage: Color Code-Blue: Health Hazard/Poison. Store in a secure poison location. Prior to working with thiafluamide you should be trained on its proper handling and storage. Store in tightly closed containers in a cool, well-ventilated area. Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: Environmentally hazardous substances, solid or liquid, usually fall in Hazard Class 9 and Packing Group III.

Spill Handling: First remove all sources of ignition. Evacuate persons not wearing protective equipment from area of spill or leak until clean up is complete. Collect powdered material in the most convenient and safe manner and deposit in sealed containers. Ventilate area after clean up is complete. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable.

Fire Extinguishing: Hazardous decomposition includes oxides of nitrogen, sulfur, and carbon, hydrogen fluoride, and hydrogen cyanide (hydrocyanic acid)[83]. Use dry chemical, carbon dioxide; water spray; or alcohol-resistant foam extinguishers. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies. From a secure, explosion-proof location, use water spray to cool exposed containers. If cooling streams are ineffective (venting sound increases in volume and pitch, tank discolors, or shows any signs of deforming), withdraw immediately to a secure position. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode.

Disposal Method Suggested: Dissolve or mix the material with a combustible solvent and burn in a chemical incinerator equipped with an afterburner and scrubber. All federal, state, and local environmental regulations must be observed.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- USEPA, Office of Pesticide Programs, Pesticide Fact Sheet, “Flufenacet.” (April 1998). http://www.epa.gov/opprd001/factsheets/flufenacet.pdf

Thiazopyr T:0425

Use Type: Herbicide

CAS Number: 117718-60-2

Formula: $C_{16}H_{17}F_5N_2O_2S$

Synonyms: 3-Pyridinecarboxylic acid, 2-(difluoromethyl)-5-(4,5-dihydro-2-thiazolyl)-4-(2-methylpropyl)-6-(trifluoromethyl)-, methyl ester

Trade Names: MANDATE®; MON-13200®; VISOR®

Chemical class: Pyridinecarboxylic acid; Picolinic Acid

California DPR Chemical Code: 3984

HSDB Number: 7015

UN/NA & ERG Number: UN2920/132

RTECS® Number: US5649212

Uses: Not permitted as an active ingredient by the European Commission after July 25, 2003. Used as a preemergent herbicide to control annual grasses and certain broadleaf weeds on citrus crops. Not approved for use in EU countries[115]. Registered for use in the U.S.

U.S. Maximum Allowable Residue Levels for Thiazopyr and its metabolites determined as 2-(difluoromethyl)-6-(trifluoromethyl)-3,4,5-pyridinetricarboxylic acid, all expressed as the parent equivalents [40 CFR 180.496]: in or on the following raw agricultural commodities: grapefruit: 0.05 ppm; and orange: 0.05 ppm.

Human toxicity (long-term)[101]: High–5.60 ppb, Health Advisory

Fish toxicity (threshold)[101]: Low–406.10450 ppb, MATC (Maximum Acceptable Toxicant Concentration)

Regulatory Authority and Advisory Information:

Carcinogenicity[83]: EPA Group C, Possible human carcinogen

Health Advisory: Tumorigen, Endocrine disruptor (S!)

Potential Ground Water Pollutant [California FAC Section 13145(d)/12811, inactive]

Description: Light tan crystalline solid or powder; granular solid. Sulfurous odor. Molecular weight = 396.38; Specific gravity (H_2O:1) = 1.3777 @ 25 °C[83]; Freezing/Melting point = 78 °C. Low solubility in water.

Incompatibilities: May react violently with strong oxidizers, bromine, 90% hydrogen peroxide, phosphorus trichloride, silver powders or dust. Incompatible with silver compounds. Mixture with some silver compounds forms explosive salts of silver oxalate.

Determination in Water: Log K_{ow} = >3.5. Values above 3.0 are likely to bioaccumulate in aquatic organisms.

Routes of Entry: Inhalation of dust, ingestion, dermal contact, eye contact.

Harmful Effects and Symptoms

Short Term Exposure: Skin: moderately irritating. Eyes: substantially irritating. High toxicity. LD_{50} (oral, rat) = >5 g/kg; LD_{50} (dermal, rat) = >5 g/kg.

Long Term Exposure: Repeated overexposure can cause effects of the kidney, liver, thyroid, blood. This chemical can cause neurotoxic effects. May affect central nervous system. Repeated exposure may cause weight loss and reduced red blood cell count. Fluorides may cause bone disease (pain and tenderness of the bones); mottled teeth in children.

Points of Attack: Central nervous system, liver, kidney, thyroid, blood, skeletal system, teeth.

Medical Surveillance: Preliminary medical exam to detect chronic diseases of central nervous system, liver, heart, kidneys, lung and skin, as well as endocrinological or immunological disturbances, should protect susceptible individuals. Periodical medical exams of internal organs, skin and eyes are important to avoid chronic occupational intoxications. They should include lab and patch tests when necessary[83]. This chemical is a suspected or known human carcinogen. Exposed persons should contact a physician for advice regarding the possible long term health effects and advice for medical monitoring.

First Aid: If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least 15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately. If this chemical contacts the skin, remove contaminated clothing and wash immediately with soap and water. Seek medical attention immediately. If this chemical has been inhaled, remove from exposure, begin rescue breathing (using universal precautions) if breathing has stopped, and CPR if heart action has stopped. Transfer promptly to a medical facility. When this chemical has been swallowed, get medical attention. Give large quantities of water and induce vomiting. Do not make an unconscious person vomit. Do not induce vomiting when formulations containing petroleum solvents are ingested

Personal Protective Methods: Wear protective gloves and clothing to prevent any reasonable probability of dermal and/or eye contact. Safety equipment suppliers/manufacturers can provide recommendations on the most protective glove/clothing material for your operation. All protective clothing (suits, gloves, footwear, headgear) should be clean, available each day, and put on before work. Contact lenses should not be worn when working with this chemical. Wear dust-proof chemical goggles and face shield unless full facepiece respiratory protection is worn. Employees should wash immediately with soap when skin is wet or contaminated. Provide emergency showers and eyewash.

Respirator Selection: Wherever and whenever workplace conditions warrant respirator use, a respiratory protection program must be followed that meets one or more of the following government standards: OSHA's 29 CFR 1910.134, ANSI Z88.2, or European Standard EN 149.

Storage: Color Code-White: Corrosive or Contact Hazard; Store separately in a corrosion-resistant location. Prior to working with this chemical you should be trained on its proper handling and storage. Store in tightly closed containers in a cool, well-ventilated area. Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: Corrosive liquids, flammable, require labels of "Corrosive" and "Flammable." They fall in Hazard Class 8.

Spill Handling: If a spill occurs, clean it up promptly. Don't wash it away. Instead, sprinkle the liquid spill with sawdust, vermiculite, or kitty litter. Sweep it into a plastic garbage bag, and dispose of it as directed on the pesticide product label. Wash all contaminated surfaces with a soap and water solution.

Fire Extinguishing: Hazardous decomposition includes oxides of nitrogen, carbon and hydrogen fluoride. As an immediate precautionary measure, isolate spill or leak area in all directions for at least 50 meters/150 feet for liquids and at least 25 meters/75 feet for solids. *If tank, rail car or tank truck is involved in a fire, isolate* for 800 meters/0.5 mile in all directions; also, consider initial evacuation for 800 meters (0.5 mile) in all directions. *On a small fire:* use dry chemical, CO_2, water spray or alcohol-resistant foam. Vapors are heavier than air and will collect in low areas. Vapors in confined areas may explode when exposed to fire. *On a large fire:* use water spray, fog or regular foam. Do not scatter spilled material with high-pressure streams of water. Move containers from fire area if you can do it without risk. Dike fire-control water for later disposal. *Fire involving tanks:* from a secure, explosion-proof location, use water spray to cool exposed containers. If cooling streams are ineffective (venting sound increases in volume and pitch, tank discolors, or shows any signs of deforming), withdraw immediately to a secure position. Always stay away from tanks engulfed in fire. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode.

Disposal Method Suggested: Containers must be disposed of properly by following package label directions or by contacting your local or federal environmental control agency, or by contacting your regional EPA office. Dissolve or mix the material with a combustible solvent and burn in a chemical incinerator equipped with an afterburner and scrubber. In accordance with 40CFR165, follow recommendations for the disposal of pesticides and pesticide containers.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- USEPA, Office of Pesticide Programs, Pesticide Fact Sheet, "Thiazopyr" (February 20, 1997). http://www.epa.gov/opprd001/factsheets/thiazopyr.pdf
- USEPA, Office of Pesticide Programs, Pesticide Residue Limits, "Thiazopyr," 40 CFR 180.496. http://www.epa.gov/pesticides/food/viewtols.htm

Thidiazuron T:0426

Use Type: Herbicide, Defoliant, Plant growth regulator

CAS Number: 51707-55-2

Formula: $C_9H_8N_4OS$

Synonyms: 5-*N*-Phenylcarbamoylamino-1,2,3-thiadiazole; 1-Phenyl-3-(1,2,3-thiadiazol-5-yl)urea; *N*-Phenyl-*N*'-1,2,3-thiadiazol-5-yl-urea; *N*-Phenyl-*N*'-(1,2,3-thiadiazyl) urea; TDZ; (N-1,2,3-Thiadiazolyl-5)-*N*'-phenylurea; Urea, *N*-phenyl-*N*'-1,2,3-thiadiazol-5-yl

Trade Names: DAZE®; DEFOLIT®; DROPP®; GINSTAR EC® (thidiazuron + diuron); LEAFLESS® Tthidiazuron; SN 49537®

Chemical class: Urea

EPA/OPP PC Code: 120301 (208100 and 208800 are old EPA code numbers)

California DPR Chemical Code: 2162

HSDB Number: 7734

UN/NA & ERG Number: UN3077 (solid)/171; UN3082 (liquid)/171

RTECS® Number: YU1395000

EC Number: 257-356-7

Uses: Used primarily as a cotton defoliant in order to increase the harvest yield. Not applied to food crops. Not approved for use in EU countries[115]. Registered for use in the U.S.

U.S. Maximum Allowable Residue Levels for Thidiazuron and its aniline-containing metabolites in or on the following food commodities: [40 CFR 180.403(a)]: cattle, fat 0.4 ppm; cattle, meat 0.4 ppm; cattle, meat byproducts 0.4 ppm; cotton, gin byproducts 24.0 ppm; cotton, undelinted seed 0.3 ppm; goat, fat 0.4 ppm; goat meat 0.4 ppm; goat, meat byproducts 0.4 ppm; hog, fat 0.4 ppm; hog, meat 0.4 ppm; hog, meat byproducts 0.4 ppm; horse, fat 0.4 ppm; horse, meat 0.4 ppm; horse, meat byproducts 0.4 ppm; milk 0.05 ppm; sheep, fat 0.4 ppm; sheep, meat 0.4 ppm; sheep, meat byproducts 0.4 ppm.

Regulatory Authority and Advisory Information:

Carcinogenicity:

Health Advisory: Developmental/Reproductive Toxin

Toxicity (oral) Category 3, CAUTION

European/International Regulations: Hazard Symbol: Xi; risk phrases: R36/37/38; safety phrases: S2; S22; S26; S36 (see Appendix 1)

WGK (German Aquatic Hazard Class): 3-Severe hazard to waters

Description: Colorless, crystalline solid or powder. EPA registered formulations include wettable powders, soluble concentrates and emulsifiable concentrates. Molecular weight = 220.26; Specific gravity (H_2O:1) = 1.495 @ 20 °C; Boiling point = (decomposes); Freezing/Melting point = 212 °C; Vapor pressure = 2×10^{-10} mmHg @ 25 °C; Henry's Law constant = 3.3×10^{-13} atm-m^3/mol @ 25 °C (est)[83]. Hazard Identification (based on NFPA-704 M Rating System): Health 2, Flammability 0, Reactivity 0. Slightly soluble in water. Physical and toxicological properties may be affected by carrier solvents in commercial formulations.

Incompatibilities: Heat of decomposition can form toxic nitrogen oxides and sulfur oxide.

Determination in Water: Log K_{ow} = <2.0. Unlikely to bioaccumulate in marine organisms.

Routes of Entry: Inhalation, dermal contact, ingestion.

Harmful Effects and Symptoms: Human health effects from the sulfonylurea herbicides at low environmental doses or at biomonitored levels from low environmental exposures are unknown. The sulfonylurea herbicides are generally of low toxicity in mammalian studies. Animal studies showed low acute toxicity and little chronic, reproductive, or developmental toxicity or teratogenic effects. Developmental or teratogenic effects tended only to occur at high or maternally toxic doses. At high sublethal, chronic oral doses, such nonspecific effects as weight loss and anemia were observed. Some chemical-specific effects were noted at high doses in animals[96].

Short Term Exposure: May cause skin and eye irritation. Moderately poisonous if ingested or inhaled. LD_{50} (oral, rat) = >2 g/kg[83]; LD_{50} (dermal, rat) = >5 g/kg[83].

Long Term Exposure: May cause reproductive and fetal effects.

Points of Attack: Reproductive cells.of mammals.

Medical Surveillance: In addition to comprehensive initial medical and work histories emphasizing reproductive experience and menstrual history, patient should have physical examination and testing of genito-urinary tract, sperm count, motility and morphology. If required, other tests, such as serum testosterone, serum follicle stimulating hormone (FSH), and serum lutenizing hormone (LH), may be indicated. Medical exam to detect chronic diseases of central nervous system, liver, heart, kidneys, lung and skin, as well as endocrinological or immunological disturbances, should protect susceptible individuals. Periodical medical exams of internal organs, skin and eyes are important to avoid chronic occupational intoxications. They should include lab and patch tests when necessary[83]. Urinary levels of the sulfonylurea herbicides reflect recent exposure. There is very limited information on the biomonitoring of sulfonylurea herbicides or their metabolites. Detection of the metabolites may reflect exposure to more than one particular sulfonylurea herbicide or exposure to environmental degradation products. The urinary metabolites dimethoxypyrimidine and dimethylpyrimidine can be used as nonspecific markers of exposure to the pyrimidinylsulfonylureas, a group that includes bensulfuron-methyl,[41] primisulfuron-methyl, and sulfosulfon. The urinary metabolite methoxymethyl triazine can be used as a nonspecific marker of exposure to the triazinylsulfonylureas, a group that includes chlorosulfuron, prosulfuron, and triasulfuron[96].

Routes of Entry: Inhalation, ingestion.

Harmful Effects and Symptoms

Short Term Exposure: Contact with eyes or skin may cause irritation or burns. Inhalation should be avoided; use NIOSH- or CEN (UK)-approved air-purifying respirators for pesticides. May be harmful if swallowed. Dermal contact may cause allergic reaction. LD_{50} (oral, rat) = >2000 mg/kg[83]; LD_{50} (dermal, rat) = >1 g/kg.

Long Term Exposure: Repeated or prolonged contact may cause skin and lung sensitization, resulting in allergies.

Points of Attack: Skin, lungs.

Medical Surveillance: In addition to comprehensive initial medical and work histories emphasizing reproductive experience and menstrual history, patient should have physical examination and testing of genito-urinary tract, sperm count, motility and morphology. If required, other tests, such as serum testosterone, serum follicle stimulating hormone (FSH), and serum lutenizing hormone (LH), may be indicated. Evaluation by a qualified allergist, including exposure history and testing, may help diagnose allergy.

First Aid: If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least 15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately. If this chemical contacts the skin, remove contaminated clothing and wash immediately with soap and water. Seek medical attention immediately. If this chemical has been inhaled, remove from exposure, begin rescue breathing (using universal precautions) if breathing has stopped, and CPR if heart action has stopped. Transfer promptly to a medical facility. When this chemical has been swallowed, get medical attention. Give large quantities of water and induce vomiting. Do not make an unconscious person vomit.

Personal Protective Methods: Wear protective gloves and clothing to prevent any reasonable probability of dermal and/or eye contact. Safety equipment suppliers/manufacturers can provide recommendations on the most protective glove/clothing material for your operation. All protective clothing (suits, gloves, footwear, headgear) should be clean, available each day, and put on before work. Contact lenses should not be worn when working with this chemical. Wear dust-proof chemical goggles and face shield unless full facepiece respiratory protection is worn. Employees should wash immediately with soap when skin is wet or contaminated. Provide emergency showers and eyewash.

Respirator Selection: Wherever and whenever workplace conditions warrant respirator use, a respiratory protection program must be followed that meets one or more of the following government standards: OSHA's 29 CFR 1910.134, ANSI Z88.2, or European Standard EN 149.

Storage: Color Code-Blue: Health Hazard/Poison. Store in a secure poison location. Store in a refrigerator and protect from exposure to oxidizers or moisture[52]. A regulated, marked area should be established where this chemical is handled, used, or stored in compliance with OSHA Standard 1910.1045. Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: Environmentally hazardous substances, solid or liquid, usually fall in Hazard Class 9.

Spill Handling: Evacuate and restrict persons not wearing protective equipment from area of spill or leak until clean up is complete. Dampen spilled material with alcohol to avoid dust. Collect powdered material in the most convenient and safe manner and deposit in sealed containers. Ventilate area of spill or leak after clean up is complete. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable.

Fire Extinguishing: Hazardous decomposition includes oxides of sulfur, nitrogen and oxygen. As an immediate precautionary measure, isolate spill or leak area in all directions for at least 50 meters/150 feet for liquids and at least 25 meters/75 feet for solids. *Fire involving storage or vehicular tanks:* isolate for 800 meters/0.5 mile in all directions; also, consider initial evacuation for 800 meters/0.5 mile in all directions. *On a small fire:* use dry chemical, CO_2, water spray or regular foam. *On a large fire:* use water spray, fog or regular foam. Do not scatter spilled material with high-pressure streams of water. Move containers from fire area if you can do it without risk. Dike fire-control water for later disposal. *Fire involving tanks:* from a secure, explosion-proof location, use water spray to cool exposed containers. If cooling streams are ineffective (venting sound increases in volume and pitch, tank discolors, or shows any signs of deforming), withdraw immediately to a secure position. Always stay away from tanks engulfed in fire. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies. If employees are

expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode.

Disposal Method Suggested: It is the responsibility of chemical waste generators to determine the toxicity and physical properties of a discarded chemical and to properly identify its classification and certification as a hazardous waste and to determine the disposal method. U.S. EPA guidelines for the classification determination are listed in ***40 CFR*** Parts 261.3. Additionally, waste generators must consult and follow all regional, national, state and local hazardous waste laws to ensure complete and accurate classification and disposal methods. Recycle any unused portion of the material for its approved use or return it to the manufacturer or supplier. Ultimate disposal of the chemical must consider: the material's impact on air quality; potential migration in soil or water; effects on animal, aquatic, and plant life; and conformance with environmental and public health regulations[83].

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- USEPA, Office of Pesticide Programs, Pesticide Residue Limits, "Thidiazuron," 40 CFR 180.403. http://www.epa.gov/pesticides/food/viewtols.htm

Thifensulfuron methyl T:0427

Use Type: Herbicide

CAS Number: 79277-27-3

Formula: $C_{11}H_{11}N_5O_6S_2$

Synonyms: Methyl 3-[(((((4-methoxy-6-methyl-1,3,5-triazin-2-yl)amino)carbonyl)amino)sulfonyl]-2-thiophenecarboxylate; 2-Thiophenecarboxylic acid, 3-[((((4-methoxy-6-methyl-1,3,5-triazin-2-yl)amino)carbonyl)amino)sulfonyl]-, methyl ester; Thiameturon-methyl

Trade Names: ALLY®; BASIS® (rimsulfuron+thifensulfuron methyl); CANVAS® (thifensulfuron methyl+tribenuron methyl+metsulfuron-methyl); DPX-M6316®; EXPRESS®; HARMONY® Extra (thifensulfuron methyl+tribenuron methyl); INM-6316®; PINNACLE®; PROSPECT®; RELIANCE® SYNCHRONY®, (chlorimuron-ethyl+thifensulfuron methyl)

Chemical class: Sulfonylurea

EPA/OPP PC Code: 128845

California DPR Chemical Code: 2237

HSDB Number: 7354

UN/NA & ERG Number: UN3077 (solid)/171; UN3082 (liquid)/171

RTECS® Number: XM8463000

EC Number: [*Annex I Index No.:* 016-096-00-2]

Uses: A herbicide for postemergence broadleaf weed control in crops for food such as soybeans and cotton. Not listed for use in EU countries[115].

U.S. Maximum Allowable Residue Levels for herbicide thifensulfuron methyl [40 CFR 180.439(a)]: in or on the following raw agricultural commodities: barley, grain 0.05 ppm; barley, straw 0.10 ppm; canola, seed 0.02 ppm; corn, field, forage 0.10 ppm; corn, field, grain 0.05 ppm; corn, field stover, 0.10 ppm; cotton, gin byproducts 0.02 ppm; cotton, undelinted seed 0.02 ppm; flax, seed 0.02 ppm; oat, grain 0.05 ppm; oat, straw 0.10 ppm; soybean 0.10 ppm; wheat, grain 0.05 ppm; and wheat, straw 0.10 ppm.

Human toxicity (long-term)[101]: Low–91.00 ppb, Health Advisory

Fish toxicity (threshold)[101]: Very low–19952.62315 ppb, MATC (Maximum Acceptable Toxicant Concentration)

Regulatory Authority and Advisory Information: Acute Oral Category: 4, Caution European/International Regulations: Hazard Symbol: N; risk phrases: R52; R53; safety phrases: S2; S60; S61 (see Appendix 1)

Description: Pale yellowish-bown liquid. Molecular weight = 387.39; Specific gravity (H_2O:1) = 1.56 @ 20 °C; Boiling point = (decomposes); Freezing/Melting point = 171–176 °C; 186 °C[Merck]; Vapor pressure = 1.3×10^{-10} mmHg @ 20 °C. Henry's Law constant = 2.92×10^{-14} atm-m^3/mol @ 25 °C (est)[83]. Soluble in water; solubility 2.8 g/L.

Incompatibilities: May react violently with strong oxidizers, bromine, 90% hydrogen peroxide, phosphorus trichloride, silver powders or dust. Incompatible with silver compounds. Mixture with some silver compounds forms explosive salts of silver oxalate.

Determination in Water: Log K_{ow} = negative. Unlikely to bioaccumulate in marine organisms.

Routes of Entry: Inhalation, dermal contact, ingestion.

Harmful Effects and Symptoms: Human health effects from the sulfonylurea herbicides at low environmental doses or at biomonitored levels from low environmental exposures are unknown. The sulfonylurea herbicides are generally of low toxicity in mammalian studies. Animal studies showed low acute toxicity and little chronic, reproductive, or developmental toxicity or teratogenic effects. Developmental or teratogenic effects tended only to occur at high or maternally toxic doses. At high sublethal, chronic oral doses, such nonspecific effects as weight loss and anemia were observed. Some chemical-specific effects were noted at high doses in animals[96].

Short Term Exposure: May cause skin and eye irritation. Moderately poisonous if ingested or inhaled. LD_{50} (oral, rat) = >5 g/kg; LD_{50} (dermal, rat) = >2 g/kg.

Long Term Exposure: Triflusulfuron-methyl produced interstitial cell hyperplasia and adenomas[96].

Medical Surveillance: Preliminary medical exam to detect chronic diseases of central nervous system, liver, heart, kidneys, lung and skin, as well as endocrinological or immunological disturbances, should protect susceptible individuals. Periodical medical exams of internal organs, skin and eyes are important to avoid chronic occupational intoxications. They should include lab and patch tests when necessary[83].

Urinary levels of the sulfonylurea herbicides reflect recent exposure. There is very limited information on the biomonitoring of sulfonylurea herbicides or their metabolites. Detection of the metabolites may reflect exposure to more than one particular sulfonylurea herbicide or exposure to environmental degradation products. The urinary metabolites dimethoxypyrimidine and dimethylpyrimidine can be used as nonspecific markers of exposure to the pyrimidinylsulfonylureas, a group that includes bensulfuron-methyl,[41] primisulfuron-methyl, and sulfosulfon. The urinary metabolite methoxymethyl triazine can be used as a nonspecific marker of exposure to the triazinylsulfonylureas, a group that includes chlorosulfuron, prosulfuron, and triasulfuron[96].

First Aid: If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least 15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately. If this chemical contacts the skin, remove contaminated clothing and wash immediately with soap and water. Seek medical attention immediately. If this chemical has been inhaled, remove from exposure, begin rescue breathing (using universal precautions) if breathing has stopped, and CPR if heart action has stopped. Transfer promptly to a medical facility. When this chemical has been swallowed, get medical attention. Give large quantities of water or milk and induce vomiting. Do not make an unconscious person vomit.

Personal Protective Methods: Wear protective gloves and clothing to prevent any reasonable probability of dermal and/or eye contact. Safety equipment suppliers/manufacturers can provide recommendations on the most protective glove/clothing material for your operation. All protective clothing (suits, gloves, footwear, headgear) should be clean, available each day, and put on before work. Contact lenses should not be worn when working with this chemical. Wear dust-proof chemical goggles and face shield unless full facepiece respiratory protection is worn. Employees should wash immediately with soap when skin is wet or contaminated. Provide emergency showers and eyewash.

Respirator Selection: Wherever and whenever workplace conditions warrant respirator use, a respiratory protection program must be followed that meets one or more of the following government standards: OSHA's 29 CFR 1910.134, ANSI Z88.2, or European Standard EN 149.

Storage: Color Code-Blue: Health Hazard/Poison. Store in a secure poison location. Store in a refrigerator and protect from exposure to oxidizers or moisture[52]. A regulated, marked area should be established where this chemical is handled, used, or stored in compliance with OSHA Standard 1910.1045. Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: Environmentally hazardous substances, solid or liquid, usually fall in Hazard Class 9.

Spill Handling: Evacuate and restrict persons not wearing protective equipment from area of spill or leak until clean up is complete. Dampen spilled material with alcohol to avoid dust. Collect powdered material in the most convenient and safe manner and deposit in sealed containers. Ventilate area of spill or leak after clean up is complete. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable.

Fire Extinguishing: Hazardous decomposition includes oxides of sulfur and nitrogen. As an immediate precautionary measure, isolate spill or leak area in all directions for at least 50 meters/150 feet for liquids and at least 25 meters/75 feet for solids. *Fire involving storage or vehicular tanks:* isolate for 800 meters/0.5 mile in all directions; also, consider initial evacuation for 800 meters/0.5 mile in all directions. *On a small fire:* use dry chemical, CO_2, water spray or regular foam. *On a large fire:* use water spray, fog or regular foam. Do not scatter spilled material with high-pressure streams of water. Move containers from fire area if you can do it without risk. Dike fire-control water for later disposal. *Fire involving tanks:* from a secure, explosion-proof location, use water spray to cool exposed containers. If cooling streams are ineffective (venting sound increases in volume and pitch, tank discolors, or shows any signs of deforming), withdraw immediately to a secure position. Always stay away from tanks engulfed in fire. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode.

Disposal Method Suggested: It is the responsibility of chemical waste generators to determine the toxicity and physical properties of a discarded chemical and to properly identify its classification and certification as a hazardous waste and to determine the disposal method. U.S. EPA guidelines for the classification determination are listed in ***40 CFR*** Parts 261.3. Additionally, waste generators must consult and follow all regional, national, state and local hazardous waste laws to ensure complete and accurate classification and disposal methods. Recycle any unused portion of the material for its approved use or return it to the manufacturer or supplier. Ultimate disposal of the chemical must consider: the material's impact on air quality; potential migration in soil or water; effects on animal, aquatic, and plant life; and conformance with environmental and public health regulations[83].

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov

- Centers for Disease Control and Prevention (CDC), National Biomonitoring Program, *Sulfonylurea Herbicides*, Atlanta, GA (2013). http://www.cdc.gov/biomonitoring/SulfonylureaHerbicides_BiomonitoringSummary.html

Thiodicarb T:0446

Use Type: Insecticide, Molluscicide, Ovicide
CAS Number: 59669-26-0
Formula: $C_{10}H_{18}N_4O_4S_3$
Synonyms: AI3-29311; Bismethomylthioether; Bis-(*O*-1-methylthioethylimino)-*N*-methylcarbamic acid)-*N,N*'-sulfide; [Carbamic acid, *N*-methyl-, compounded with (2-methylthio)acetaldoxime]bis-, thioether; Caswell No. 900AA; Dimethyl-*N,N*'-[thiobis((methylimino) carbonyl)oxy)]bis(ethanimidothioate); Dimethyl *N,N*'-[thiobis((methylimino)carbonyloxy)]bis(thioimidoacetate); Dimethyl *N,N*'-[thiobis((methylimino) carbonyloxy)] bis(ethanimidothioate); Ethanimidothioic acid, *N'N*'-[thiobis((methylimino)carbonyloxy)]bis-, dimethyl ester; 3,7,9,13-Tetramethy l-5,11-dioxa-2,8,14-trithia-4,7,9,12-tetra-azapentadeca-3,12-diene-6,10-dione; *N,N*'-[Thiobis((methylimino)carbonyloxy)]bis dimethylester
Trade Names: CGA® 45156; CHIPCO[C]; DICARBOSULF®; DICARBASULF®; LARVIN®; LEPICRON®; SEMEVIN®; NIVRAL®; UC-51762®; UC 51769®; UC 80502®
Chemical class: Carbamate (N-methyl)
EPA/OPP PC Code: 114501
California DPR Chemical Code: 2202
HSDB Number: 6940
UN/NA & ERG Number: UN2757 (solid)/151
RTECS® Number: KJ4301050
EC Number: 261-848-7; Not classified in Annex I
Uses: Not approved for use in EU countries[115]. Registered for use in the U.S. Thiodicarb is used primarily on cotton, sweet corn, and soybeans. The remaining usage is spread among leafy vegetables, cole crops, ornamentals, and other minor use sites. Thiodicarb acts as an ovicide against cotton bollworms and budworms.
U.S. Maximum Allowable Residue Levels for Methomyl [40 CFR 180.253]: The U.S. EPA has determined that methomyl is a degradate of thiodicarb, which is a registered pesticide. Therefore, methomyl residues resulting from applications of both thiodicarb and methomyl have been considered in an aggregate risk assessment and compared to appropriate toxicological endpoints for methomyl
Human toxicity (long-term)[101]: Intermediate–18.61702 ppb, CHCL (Chronic Human Carcinogen Level)
Fish toxicity (threshold)[101]: Low–353.55339 ppb, MATC (Maximum Acceptable Toxicant Concentration)
Regulatory Authority and Advisory Information:
Carcinogenicity[83]: EPA Group B2, Probable human carcinogen.
California Proposition 65 Chemical: Carcinogen (8/20/1999)
Acute Oral Category: 2, WARNING
Health Advisory: Nerve Toxin (S!)
EPA Hazardous Waste Number (RCRA No.): U410
RCRA Universal Treatment Standards: Wastewater (mg/L), 0.019; Non-wastewater (mg/kg), 1.4
Safe Drinking Water Act: Priority List (55 FR 1470)
EPCRA Section 313 Form R *de minimis* concentration reporting level: 1.0%
European/International Regulations: Hazard Symbol: T, Xi, N; risk phrases: R23; R25; R43; R50/53; Safety phrases: S2; S22; S24; S36/37, S45; S60, S61 (see Appendix 1)
Description: White to light tan crystalline powder. Slight sulfurous odor. Registered with the EPA as liquid, flowable concentrate, granular, pelleted/tableted, water-dispersible granules, and wettable powder. Molecular weight = 354.47; Specific gravity (H_2O:1) = 1.47 @ 20 °C; Boiling point = (decomposes); Freezing/Melting point = 169-173 °C; Vapor pressure = 1.1×10^{-7} mmHg @ 20 °C. Low solubility in water.
Incompatibilities: May react violently with chlorobenzenediazonium salts, mercurous chloride. Incompatible with cadmium bromide, zinc acetate. May form explosive materials with phosphorus pentachloride. Carbamates are incompatible with strong oxidizing acids, peroxides, and hydro-peroxides; strong reducing agents such as hydrides; strong acids and bases. Contact with nitrides or chemically active metals (aluminum, copper, magnesium, neptunium, sodium, tin, titanium, zinc, etc.) causes the release of potentially explosive hydrogen gas and a metal salt. Moisture may cause hydrolysis or other forms of decomposition. Sunlight and UV can cause decomposition of aqueous solutions[83].
Permissible Concentration in Water: Runoff from spills or fire control may cause water pollution.
Determination in Water: Log K_{ow} = <2.0. Unlikely to bioaccumulate in marine organisms.
Routes of Entry: Dermal contact, ingestion and inhalation.
Harmful Effects and Symptoms
Short Term Exposure: Eye pupils are small, blurred vision, eye watering, runny nose, cough, shortness of breath, salivation, nausea, stomach cramps, diarrhea, and vomiting, increased blood pressure, profuse sweating, hypermotility, hallucinations, agitation, tingling of the skin, slow heartbeat, convulsions, fluid in lungs, loss of consciousness, incontinence, breathing stops, death. Carbamates inhibit the acetylcholinesterase enzymes and alter the way in which nervous impulses are transmitted. However, within several hours carbamates spontaneously detach from the enzymes. LD_{50} (oral, rat) = 60–625 mg/kg; LD_{50} (dermal, rat) = >2 g/kg.
Long Term Exposure: A potent acetylcholinesterase (AChE) inhibitor; cumulative effect is possible. Neurotoxic. This chemical may damage the nervous system with repeated exposure, resulting in convulsions, respiratory failure. May cause liver damage. Skin sensitizer.
Points of Attack: Respiratory system, lungs, central nervous system, cardiovascular system, skin, eyes, plasma and red blood cell cholinesterase.
Medical Surveillance: Routine biological monitoring of pesticide applicators and field workers includes testing

of plasma and red blood cell acetylcholinesterase levels (for enzyme poisoned by this chemical). These tests are normally accurate only if done within about two hours of exposure. If exposure stops, plasma levels return to normal in 1-2 weeks while red blood cell levels may be reduced for 1-3 months. When acetylcholinesterase enzyme levels are reduced by 25% or more below preemployment levels, risk of poisoning is increased, even if results are in lower ranges of "normal." Reassignment to work not involving carbamate pesticides is recommended until enzyme levels recover. Do not drink any alcoholic beverages before or during use. This chemical is a suspected or known human carcinogen. Exposed persons should contact a physician for advice regarding the possible long term health effects and advice for medical monitoring. In addition to comprehensive initial medical and work histories emphasizing reproductive experience and menstrual history, patient should have physical examination and testing of genito-urinary tract, sperm count, motility and morphology. If required, other tests, such as serum testosterone, serum follicle stimulating hormone (FSH), and serum lutenizing hormone (LH), may be indicated. Medical observation is recommended for 24 to 48 hours following breathing overexposure, as pulmonary edema may be delayed. Cigarette smoking may exacerbate pulmonary injury and should be discouraged for at least 72 hours following exposure. Also consider complete blood count and chest x-ray following acute overexposure. Evaluation by a qualified allergist, including exposure history and testing, may help diagnose allergy.

First Aid: Speed in removing material from eyes and skin is of extreme importance. *Eyes:* Eye contact can cause dangerous amounts of these chemicals to be quickly absorbed through the mucous membrane into the bloodstream. Immediately and gently flush eyes with plenty of warm or cold water (NO hot water) for at least 15 minutes, occasionally lifting the upper and lower eyelids. Get medical aid immediately. Skin: Get medical aid. Dermal contact can cause dangerous amounts of these chemicals to be absorbed into the bloodstream. Wearing the appropriate PPE equipment and respirator for carbamate pesticides, immediately flush skin with plenty of soap and water for at least 15 minutes while removing contaminated clothing and shoes. Shampoo hair promptly if contaminated; protect eyes. *Ingestion:* Call poison control. Loosen all clothing. Never give anything by mouth to an unconscious person. Get medical aid. *Do NOT induce vomiting*. *If conscious, alert, and able to swallow, rinse mouth and have victim drink 4 to 8 ounces of water. Check to see if poison control instructs you to use ipecac syrup, otherwise administer slurry of activated charcoal (2 oz in 8 oz of water). If victim is *unconscious or having convulsions,* do nothing except keep victim warm. **In some cases you may be specifically instructed by poison control to induce vomiting by way of 2 tablespoons of syrup of ipecac (adult) washed down with a cup of water*. Do NOT give activated charcoal before or with ipecac syrup. *Inhalation:* Get medical aid. Do not contaminate yourself. Wearing the appropriate PPE equipment and respirator for carbamate pesticides, immediately remove the victim from the contaminated area to fresh air. If the victim is not breathing, administer artificial respiration. Do not use mouth-to-mouth method if victim ingested or inhaled the substance; give artificial respiration with the aid of a pocket mask equipped with a one-way valve or other proper respiratory medical device. If breathing is difficult, administer oxygen through bag/mask apparatus until medical help arrives. Do not leave victim unattended. *Note to physician or authorized medical personnel.* Administer atropine, 2 mg (1/30 gr) intramuscularly or intravenously as soon as any local or systemic signs or symptoms of an intoxication are noted; repeat the administration of atropine every 3 to 8 minutes until signs of atropinization (mydriasis, dry mouth, rapid pulse, hot and dry skin) occur; initiate treatment in children with 0.05 mg/kg of atropine; repeat at 5 to 10 minute intervals. Watch respiration, and remove bronchial secretions if they appear to be obstructing the airway; intubate if necessary. *Medical note:* 2-PAMCI may be contraindicated in the case of some carbamate poisonings. As first aid for pulmonary edema, a doctor or authorized paramedic might consider administering a corticosteroid spray.

Personal Protective Methods: Wear protective gloves and clothing to prevent any reasonable probability of dermal and/or eye contact. Safety equipment suppliers/manufacturers can provide recommendations on the most protective glove/clothing material for your operation. DuPont™ Tychem® suit fabrics[88]. All protective clothing (suits, gloves, footwear, headgear) should be clean, available each day, and put on before work. Contact lenses should not be worn when working with this chemical. Wear dust-proof chemical goggles and face shield unless full facepiece respiratory protection is worn. Employees should wash immediately with soap when skin is wet or contaminated. Provide emergency showers and eyewash.

Respirator Selection: *At concentrations above the NIOSH REL, or where there is no REL, at any detectable concentration:* SCBAF:Pd,Pp (APF = 10,000) (any self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode); or SaF:Pd,Pp:ASCBA (APF = 10,000) (any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary self-contained positive-pressure breathing apparatus). *Escape*: GmFOv100 (APF = 50) [any air-purifying, full facepiece respirator (gas mask) with a chin-style, front- or back-mounted organic vapor canister having an N100, R100, or P100 filter]; or SCBAE (any appropriate escape-type, self-contained breathing apparatus).

Storage: Color Code-Blue: Health Hazard/Poison. Store in a secure poison location. Prior to working with this chemical you should be trained on its proper handling and storage. Store in tightly closed containers in a cool, well-ventilated area away from strong alkalis (such as sodium hydroxide, sodium bicarbonate, etc.). Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: This is a solid toxic carbamate and should be labeled "poisonous materials." It falls into Hazard Class 6.1.

Spill Handling: For solids, isolate spill or leak area in all directions for at least 25 meters/75 feet. Increase, in the downwind direction, as necessary. Do not touch damaged containers or spilled material unless wearing appropriate protective clothing. Stop leak if you can do it without risk. Prevent entry into waterways, sewers, basements or confined areas. Cover with plastic sheet to prevent spreading. Absorb or cover with dry earth, sand or other non-combustible material and transfer to containers. Do not allow water to get inside containers.

Fire Extinguishing: Hazardous decomposition includes oxides of nitrogen, sulfur, and carbon. *On small fire:* use dry chemical powder, carbon dioxide, water spray, or foam. *On large fire:* use water spray, fog or alcohol-resistant foam. Do not scatter material using straight water jet streams. Dike fire-control water for later disposal; do not scatter the material. Move containers from fire area if you can do it without risk. *Fire involving storage or vehicular tanks:* isolate for 800 meters/0.5 mile in all directions; also, consider initial evacuation for 800 meters/0.5 mile in all directions. Fight fire from maximum distance or use unmanned hose holders or monitor nozzles. Do not allow water to get inside containers. Cool containers with flooding quantities of water until well after fire is out. Withdraw immediately in the case of rising sound from venting safety devices or discoloration of tank. *Always* stay away from tanks engulfed in fire. For massive fire, use unmanned hose holders or monitor nozzles; if this is impossible, withdraw from area and let fire burn.

Disposal Method Suggested: Do not discharge into drains or sewers. Dispose of waste material as hazardous waste using a licensed disposal contractor to an approved landfill. Consult with environmental regulatory agencies for guidance on acceptable disposal practices. Generators of waste containing this contaminant (≥100 kg/mo) must conform with EPA regulations governing storage, transportation, treatment, and waste disposal. Incineration with effluent gas scrubbing is recommended. Containers must be disposed of properly by following package label directions or by contacting your local or federal environmental control agency, or by contacting your regional EPA office.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- USEPA, "Rereregistration Eligibility Decision (RED), Thiodicarb," Office of Prevention, Pesticides and Toxic Substances," Washington DC. (December 1998). http://www.epa.gov/REDs/2675red.pdf
- Pesticide Management Education Program, "Thiodicarb (Larvin) Chemical Fact Sheet 8/84," Cornell University, Ithaca, NY (August 1984). http://pmep.cce.cornell.edu/profiles/insect-mite/propetamphos-zetacyperm/thiodicarb/insect-prof-thiodicarb.html

Thiophanate-methyl T:0485

Use Type: Fungicide

CAS Number: 23564-05-8 (thiophanate-methyl); 23564-06-9 (thiophanate-ethyl)

Formula: $C_{12}H_{14}N_4O_4S_2$

Synonyms: Allophanic acid, 4,4'-*O*-phenylenebis(3-thio-, diethyl ester; 1,2-Bis(ethoxycarbonylthioureido)benzene; 1,2-Bis(3-(ethoxycarbonyl)-2-thioureido)benzene; 1,2-Bis[3-(ethoxycarbonyl)thioureido]benzene; Carbamic acid, [1,2-phenylenebis(iminocarbonothioyl)]bis-, diethyl ester; Caswell No. 344A; Cercobin-methyl; 1,2-Di-(3-ethoxycarbonyl-2-thioureido)benzene; Diethyl [1,2-phenylenebis(iminocarbonothioyl)]bis(carbamate); Diethyl [(1,2-phenylene)bis(iminocarbonothioyl)]bis(carbamate); Diethyl 4,4'-*O*-phenylenebis(3-thioallophanate); Diethyl 4,4'-(*O*-phenylene)bis(3-thioallophanate); Ethyl thiophanate; 4,4'-*O*-Phenylenebis(ethyl 3-thioallophanate); [1,2-Methyl thiophanate; Phenylenebis(iminocarbonothioyl)]biscarbamic acid diethyl ester; (1,2-Phenylenebis[iminocarbonothioyl)] biscarbamic acid diethyl ester; 4,4'-*O*-Phenylenebis(3-thioallophanic acid)dimethyl ester; Thiofanate; Thiophanate; Thiophenite

Trade Names: BASF® 32500 F; BASF® 32500 Fungicide; CERCOBIN®; CLEARY® 3336; CONSYST®; DITEK®[C]; DOMAIN®; DOUSAN®[C]; ENOVIT®; EVOLVE®; FANATE®; FUNGITOX®; FUNGO®; MILDOTHANE® Turf Liquid; NEOTOPSIN®; NF-35®; NF-44®; NSC 170810®; PELT®; PRO-TURF®; SIPCAVIT®; SNARE®; SPECTRO®; SYSTEC®; SYSTEMIC® FUNGICIDE; TD 1771®; TOPSIN®; TOPSIN-WP METHYL®; 3336 TURF FUNGICIDE®; ZYBAN®

Chemical class: Benzimidazole; Carbamate

EPA/OPP PC Code: 102001

California DPR Chemical Code: 1696

HSDB Number: 6937 (-methyl) actively registered in U.S; 6938 (-ethyl) not currently registered in U.S.

UN/NA & ERG Number: UN2757 (solid)/151

RTECS® Number: BA3675000

EC Number: 245-740-7 [*Annex I Index No.*006-069-00-3]

Uses: Thiophanate-methyl is a systemic fungicide used to control a broad spectrum of fungal diseases on fruits, vegetables, turf and ornamentals, including shade trees, and diseases in the field, nurseries, and in greenhouses. *Note:* Do not confuse with thiophanate-ethyl (CAS: 23564-06-9), which is not currently registered for use in the U.S. Registered for use in EU countries[115]. Registered for use in the U.S.

U.S. Maximum Allowable Residue Levels for Thiophanate-Methyl and its metabolite methyl 2-benzimidazoyl carbamate (MBC), calculated as thiophanate-methyl [40 CFR 180.371(a)]: in or on almond 0.1 ppm; almond, hulls 0.5 ppm; apple 2.0 ppm; apricot 15.0 ppm;

banana 2.0 ppm; bean, dry, seed 0.2 ppm; bean, snap, succulent 0.2 ppm; beet, sugar, roots 0.2 ppm; beet, sugar, tops 15.0 ppm; cattle, fat 0.15 ppm; cattle, meat 0.15 ppm; cattle, meat byproducts 0.15 ppm; cherry, sweet 20.0 ppm; cherry, tart 20.0 ppm; goat, fat 0.15 ppm; goat, meat 0.15 ppm; goat, meat byproducts 0.15 ppm; grape 5.0 ppm; horse, fat 0.15 ppm; horse, meat 0.15 ppm; horse, meat byproducts 0.15 ppm; milk 0.15 ppm; onion, bulb 0.5 ppm; onion, green 3.0 ppm; peach 3.0 ppm; peanut 0.1 ppm; peanut, hay 5.0 ppm; pear 3.0 ppm; pecan 0.1 ppm; pistachio 0.1 ppm; plum 0.5 ppm; potato 0.1 ppm; sheep, fat 0.15 ppm; sheep, meat 0.15 ppm; sheep, meat byproducts 0.15 ppm; soybean, seed 0.2 ppm; soybean, hulls 1.5 ppm; strawberry 7.0 ppm; ppm; sugarcane, cane 0.1 ppm; vegetable, cucurbit, group 9 1.0 ppm; ppm; wheat, grain 0.1 ppm; wheat, hay 0.1 ppm; wheat, straw 0.1 ppm. ***Tolerances with a regional registration, as defined in 180.1(m) [40 CFR 180.371(c)]:*** in or on canola, seed 0.1 ppm.

Regulatory Authority and Advisory Information:

Carcinogenicity[83]: EPA, Likely to be carcinogenic to humans

California Proposition 65 Chemical: Listed female and male reproductive toxin (5/18/1999)

EPA Oral reference dose (RfD) = 0.08 mg/kg/day.

Health Advisory: Developmental/Reproductive Toxin

Toxicity (oral) Category 4, Caution.

Potential Ground Water Pollutant [California FAC Section 13145(d)/12811, active]

EPA Hazardous Waste Number (RCRA No.): U409

EPCRA Section 313 Form R *de minimis* concentration reporting level: 1.0%

European/International Regulations: Hazard Symbol: Xn, N; risk phrases: R20; R43; R50/53; R68(3); safety phrases: S2; S36/37; S46; S60; S61 (see Appendix 1)

Description: Colorless crystalline solid, or light brown powder. EPA registered formulations include dust, granular, wettable powder, water-dispersible granular, and flowable concentrate, ranging from 1.5% to 90% active ingredient Molecular weight = 342.42; 370.48 (-ethyl); Specific gravity (H_2O:1) = 1.44.5 @ 20 °C; Boiling point = (decomposes); Freezing/Melting point = (decomposes) 172.22 °C[88]; Vapor pressure = 1 x10^{-7} mmHg @ 20 deg°C[88]. Henry's Law constant = 1.21×10^{-9} atm-m^3/mol @ 25 °C (est)[83]. Low solubility in water; solubility = <1 mg/mL @ 20 °C[88]. Physical and toxicological properties may be affected by carrier solvents in commercial formulations.

Incompatibilities: Decomposes in temperatures >150 °C. Carbamates are incompatible with strong oxidizing acids, peroxides, and hydro-peroxides; strong reducing agents such as hydrides; strong acids and bases. Contact with nitrides or chemically active metals (aluminum, copper, magnesium, neptunium, sodium, tin, titanium, zinc, etc.) causes the release of potentially explosive hydrogen gas and a metal salt. May form explosive materials with phosphorus pentachloride. Contact with copper salts can form dangerous complexes.

Permissible Exposure Limits in Air: No OELs have been established in the US for this chemical.

Determination in Air: Filter; none; Gravimetric; NIOSH IV [Particulates NOR; #0500 (total), #0600 (respirable)][18].

Determination in Water: Log K_{ow} = <2.0. Unlikely to bioaccumulate in marine organisms.

Routes of Entry: Absorbed through the skin, inhalation, ingestion.

Harmful Effects and Symptoms

Short Term Exposure: Eye pupils are small, blurred vision, eye watering, runny nose, cough, shortness of breath, salivation, nausea, stomach cramps, diarrhea, and vomiting, increased blood pressure, profuse sweating, hypermotility, hallucinations, agitation, tingling of the skin, slow heartbeat, convulsions, fluid in lungs, loss of consciousness, incontinence, breathing stops, death. Carbamates inhibit the acetylcholinesterase enzymes and alter the way in which nervous impulses are transmitted. However, within several hours carbamates spontaneously detach from the enzymes. Skin sensitizer. LD_{50} (oral, rat) = >5 g/kg; >2000 (-ethyl); LD_{50} (dermal, rat) = >2 g/kg.

Long Term Exposure: A potent acetylcholinesterase (AChE) inhibitor; cumulative effect is possible. This chemical may damage the nervous system with repeated exposure, resulting in convulsions, respiratory failure. May cause liver damage. May be mutagenic. Cancer risk. Skin sensitizer.

Points of Attack: Respiratory system, lungs, central nervous system, cardiovascular system, skin, eyes, plasma and red blood cell cholinesterase.

Medical Surveillance: This chemical is a suspected or known human carcinogen. Exposed persons should contact a physician for advice regarding the possible long term health effects and advice for medical monitoring. In addition to comprehensive initial medical and work histories emphasizing reproductive experience and menstrual history, patient should have physical examination and testing of genito-urinary tract, sperm count, motility and morphology. If required, other tests, such as serum testosterone, serum follicle stimulating hormone (FSH), and serum lutenizing hormone (LH), may be indicated. Medical observation is recommended for 24 to 48 hours following breathing overexposure, as pulmonary edema may be delayed. Cigarette smoking may exacerbate pulmonary injury and should be discouraged for at least 72 hours following exposure. Before employment and at regular times after that, the following are recommended: Plasma and red blood cell cholinesterase levels (tests for the enzyme poisoned by this chemical). If exposure stops, plasma levels return to normal in 1-2 weeks while red blood cell levels may be reduced for 1-3 months. When acetylcholinesterase enzyme levels are reduced by 25% or more below preemployment levels, risk of poisoning is increased, even if results are in lower ranges of "normal." Reassignment to work not involving carbamate pesticides is recommended until enzyme levels recover. If symptoms develop or overexposure occurs, repeat the above tests as soon as possible and get an exam of the nervous system. Also consider complete blood count and chest x-ray following acute overexposure. Evaluation by a qualified allergist, including exposure history and testing may help diagnose allergy.

First Aid: Speed in removing material from eyes and skin is of extreme importance. *Eyes:* Eye contact can cause dangerous amounts of these chemicals to be quickly absorbed through the mucous membrane into the bloodstream. Immediately and gently flush eyes with plenty of warm or cold water (NO hot water) for at least 15 minutes, occasionally lifting the upper and lower eyelids. Get medical aid immediately. *Skin:* Get medical aid. Dermal contact can cause dangerous amounts of these chemicals to be absorbed into the bloodstream. Wearing the appropriate PPE equipment and respirator for carbamate pesticides, immediately flush skin with plenty of soap and water for at least 15 minutes while removing contaminated clothing and shoes. Shampoo hair promptly if contaminated; protect eyes. *Ingestion:* Call poison control. Loosen all clothing. Never give anything by mouth to an unconscious person. Get medical aid. *Do NOT induce vomiting*. *If conscious, alert, and able to swallow, rinse mouth and have victim drink 4 to 8 ounces of water. Check to see if poison control instructs you to use ipecac syrup, otherwise administer slurry of activated charcoal (2 oz in 8 oz of water). If victim is *unconscious or having convulsions,* do nothing except keep victim warm. **In some cases you may be specifically instructed by poison control to induce vomiting by way of 2 tablespoons of syrup of ipecac (adult) washed down with a cup of water*. Do NOT give activated charcoal before or with ipecac syrup. *Inhalation:* Get medical aid. Do not contaminate yourself. Wearing the appropriate PPE equipment and respirator for carbamate pesticides, immediately remove the victim from the contaminated area to fresh air. If the victim is not breathing, administer artificial respiration. Do not use mouth-to-mouth method if victim ingested or inhaled the substance; give artificial respiration with the aid of a pocket mask equipped with a one-way valve or other proper respiratory medical device. If breathing is difficult, administer oxygen through bag/mask apparatus until medical help arrives. Do not leave victim unattended. *Note to physician or authorized medical personnel.* Administer atropine, 2 mg (1/30 gr) intramuscularly or intravenously as soon as any local or systemic signs or symptoms of an intoxication are noted; repeat the administration of atropine every 3 to 8 minutes until signs of atropinization (mydriasis, dry mouth, rapid pulse, hot and dry skin) occur; initiate treatment in children with 0.05 mg/kg of atropine; repeat at 5 to 10 minute intervals. Watch respiration, and remove bronchial secretions if they appear to be obstructing the airway; intubate if necessary. *Medical note:* 2-PAMCI may be contraindicated in the case of some carbamate poisonings. As first aid for pulmonary edema, a doctor or authorized paramedic might consider administering a corticosteroid spray.

Personal Protective Methods: Wear protective gloves and clothing to prevent any reasonable probability of dermal and/or eye contact. Safety equipment suppliers/manufacturers can provide recommendations on the most protective glove/clothing material for your operation. DuPont™ Tychem® suit fabrics[88]. All protective clothing (suits, gloves, footwear, headgear) should be clean, available each day, and put on before work. Contact lenses should not be worn when working with this chemical. Wear dust-proof chemical goggles and face shield unless full facepiece respiratory protection is worn. Employees should wash immediately with soap when skin is wet or contaminated. Provide emergency showers and eyewash.

Respirator Selection: *At concentrations above the NIOSH REL, or where there is no REL, at any detectable concentration:* SCBAF:Pd,Pp (APF = 10,000) (any self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode); or SaF:Pd,Pp:ASCBA (APF = 10,000) (any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary self-contained positive-pressure breathing apparatus). *Escape*: GmFOv100 (APF = 50) [any air-purifying, full facepiece respirator (gas mask) with a chin-style, front- or back-mounted organic vapor canister having an N100, R100, or P100 filter]; or SCBAE (any appropriate escape-type, self-contained breathing apparatus).

Storage: Color Code-Blue: Health Hazard/Poison. Store in a secure poison location. Prior to working with this chemical you should be trained on its proper handling and storage. A regulated, marked area should be established where this chemical is handled, used, or stored. Store in tightly closed containers in a cool, well-ventilated area away from strong alkalis (such as sodium hydroxide, sodium bicarbonate, etc.). Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: This is a solid toxic carbamate and should be labeled "poisonous materials." It falls into Hazard Class 6.1.

Spill Handling: For solids, isolate spill or leak area in all directions for at least 25 meters/75 feet. Increase, in the downwind direction, as necessary. Do not touch damaged containers or spilled material unless wearing appropriate protective clothing. Stop leak if you can do it without risk. Prevent entry into waterways, sewers, basements or confined areas. Cover with plastic sheet to prevent spreading. Absorb or cover with dry earth, sand or other non-combustible material and transfer to containers. Do not allow water to get inside containers.

Fire Extinguishing: Hazardous decomposition includes oxides of nitrogen, sulfur, and carbon. *On small fire:* use dry chemical powder, carbon dioxide, water spray, or foam. *On large fire:* use water spray, fog or alcohol-resistant foam. Do not scatter material using straight water jet streams. Dike fire-control water for later disposal; do not scatter the material. Move containers from fire area if you can do it without risk. *Fire involving storage or vehicular tanks:* isolate for 800 meters/0.5 mile in all directions; also, consider initial evacuation for 800 meters/0.5 mile in all directions. Fight fire from maximum distance or use unmanned hose holders or monitor nozzles. Do not allow water to get inside containers. Cool containers with flooding quantities of water until well after fire is out. Withdraw immediately in the case of rising sound from venting safety devices or discoloration of tank. *Always* stay away from tanks engulfed in fire. For massive fire, use unmanned hose holders or monitor nozzles; if this is impossible, withdraw from area and let fire burn.

Disposal Method Suggested: Do not discharge into drains or sewers. Dispose of waste material as hazardous waste using a licensed disposal contractor to an approved landfill. Consult with environmental regulatory agencies for guidance on acceptable disposal practices. Generators of waste containing this contaminant (≥100 kg/mo) must conform with EPA regulations governing storage, transportation, treatment, and waste disposal. Incineration with effluent gas scrubbing is recommended. Containers must be disposed of properly by following package label directions or by contacting your local or federal environmental control agency, or by contacting your regional EPA office.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- USEPA, Office of Pesticide Programs, Pesticide Residue Limits, "Thiophanate-Methyl," 40 CFR 180.371. http://www.epa.gov/pesticides/food/viewtols.htm
- Pesticide Management Education Program, "Thiophanate-methyl (Topspin M) Chemical Profile 2/85," Cornell University, Ithaca, NY (February 1985). http://pmep.cce.cornell.edu/profiles/fung-nemat/tcmtb-ziram/thiophanate-methyl/fung-prof-thiophanate.html

Thiram T:0520

Use Type: Fungicide, Rodenticide

CAS Number: 137-26-8

Formula: $C_6H_{12}N_2S_4$

Synonyms: Aceto TETD; AI3-00987; Bis(diethylthiocarbamoyl) sulfide; Bis[(dimethylamino) carbonothioyl] disulphide; Bis[(dimethylamino)carbonothioyl] disulfide; Bis(dimethylthiocarbamoyl) disulfide; Bis(dimethylthiocarbamoyl) disulphide; Disulfide, bis(dimethylthiocarbamoyl); α,α'-Dithiobis(dimethylthio)formamide; *N,N*-(Dithiodicarbonothioyl) bis(*N*-methylmethanamine); ENT 987; Formamide, 1,1'-dithiobis(*N,N*-dimethylthio-; Methyl thiram; Methylthiuram disulfide; Methyl tuads; NSC 1771; Teramethylthiuram disulfide; Tetramethyldiurane sulphite; Tetramethylenethiuram disulfide; Tetramethylenethiuram disulphide; Tetramethylthiocarbamoyldisulphide; Tetramethylthioperoxydicarbonic diamide; Tetramethylthiuram; Tetramethylthiuram bisulfide; Tetramethylthiuram bisulphide; Tetramethylthiuram disulfide; *N,N*-Tetramethylthiuram disulfide; *N,N,N',N'*-Tetramethylthiuram disulfide; Tetramethylthiuram disulphide; Tetramethylthiuran disulphide; Tetramethylthiurane disulfide; Tetramethyl thiurane disulphide; Tetramethylthiurum disulfide; Tetramethylthiurum disulphide; Tetrathiuram disulfide; Tetrathiuram disulphide; Thioperoxydicarbo NIC diamide, Tetramethyl-; Tiram (Spanish); Tiuramyl; TMTDS; TTD

Trade Names: AAPIROL®; AATACK®; AATIRAM®; ACCELERATOR T®; ACCELERATOR THIURAM®; ACCEL TMT®; AGROSOL POUR-ON®; ANLES®; ARASAN®[C]; ATIRAM®; ATTACK®; AULES®; CHIPCO THIRAM 75®; CRYLCOAT®; CUNITEX®; CYURAM DS®; DELSAN®; EBECRYL®; EKAGOM TB®; EVERSHIELD T SEED PROTECTORANT®; FALITIRAM®; FERMIDE®; FERNACOL®; FERNASAN®; FERNIDE®; FLO PRO T SEED PROTECTANT®; FMC 2070®[C]; FORMALSOL®; HERMAL®; HERYL®; HEXATHIR®; HY-VIC®; KODIAK T®; KREGASAN®; LIQUID MOLY-CO-THI®; MERCURAM®; METIURAC®; MOLY-T®; NA2771®; NOBECUTAN®; NOMERSAN®; NORMERSAN®; OPTIMA®; PANORAM 75®; POLYRAM ULTRA®; POMARSOL®; POMARSOL FORTE®; POMASOL®; PRO-GRO®; PURALIN®; RAXIL®; REZIFILM®; ROOTONE®; ROYAL TMTD®; RTU-BAYTAN-THIRAM®; RTU FLOWABLE SOYBEAN FUNGICIDE®; SADOPLON®; SOLUCRYL®; SPOTRETE®; SPOTRETE-F®; SQ 1489®; SRANAN-SF-X®; TERSAN 75®[C]; TERSANTETRAMETHYL DIURANE SULFIDE®; TETRAPOM®; TETRASIPTON®; THIANOSAN®; THILLATE®; THIMAR®; THIMER®; THIOKNOCK®; THIOSAN®; THIOSCABIN®; THIOTEX®; THIOTOX®; THIRAM 75®; THIRAM 80®; THIRAMAD®; THIRAM B®; THIRAMPA®; THIRASAN®; THIULIN®; THIULIX®; THIURAD®; THIURAMIN®; THIURAMYL®; THYLATE®; TIRAMPA®; TITAN FL®; TRAMETAN®; TRIDIPAM®; TRIPOMOL®; TUADS®; TUEX®; TULISAN®; UCECOAT®; UCECRYL®; UVECRYL®; VANCIDA TM-95®; VANCIDE TM®; VITAFLO 280®; VITAVAX® Thiram; VITAVAX-T®; VUAGT-1-4®; VULCAFOR TMTD®; VULKACIT MTIC®; VULKACIT THIURAM®; VULKACIT THIURAM/C®

Chemical class: Dithiocarbamate

EPA/OPP PC Code: 079801

California DPR Chemical Code: 589

HSDB Number: 863

UN/NA & ERG Number: UN2771(solid)/151

RTECS® Number: JO14000000

EC Number: 205-286-2 [*Annex I Index No.:* 006-005-00-4]

Uses: Thiram is used as a fungicide to prevent crop damage in the field and to prevent crops from deterioration in storage or transport. Thiram is also used as a seed, nut, fruit, and mushroom disinfectant from a variety of fungal diseases. In addition, it is used as an animal repellent to protect fruit trees and ornamentals from damage by rabbits, rodents, and deer. Thiram has been used in the treatment of human scabies, as a sun screen, and as a bactericide applied directly to the skin or incorporated into soap. Thiram is used as a rubber accelerator and vulcanizer and as a bacteriostat for edible oils and fats. It is also used as a rodent repellent, wood preservative, and may be used in the blending of lubricant oils. Registered for use in EU countries[115]. Registered for use in the U.S.

U.S. Maximum Allowable Residue Levels for Thiram [40 CFR 180.132]: apple 7 ppm; banana, pulp 1 ppm; peach 7 ppm; strawberry 7 ppm.

Human toxicity (long-term)[101]: Low–56.0 ppb, Health Advisory

Fish toxicity (threshold)[101]: Extra high–0.53654 ppb, MATC (Maximum Acceptable Toxicant Concentration)

Regulatory Authority and Advisory Information:

Carcinogenicty: EPA, Not likely to be a human carcinogen; IARC: Group 3, unclassifiable as to human carcinogenicity

Health Advisory: Tumorigen; Mutagen, Reproductive Toxin (TRI), Endocrine disruptor (S!), Skin irritant/sensitizer

Toxicity (oral) Category 3, CAUTION

FAO Acceptable Daily Intake (ADI) =0.01 mg/kg

EPA Hazardous Waste Number (RCRA No.): U244

Superfund/EPCRA 40CFR302.4 RQ: CERCLA, 10 lb (4.54 kg)

EPCRA Section 313 Form R *de minimis* concentration reporting level: 1.0%

Rotterdam Convention Annex III [Chemicals Subject to the Prior Informed Consent Procedure (PIC)] (as dustable powder formulations containing a combination of Benomyl @ or >7%; carbofuran @ or >10%; thiram @ or >15%)

European/International Regulations: Hazard Symbol: Xi, Xn, N; risk phrases: R20/22; R36/38; R43; R48/22; R50/53; safety phrases: S2; S26; S36/37; S60; S61 (see Appendix 1)

WGK (German Aquatic Hazard Class): 3-Severe hazard to waters

Description: Thiram is a colorless to yellow, crystalline solid. Characteristic odor. Commercial product can be a soluble concentrate that may be mixed with water and used as a spray. Commercial pesticide products may be dyed blue. Molecular weight = 240.44; Specific gravity (H_2O:1) = 1.43 @ 20 °C; Boiling point = 129 °C @ 20 mmHg[88]; Freezing/Melting point = 155–156 °C; Vapor pressure = 1.7×10^{-5} mmHg @ 25 °C; Flash point = 88 °C (cc); 137.8 °C[88]. Hazard Identification (based on NFPA-704 M Rating System): Health 2, Flammability 1, Reactivity 0. Slightly soluble in water; solubility = <1 mg/mL @ 22.2 °C. Physical and toxicological properties may be affected by carrier solvents in commercial formulations.

Incompatibilities: Combustible material. Dust may form explosive mixture in air. Water, acid, oxidizing materials. Heat, or contact with moisture or acids causes rapid decomposition and the generation of toxic and flammable hydrogen sulfide and carbon disulfide. Flammable gases are generated by reaction with aldehydes, nitrides, and hydrides. Incompatible with oxidizers including peroxides, acids, acid halides, mercury[88]. Decomposition products in fire include oxides of nitrogen and sulfur. Corrosive to iron, copper brass and zinc metals, especially in the presence of moisture. Heat alkalies (lime), moisture can cause decomposition. Decomposes on prolonged storage. Degradation produces ethylene thiourea.

Permissible Exposure Limits in Air: NIOSH IDLH: 100 mg/m^3

OSHA PEL: 5 mg/m^3 TWA

NIOSH REL: 5 mg/m^3 TWA

ACGIH TLV®[1]: 0.05 mg/m^3, measured as inhalable fraction and vapor TWA; not classifiable as a human carcinogen

Protective Action Criteria (PAC) Ver. 27[89]

PAC-1: 0.15 mg/m^3
PAC-2: 6.8 mg/m^3
PAC-3: 1500 mg/m^3

DFG MAK: MAK: 1 mg/m^3, inhalable fraction TWA; Peak Limitation Category II(2); danger of skin sensitization; Pregnancy Risk Group C

Determination in Air: Filter; CH_3CN; High-pressure liquid chromatography/Ultraviolet detection; NIOSH IV, Method #5005[18].

Permissible Concentration in Water: Federal Drinking Water Guidelines: 40 ppb[93]. State Drinking Water Guidelines: Florida 35 μg/L; Maine 35 μg/L.

Determination in Water: EPA EMSLC Method 630. The Determination of Dithiocarbamate Pesticides in Municipal and Industrial Wastewater by UV-VIS Spectrophotometry. Log K_{ow} = <2.0. Unlikely to bioaccumulate in marine organisms. See also disulfiram.

Routes of Entry: Inhalation, ingestion, skin and/or eye contact.

Harmful Effects and Symptoms

Short Term Exposure: Irritates the eyes, skin, and respiratory tract. High exposures can cause kidney and liver damage. Brain and nerve damage can also occur. *Inhalation:* Inhalation can cause irritation of the respiratory tract with stuffy nose, nosebleeds, hoarseness, cough and/or phlegm. Animal studies indicate that irritation of the nose and throat may occur at levels above 5 mg/m^3. *Skin:* Exposure to spray containing 45% thiram resulted in irritation and skin sensitization. Skin irritation can lead to rash, and allergy. *Eyes:* May cause irritation, tearing and sensitivity to light. *Ingestion:* No information available on human exposure. In animal studies, 38 ppm in food caused nausea, vomiting, diarrhea, hyperexcitability, weakness and loss of muscle control. Death may occur from ingestion of approximately one teaspoonful. *Note:* Unlike carbamates the dithiocarbamates are not cholinesterase inhibitors, but some of them may react with recently ingested alcohol or alcohol-containing products including wine, medications, and cold remedies such as cough-syrups. LD_{50} (oral, rat) = 500[83]; LD_{50} (dermal, rat) = >2 g/kg.

Long Term Exposure: Repeated or prolonged contact may cause skin sensitization. Prolonged contact has caused eye irritation, tearing, increased sensitivity to light, reduced night vision and blurred vision. Occupational exposures to 0.03 mg/m^3 over a 5 year period has caused mild irritation of the nose and throat. Whether it has this effect in humans is not known. May affect the thyroid and liver. Thiram has caused birth defects in laboratory animals and has been shown to be a teratogen in animals.

Points of Attack: Eyes, skin, respiratory system and central nervous system.

Medical Surveillance: Preplacement and periodic medical examinations should give special attention to history of skin allergy, eye irritation, and significant respiratory, liver, or kidney disease. Workers should be aware of the potentiating action of alcoholic beverages when working with tetramethylthiuram disulfide. Evaluation by a qualified allergist, including exposure history and testing, may help diagnose allergy.

First Aid: If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least 15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately. If this chemical contacts the skin, remove contaminated clothing and wash immediately with soap and water. Seek medical attention immediately. If this chemical has been inhaled, remove from exposure, begin rescue breathing (using universal precautions) if breathing has stopped, and CPR if heart action has stopped. Transfer promptly to a medical facility. When this chemical has been swallowed, get medical attention. Give large quantities of water and induce vomiting. Do not make an unconscious person vomit.

Personal Protective Methods: Reacts with the following absorbent materials: Cellulose-Based; Mineral- and Clay-Based; Dirt/Earth[88]. Wear protective gloves and clothing to prevent any reasonable probability of dermal and/or eye contact. Safety equipment suppliers/manufacturers can provide recommendations on the most protective glove/clothing material for your operation. All protective clothing (suits, gloves, footwear, headgear) should be clean, available each day, and put on before work. Contact lenses should not be worn when working with this chemical. Wear splash-proof chemical goggles and face shield unless full facepiece respiratory protection is worn. Employees should wash immediately with soap when skin is wet or contaminated. Provide emergency showers and eyewash.

Respirator Selection: SCBA >0.15 mg/m^3. NIOSH: *50 mg/m^3:* CcrOv95 (APF = 10) [any air-purifying half-mask respirator equipped with an organic vapor cartridge(s) in combination with an N95, R95, or P95 filter. The following filters may also be used: N99, R99, P99, N100, R100, P100]; or Sa (APF = 10) (any supplied-air respirator). *100 mg/m^3:* Sa:Cf (APF = 25) (any supplied-air respirator operated in a continuous-flow mode); or CcrFOv100 (APF = 50) [any air-purifying full facepiece respirator equipped with organic vapor cartridge(s) in combination with an N100, R100, or P100 filter]; or GmFOv100 (APF = 50) [Any air-purifying, full facepiece respirator (gas mask) with a chin-style, front- or back-mounted organic vapor canister having an N100, R100, or P100 filter]; or PaprOvHie (APF = 25) (any powered air-purifying respirator with an organic vapor cartridge in combination with a high-efficiency particulate filter); or SCBAF (APF = 50) (any self-contained breathing apparatus with a full facepiece); or SaF (APF = 50) (any supplied-air respirator with a full facepiece). *Emergency or planned entry into unknown concentrations or IDLH conditions:* SCBAF: Pd,Pp (APF = 10,000) (any self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode); or SaF: Pd,Pp: ASCBA (APF = 10,000) (any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary self-contained breathing apparatus operated in a pressure-demand or other positive-pressure mode). *Escape:* GmFOv100 (APF = 50) [Any air-purifying, full facepiece respirator (gas mask) with a chin-style, front- or back-mounted organic vapor canister having an N100, R100, or P100 filter]; or SCBAE (any appropriate escape-type, self-contained breathing apparatus).

Note: Substance reported to cause eye irritation or damage; may require eye protection.

Storage: Color Code-Blue: Health Hazard/Poison: Store in a secure poison location. Prior to working with this chemical you should be trained on its proper handling and storage. Store in a cool place away from strong oxidizers; strong acids; oxidizable materials. Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: Thiocarbamate and dithiocarbamate pesticides, solid, toxic, require a label of "poisonous materials." They usually fall in Hazard Class 6.1. STN: 49 411 87.

Spill Handling: Immediate steps should be taken to limit spread to the environment. Easily penetrates the soil to contaminate groundwater and waterways[88]. Evacuate persons not wearing protective equipment from area of spill or leak until clean up is complete. Cover the spill with weak solution of calcium hypochlorite (Up to 15%). Collect powdered material in the most convenient and safe manner and deposit in sealed containers. Ventilate area after clean up is complete. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable.

Fire Extinguishing: Hazardous decomposition includes sulfur dioxide, carbon disulfide; and oxides of nitrogen and carbon. This chemical is a combustible solid. Use dry chemical, carbon dioxide; water spray; or alcohol foam extinguishers. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies. From a secure, explosion-proof location, use water spray to cool exposed containers. If cooling streams are ineffective (venting sound increases in volume and pitch, tank discolors, or shows any signs of deforming), withdraw immediately to a secure position. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode.

Disposal Method Suggested: Consult with environmental regulatory agencies for guidance on acceptable disposal practices. Generators of waste containing this contaminant (≥100 kg/mo) must conform with EPA regulations governing storage, transportation, treatment, and waste disposal. Thiram can be dissolved in alcohol or other flammable solvent and burned in an incinerator with an afterburner and scrubber.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- EXTOXNET, Extension Toxicology Network, "Pesticide Information Profile, Thiram," Oregon State University, Corvallis, OR (June 1996). http://extoxnet.orst.edu/pips/thiram.htm
- USEPA, Office of Pesticide Programs, Pesticide Residue Limits, "Thiram," 40 CFR 180.132. http://www.epa.gov/pesticides/food/viewtols.htm
- Sax, N. I., Ed., "Dangerous Properties of Industrial Materials Report," 1, No. 5, 41-42 (1981)
- New York State Department of Health, "Chemical Fact Sheet: Thiram," Albany, NY, Bureau of Toxic Substance Assessment (April 1986)
- New Jersey Department of Health and Senior Services, "Hazardous Substance Fact Sheet, Thiram," Trenton, NJ (March 1989, rev. June 2000). http://www.state.nj.us/health/eoh/rtkweb/1854.pdf

Tralkoxydim T:0649

Use Type: Herbicide

CAS Number: 87820-88-0

Formula: $C_{20}H_{27}NO_3$

Synonyms: 2-Cyclohexen-1-one, 2-[1-(ethoxyimino)propyl]-3-hydroxy-5-(2,4,6-trimethylphenyl)-; 2-[1-(Ethoxyimino)propyl]-3-hydroxy-5-mesitylcyclohex-2-en-one; 2-[1-(Ethoxyimino)propyl]-3-hydroxy-5-(2,4,6-trimethylphenyl)-2-cyclohexen-1-one; Tralkoxydime

Trade Names: ACHIEVE®; ACHIEVE®-40DG; ALPHA GRASP®; ICI-A 604®; PP 604®; SPLENDOR®

Chemical class: Cyclohexanone; Cyclohexanedione (oxime)

EPA/OPP PC Code: 121000

California DPR Chemical Code: 5457

HSDB Number: 7016

UN/NA & ERG Number: UN2588 (Pesticide, solid, poisonous, n.o.s.)/151; UN2902 (Pesticide, liquid, poisonous, n.o.s.)/151

RTECS® Number: GW7191600

Uses: Tralkoxydim is a post-emergent herbicide applied to actively growing weeds in wheat, barley, triticale and cereal rye to control wild oats, green foxtail, yellow foxtail, annual ryegrass and Persian darnel. Registered for use in EU countries[115]. Registered for use in the U.S.

U.S. Maximum Allowable Residue Levels for Tralkoxydim [40 CFR 180.548]: time-limited levels were revoked on 2/28/2003

Human toxicity (long-term)[101]: Intermediate–20.83 ppb, CHCL (Chronic Human Carcinogen Level)

Fish toxicity (threshold)[101]: Very low–1154.96119 ppb, MATC (Maximum Acceptable Toxicant Concentration)

Regulatory Authority and Advisory Information:

Carcinogenicity[83]: EPA, Likely to be carcinogenic to humans

Toxicity (oral) Category 3, CAUTION

Description: Off white, beige to pale pink crystalline solid or powder. Faint burnt odor. Molecular weight = 329.47; Boiling point = (decomposes); Specific gravity (H_2O:1) = 1.14 @ 20 °C; Freezing/Melting point = 105–110 °C; Vapor pressure = 3.5×10^{-9} mmHg @ 25 °C; Specific gravity (H_2O:1) = 1.16 @ 20 °C; Flash point = >225 °C; Slightly soluble in water; solubility <10 mg/L.

Incompatibilities: Keep away from strong oxidizers and alkaline materials. Non-corrosive, stable at normal warehouse temperature.

Permissible Concentration in Water: Hydrolysis half-life of 6.3 days (pH 5), 114 days (pH 7), 1594 days (pH 9)[83]. Runoff from spills or fire control may cause water pollution.

Determination in Water: Log K_{ow} = ~2.0. Unlikely to bioaccumulate in marine organisms.

Routes of Entry: Inhalation, ingestion, dermal absorption.

Harmful Effects and Symptoms

Short Term Exposure: Highly toxic. May be fatal if inhaled, swallowed, or absorbed through the unbroken skin. Health effects may be delayed. LD_{50} (oral, rat) = 900 mg/kg; LD_{50} (dermal, rat) = >2 g/kg.

Long Term Exposure: May cause liver problems and affect the adrenal glands.

Points of Attack: Liver, adrenal glands.

Medical Surveillance: Preliminary medical exam to detect chronic diseases of central nervous system, liver, heart, kidneys, lung and skin, as well as endocrinological or immunological disturbances, should protect susceptible individuals. Periodical medical exams of internal organs, skin and eyes are important to avoid chronic occupational intoxications. They should include lab and patch tests when necessary[83]. This chemical is a suspected or known human carcinogen. Exposed persons should contact a physician for advice regarding the possible long term health effects and advice for medical monitoring. Tests of liver and adrenal gland function.

First Aid: If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least 15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately. Give artificial respiration if victim is not breathing. *Do not* use mouth-to-mouth method if victim ingested or inhaled the substance;

give artificial respiration with the aid of a pocket mask equipped with a one-way valve or other proper respiratory medical device. Administer oxygen if breathing is difficult. Remove and isolate contaminated clothing and shoes. In cases of contact with substance, immediately flush skin or eyes with running water for at least 20 minutes. For minor skin contact, avoid spreading material on unaffected skin. Keep victim warm and quiet. Effects of exposure (inhalation, ingestion or skin contact) to substance may be delayed. Ensure that medical personnel are aware of the material(s) involved and take precautions to protect themselves.

Personal Protective Methods: Applicators and other handlers must wear: Coveralls worn over long-sleeved shirt and long pants; Chemical-resistant gloves such as DuPont™ Tychem® suit fabrics, barrier laminate, or Viton®; Chemical-resistant footwear plus socks; Protective eye wear; Chemical-resistant headgear for overhead exposure; Chemical-resistant apron when cleaning equipment, mixing, or loading[83]. Agricultural Use/Engineering Controls: When handlers use closed systems, enclosed cabs, or aircraft in a manner that meets the requirements listed in the Worker Protection Standard (WPS) for agricultural pesticides, ***40 CFR 170.240(d)(4-6),*** the handler PPE requirements may be reduced or modified as specified in the Worker Protection Standard. Firefighters should wear NIOSH-approved self-contained breathing apparatus and full protective clothing.

Respirator Selection: Wherever and whenever workplace conditions warrant respirator use, a respiratory protection program must be followed that meets one or more of the following government standards: OSHA's 29 CFR 1910.134, ANSI Z88.2, or European Standard EN 149.

Storage: Color Code-Blue: Health Hazard/Poison. Store in a secure poison location. Prior to working with this chemical you should be trained on its proper handling and storage. Where possible, automatically transfer material from other storage containers to process containers. Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: Pesticides, solid, toxic/poisonous, n.o.s require a shipping label of "poisonous materials" and fall in Hazard Class 6.1. Technical name required.

Spill Handling: Wearing protective equipment, clean up with dampened absorbent paper and transfer material to a suitable trash container. Seal the absorbent paper and your clothing in a vapor-tight plastic bag for eventual disposal. Wash all contaminated surfaces with a soap and water solution. Do not reenter the contaminated area until and expert verifies that the area has been properly cleaned.

Fire Extinguishing: Decomposition products in fire include toxic oxides of nitrogen and carbon *On a small fire:* use dry chemical, CO_2 or water spray. *On a large fire:* use water spray, fog or regular foam. Move containers from fire area if you can do it without risk. Dike fire-control water for later disposal; do not scatter the material. Use water spray or fog; do not use straight streams. *Fire involving storage or vehicular tanks:* isolate for 800 meters/0.5 mile in all directions; also, consider initial evacuation for 800 meters/0.5 mile in all directions. Fight fire from maximum distance or use unmanned hose holders or monitor nozzles. Do not get water inside containers. Cool containers with flooding quantities of water until well after fire is out. Withdraw immediately in the case of rising sound from venting safety devices or discoloration of tank. ALWAYS stay away from tanks engulfed in fire. For massive fire, use unmanned hose holders or monitor nozzles; if this is impossible, withdraw from area and let fire burn. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies.

Disposal Method Suggested: Recycle any unused portion of the material for its approved use or return it to the manufacturer or supplier. Ultimate disposal of the chemical must consider: the material's impact on air quality; potential migration in soil or water; effects on animal, aquatic, and plant life; and conformance with environmental and public health regulations[83].

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- USEPA, Office of Pesticide Programs, Pesticide Fact Sheet, "Tralkoxydim" (December 4, 1998). http://www.epa.gov/opprd001/factsheets/tralkoxystrobin.pdf

Tralomethrin T:0651

Use Type: Insecticide

CAS Number: 66841-25-6

Formula: $C_{22}H_{19}Br_4NO_3$

Synonyms: (S)–α-Cyano-3-phenoxybenzyl (1R,3R)-3-(2,2–dibromovinyl-2,2-dimethylcyclopropanecarboxylate [metabolate of tralomethrin]; (S)–α-Cyano-3-phenoxybenzyl (1S,3R)-3-(2,2–dibromovinyl)-2,2-dimethylcyclopropanecarboxylate [metabolate of tralomethrin]; Cyano(3-phenoxyphenyl)methyl; Cyclopropanecarboxylic acid, 2,2-dimethyl-3-(1,2,2,2-tetrabromoethyl)-, cyano(3-phenoxyphenyl)methyl ester; 2,2-Dimethyl-3-(1,2,2,2-tetrabromoethyl)cyclopropropanecarboxlic acid, cyano(3-phenoxyphenyl)methyl ester;2,2-Dimethyl-3-(1,2,2,2-tetrabromoethyl)cyclopropanecarboxylate; (1R,3S)3[(1'RS)(1',2',2',2'-Tetrabromoethyl)]-2,2-dimethylcyclopropanecarboxylic acid, (S)-α-cyano-3-phenoxybenzyl ester; Tralomethrine

Trade Names: DETHMOR®; HAG-107®; RU-25472®; RU-25474®; SCOUT®; SCOUT® X-TRA Gel insecticide

Chemical class: Pyrethroid

EPA/OPP PC Code: 121501; (128822 old EPA code number)

California DPR Chemical Code: 2329

HSDB Number: 6740

UN/NA & ERG Number: UN3352 (liquid)/151; UN3349 (solid)/151

RTECS® Number: GZ2009500

EC Number: 266-493-1.

Uses: Not approved for use in EU countries[115]. Registered for use in the U.S.

U.S. Maximum Allowable Residue Levels for Tralomethrin and its metabolites (S)-alpha-cyano-3-phenoxybenzyl (1R,3S)-3(2,2-dibromovinyl)-2,2-dimethyl- cyclopropanecarboxylate and (S)-alpha-cyano-3-phenoxybenzyl (1S,3R)-3-(2,2-dibromovinyl)-2,2-dimethyl-cyclopropanecarboxylate calculated as the parent. [40 CFR 180.422(a)(1)]: in or on the following food commodities: broccoli 0.5 ppm; cottonseed 0.02 ppm; cottonseed oil 0.20 ppm; lettuce, head; lettuce, leaf 3.0 ppm; soybeans 0.05 ppm; and sunflower seed 0.05 ppm. ***[40 CFR 180.422(a)(2]:*** in or on all food items (other than those covered by a higher tolerance as a result of use on growing crops) in food-handling establishments, 0.02 ppm. ***[40 CFR 180.422(a)(3)]:*** for the combined residues of the insecticide tralomethrin and its metabolites cis-deltamethrin [(S)-alpha-cyano-3-phenoxybenzyl (1R,3S)-3(2,2-dibromovinyl)-2,2-dimethyl-cyclopropanecarboxylate] and trans-deltamethrin [(S)-alpha-cyano-3-phenoxybenzyl (1S,3R)-3-(2,2-dibromovinyl)-2,2-dimethyl-cyclop ropanecarboxylate] as follows: in or on all feed items (other than those covered by a higher tolerance as a result of use on growing crops) in feed-handling establishments, 0.02 ppm.

Human toxicity (long-term)[101]: Low–52.50 ppb, Health Advisory

Fish toxicity (threshold)[101]: Extra high–0.06714 ppb, MATC (Maximum Acceptable Toxicant Concentration)

Regulatory Authority and Advisory Information:

Toxicity (oral) Category 2, WARNING

Health Advisory: Endocrine disruptor (?), Skin irritant/sensitizer

European/International Regulations: Hazard Symbol: Xi, Xn, N; risk phrases: R22; R36/38; R50/53; safety phrases: S2; S26; S60; S61 (see Appendix 1)

Description: Yellow-orange resinous solid. Commercial product is available as wettable powder or as an emulsifiable concentrate. Molecular weight = 665.05; Specific gravity (H_2O:1) = 1.67 @ 20 °C; Boiling point = (decomposes); Freezing/Melting point = 141 °C; Vapor pressure = 3.5×10^{-11} mmHg @ 25 °C;. Soluble in water; solubility = <100 μg/L. Physical and toxicological properties may be affected by carrier solvents in commercial formulations.

Incompatibilities: May react violently with strong oxidizers, bromine, 90% hydrogen peroxide, phosphorus trichloride, silver powders or dust. Incompatible with silver compounds. Mixture with some silver compounds forms explosive salts of silver oxalate.

Permissible Exposure Limits in Air:

NIOSH[2] IDLH = 5,000 ppm

OSHA PEL: 5 mg/m^3 TWA

NIOSH REL: 5 mg/m^3 TWA

ACGIH TLV®[1]: 5 mg/m^3 TWA

Determination in Air: Collection by impinger or fritted bubbler, analysis by gas-liquid chromatography/ultraviolet. See NIOSH IV, Method #5008 ***U.S. Maximum Allowable Residue Levels.*** (pyrethrum).

Permissible Concentration in Water: Acceptable Daily Intake (ADI) = 0.02 mg/kg as pyrethroid.

Determination in Water: Collection by impinger or fritted bubbler, analysis by gas-liquid chromatography/ultraviolet. See NIOSH IV, Method #5008. Log K_{ow} = >4.5. Values above 3.0 are likely to bioaccumulate in aquatic organisms.

Routes of Entry: Inhalation, ingestion, absorbed through skin.

Harmful Effects and Symptoms

Short Term Exposure: Contact may cause burns to skin and eyes. Poisonous; may be fatal if inhaled, swallowed or absorbed through skin. Pyrethroids can cause dermatitis which may be allergic in nature. Persons with pre-existing skin disorders may be more susceptible to the effects of this agent. LD_{50} (oral, rat) = <100 mg/kg; LD_{50} (dermal, rat) = >1500 mg/kg.

Long Term Exposure: Dermatitis and lung allergy.

Points of Attack: Skin, lungs.

Medical Surveillance: The following are recommended: Employees should be screened for history of certain medical conditions which might place the employee at increased risk from pyrethroid exposure. Chronic respiratory disease: In persons with chronic respiratory disease, especially asthma, the inhalation of pyrethroids might cause exacerbation of symptoms due to their sensitizing properties. Lung function tests. These may be normal if the person is not having an attack at the time of the test. Consider chest x-ray if lung symptoms are present. Evaluation by a qualified allergist, including exposure history and testing, may help diagnose allergy. Any employee developing the above-listed conditions should be referred for further medical examination[9].

First Aid: If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least 15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately. If this chemical contacts the skin, remove contaminated clothing and wash immediately with soap and water. Seek medical attention immediately. If this chemical has been inhaled, remove from exposure, begin rescue breathing (using universal precautions) if breathing has stopped, and CPR if heart action has stopped. Transfer promptly to a medical facility. When this chemical has been swallowed, get medical attention. Give large quantities of water and induce vomiting. Do not make an unconscious person vomit. Do not induce vomiting when formulations containing petroleum solvents are ingested.

Respirator Selection: NIOSH/OSHA *for pyrethrum*: *50 mg/m^3:* CcrOv95 (APF = 10) [any air-purifying half-mask respirator equipped with an organic vapor cartridge(s) in combination with an N95, R95, or P95 filter. The following filters may also be used: N99, R99, P99, N100, R100, P100]; or Sa (APF = 10) (any supplied-air respirator). *125 mg/m^3:* Sa:Cf (APF = 25) (any supplied-air respirator operated in a continuous-flow mode); or PaprOvHie (APF = 25) (any air-purifying full facepiece respirator equipped with an organic vapor cartridge in combination with a high-efficiency particulate filter). *250 mg/m^3:* CcrFOv100 (APF = 50) [any air-purifying full facepiece respirator equipped with organic vapor cartridge(s) in combination with an N100, R100, or P100 filter]; or PaprTOvHie (APF = 50) [any powered, air-purifying respirator with a tight-fitting face-piece and organic vapor cartridge(s) in combination with a high-efficiency particulate filter]; or SCBAF (APF = 50) (any self-contained breathing apparatus with full facepiece); or SaF (APF = 50) (any supplied-air respirator with a full facepiece). *5000 mg/m^3:* SaF:Pd,Pp (APF = 2000) (any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode). *Emergency or planned entry into unknown concentrations or IDLH conditions:* SCBAF:Pd,Pp (APF = 10,000) (any self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode); or SaF:Pd,Pp:ASCBA (APF = 10,000) (any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary self-contained breathing apparatus operated in a pressure-demand or other positive-pressure mode). *Escape:* GmFOv100 (APF = 50) [any air-purifying, full facepiece respirator (gas mask) with a chin-style, front- or back-mounted organic vapor canister having an N100, R100, or P100 filter]; or SCBAE (any appropriate escape-type, self-contained breathing apparatus).

Note: Substance reported to cause eye irritation or damage; may require eye protection.

Storage: Color Code-Blue: Health Hazard/Poison. Store in a secure poison location at temperature <35 °C and away from alkaline materials. Prior to working with this chemical you should be trained on its proper handling and storage. Store in tightly closed containers in a cool, well-ventilated area. Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: This material is a toxic pesticide and should be labeled "poisonous materials." It falls into Hazard Class 6.1.

Spill Handling: First remove all sources of ignition. Evacuate persons not wearing protective equipment from area of spill or leak until clean up is complete. Ventilate area of spill or leak. Use water spray to reduce vapor. Absorb liquids in vermiculite, dry sand, earth, or a similar material and deposit in sealed containers. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable.

Fire Extinguishing: Hazardous decomposition includes oxides of carbon and hydrogen bromide gas. *On a small fire:* use dry chemical, CO_2 or water spray. *On a large fire:* use water spray, fog or regular foam. Move containers from fire area if you can do it without risk. Dike fire-control water for later disposal; do not scatter the material. Use water spray or fog; do not use straight streams. *Fire involving storage or vehicular tanks:* isolate for 800 meters/0.5 mile in all directions; also, consider initial evacuation for 800 meters/0.5 mile in all directions. Fight fire from maximum distance or use unmanned hose holders or monitor nozzles. Do not get water inside containers. Cool containers with flooding quantities of water until well after fire is out. Withdraw immediately in the case of rising sound from venting safety devices or discoloration of tank. ALWAYS stay away from tanks engulfed in fire. For massive fire, use unmanned hose holders or monitor nozzles; if this is impossible, withdraw from area and let fire burn. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies.

Disposal Method Suggested: Incineration would be an effective disposal procedure where permitted. If an efficient incinerator is not available, the product should be mixed with large amounts of combustible material and contact with the smoke should be avoided. In accordance with 40CFR165, follow recommendations for the disposal of pesticides and pesticide containers.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- USEPA, Office of Pesticide Programs, Pesticide Residue Limits, "Tralomethrin," 40 CFR 180.422. http://www.epa.gov/pesticides/food/viewtols.htm

Triadimefon T:0653

Use Type: Fungicide

CAS Number: 43121-43-3

Formula: $C_{14}H_{16}ClN_3O_2$
Synonyms: 2-Butanone, 1-(4-chlorophenoxy)-3,3-dimethyl-1-(1-*H*-1,2,4-triazol-1-yl)-; 2-Butanone, 1-(4-chlorophenoxy)-3,3-dimethyl-1-(1,2,4-triazol-1-yl)-; 1-[(*tert*-Butylcarbonyl-4-chlorophenoxy)methyl]-1*H*-1,2,4-triazole; Caswell No. 862AA; 1-(4-Chlorophenoxy)-3,3-dimethyl-1-(1*H*-1,2,4-triazol-1-yl)-2-butanone; 1-(4-Chlorophenoxy)-3,3-dimethyl-1-(1,2,4-triazol-1-yl)-butan-2-one;1-(4-Chlorophenoxy)-3,3-dimethyl-1-(1*H*-1,2,4-triazol-1-yl) butanone-; 1-(4-Chlorophenoxy)-3,3-dimethyl-1-(1,2,4-triazol-1-yl)-2-butan-2-one; 1-(4-Chlorophenoxy)-3,3-dimethyl-1-(1*H*-1,2,4-triazol-1-yl)-2-butanone; 1-(4-Chlorophenoxy)-3,3-dimethyl-1-(1,2,4-triazol-1-yl) butanone-; NSC 303303; Triadimefon triazole fungicide; Triadimefone;Triadimeform;1*H*-1,2,4-Triazole,1-[(*tert*-butylcarbonyl-4-chlorophenoxy)methyl]-; 1-(1,2,4-Triazoyl-1)-1-(4-chloro-phenoxy)3,3-dimethylbutanone; 1-[(*tert*-Butylcarbonyl-4-chlorophenoxy)methyl]-
Trade Names: ACCOST®; ACIZOL®; AMIRAL®; BAY® 6681-F; BAYLETON®; BAY®-MEB-6447; BAYER® 6681-F; BAYER® MEB-6447; MEB 6447®; PRO-TEK®; ROFON®
Chemical class: Azole; Triazole; Chlorophenoxy acid/ester
EPA/OPP PC Code: 109901
California DPR Chemical Code: 2133
HSDB Number: 6857
UN/NA & ERG Number: UN2588 (Pesticide, solid, poisonous, n. o. s.)/151; UN2902 (Pesticide, liquid, poisonous, n.o.s.)/151
RTECS® Number: EL7100000
EC Number: 256-103-8 [Annex I Index No.: 606-037-00-4]
Uses: Triadimefon is a systemic fungicide that is used to control powdery mildews, rusts, and other fungi on coffee, seed grasses, cereals, fruits, grapes, vegetables, vines, pineapple, sugar cane, sugar beets, turf, shrubs, and trees. Not approved for use in EU countries[115]. Registered for use in the U.S.
U.S. Maximum Allowable Residue Levels for Triadimefon ***[40 CFR 180.410 (a)]:*** pineapple 3.0 ppm. All other tolerances were revoked on 7/25/2010.
Human toxicity (long-term)[101]: Intermediate–28.00 ppb, Health Advisory
Fish toxicity (threshold)[101]: Intermediate–68.11770 ppb, MATC (Maximum Acceptable Toxicant Concentration)
Regulatory Authority and Advisory Information:
Carcinogenicity[83]: EPA Group C, Possible human carcinogen
California Proposition 65 Chemical: Developmental/Reproductive toxin; female and male (3/30/1999).
Health Advisory: Mutagen, Developmental/Reproductive Toxin, Developmental toxin (TRI); Endocrine disruptor (S!)
Acute Oral Category: 2, WARNING
AB 2588-Air Toxics "Hot Spots" Chemicals (CAL) as chlorophenoxy pesticides
EPCRA Section 313 Form R *de minimis* concentration reporting level: 1.0%
European/International Regulations: Hazard Symbol: Xi, Xn, N; risk phrases: R22; R43; R50/53; safety phrases: S2; S24; S37; S61 (see Appendix 1)
WGK (German Aquatic Hazard Class): 2-Water polluting
Description: Colorless to pale yellow crystalline solid. Slight odor. Commercial product is available in various forms, including wettable powders and as an emulsifiable concentrate. Molecular weight = 293.75; Specific gravity (H_2O:1) = 1.27 @ 20 °C; Boiling point = (decomposes); Freezing/Melting point = 82.3 °C; Vapor pressure = 1.5×10^{-8} mmHg @ 25 °C; Flash point = 71.5 °C. Henry's Law constant = 8.10×10^{-11} atm-m^3/mol @ 25 °C (est)[83]. Low solubility in water; solubility = <1 mg/L @ 20 °C. Physical and toxicological properties may be affected by carrier solvents in commercial formulations.
Incompatibilities: Keep away from strong oxidizers and acidic media, anhydrides, acid halides, active hydrogen compounds[88].
Determination in Water: Log K_{ow} = >3.0. Values above 3.0 are likely to bioaccumulate in aquatic organisms.
Routes of Entry: Inhalation, ingestion, absorbed through the skin.
Harmful Effects and Symptoms
Short Term Exposure: Poisonous; may be fatal if inhaled, swallowed, or absorbed through skin. Severely irritates eyes, skin and respiratory tract, with burning sensation, pain, redness and swelling. Metabolic stimulant. If inhaled, causes coughing, dilated pupils, headache, profuse perspiration, intense thirst, extreme fatigue, rapid pulse, high fever, clammy, flushed skin, rapid breathing, nausea, vomiting, cyanosis (bluish tint to skin and lips), anxiety and confusion, convulsions, risk of lung edema. If swallowed, face and lips turn bluish. Liver injury with associated jaundice, kidney failure, and cardiac arrhythmias are commonly noted. Nerve damage, which may be delayed, may include swelling of legs and feet, muscle twitch and stupor. Severe exposure can cause death from heart failure. Dust or liquid left in contact with the skin for several hours may be absorbed. This may result in severe delayed symptoms as listed above. These symptoms may last for months or years. LD_{50} (oral, rat) = 90–300 mg/kg; LD_{50} (dermal, rat) = >2000 mg/kg[83].
Long Term Exposure: Workers exposed to chlorophenoxy compounds over a 5 to 10 year period at levels above 10 mg/m^3 complained of weakness, rapid fatigue, headache and vertigo. Liver and thyroid damage, low blood pressure and slowed heartbeat were also found. Based on animal tests, may affect human reproduction. Skin sensitizer.
Points of Attack: Eyes, skin, respiratory system, central nervous system, cardiovascular system, liver, kidney, thyroid.
Medical Surveillance: This chemical is a suspected or known human carcinogen. Exposed persons should contact a physician for advice regarding the possible long term health effects and advice for medical monitoring. In addition to comprehensive initial medical and work histories emphasizing reproductive experience and menstrual history, patient should have physical examination and testing of genito-urinary tract, sperm count, motility and morphology. If required, other tests, such as serum testosterone, serum follicle stimulating hormone (FSH),

and serum lutenizing hormone (LH), may be indicated. If symptoms develop or overexposure is suspected, the following may be useful: Liver and kidney function tests. Exam of the nervous system. Evaluation by a qualified allergist, including exposure history and testing, may help diagnose allergy.

First Aid: If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least 15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately. Give artificial respiration if victim is not breathing. *Do not* use mouth-to-mouth method if victim ingested or inhaled the substance; give artificial respiration with the aid of a pocket mask equipped with a one-way valve or other proper respiratory medical device. Administer oxygen if breathing is difficult. Remove and isolate contaminated clothing and shoes. In cases of contact with substance, immediately flush skin or eyes with running water for at least 20 minutes. For minor skin contact, avoid spreading material on unaffected skin. Keep victim warm and quiet. Effects of exposure (inhalation, ingestion or skin contact) to substance may be delayed. Ensure that medical personnel are aware of the material(s) involved and take precautions to protect themselves.

Personal Protective Methods: Incompatible with Clay- and Mineral-based absorbents[88]. Applicators and other handlers must wear: Coveralls worn over long-sleeved shirt and long pants; Chemical-resistant gloves such as DuPont™ Tychem® suit fabrics, barrier laminate, or Viton®; Chemical-resistant footwear plus socks; Protective eye wear; Chemical-resistant headgear for overhead exposure; Chemical-resistant apron when cleaning equipment, mixing, or loading[83]. Agricultural Use/Engineering Controls: When handlers use closed systems, enclosed cabs, or aircraft in a manner that meets the requirements listed in the Worker Protection Standard (WPS) for agricultural pesticides, ***40 CFR 170.240(d)(4-6),*** the handler PPE requirements may be reduced or modified as specified in the Worker Protection Standard. Firefighters should wear NIOSH-approved self-contained breathing apparatus and full protective clothing.

Respirator Selection: Follow regulations in OSHA 29CFR1910.134 or European Standard EN149. Use a NIOSH/MSHA- or European Standard EN149-approved respirator; or use an approved supplied-air respirator with a full facepiece operated in the positive-pressure mode, or with a full facepiece, hood, or helmet in the continuous flow mode; or use a NIOSH/MSHA- or European Standard EN149-approved self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive-pressure mode.

Storage: Color Code-Blue: Health Hazard/Poison: Store in a secure poison location. Prior to working with this chemical you should be trained on its proper handling and storage. Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: Pesticides, solid, toxic/poisonous, n.o.s require a shipping label of "poisonous materials" and fall in Hazard Class 6.1. Technical name required.

Spill Handling: Evacuate persons not wearing protective equipment from area of spill or leak until clean up is complete. Collect powdered material in the most convenient and safe manner and deposit in sealed containers. Ventilate area after clean up is complete. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable. Soil Adsorption Index (K_{oc}) = 130.

Fire Extinguishing: Hazardous decomposition includes oxides of nitrogen and carbon, amines, hydrazine and hydrogen chloride gas. *On a small fire:* use dry chemical, CO_2 or water spray. *Ona a large fire:* use water spray, fog or regular foam. Move containers from fire area if you can do it without risk. Dike fire-control water for later disposal; do not scatter the material. Use water spray or fog; do not use straight streams. *Fire involving storage or vehicular tanks:* isolate for 800 meters/0.5 mile in all directions; also, consider initial evacuation for 800 meters/0.5 mile in all directions. Fight fire from maximum distance or use unmanned hose holders or monitor nozzles. Do not get water inside containers. Cool containers with flooding quantities of water until well after fire is out. Withdraw immediately in the case of rising sound from venting safety devices or discoloration of tank. ALWAYS stay away from tanks engulfed in fire. For massive fire, use unmanned hose holders or monitor nozzles; if this is impossible, withdraw from area and let fire burn. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies.

Disposal Method Suggested: Strong acid or alkaline hydrolysis leads to complete degradation of triadimefon. However, large quantities of triadimefon should be incinerated in a unit operating @ 850 °C equipped with off-gas scrubbing equipment. Containers must be disposed of properly by following package label directions or by contacting your local or federal environmental control agency, or by contacting your regional EPA office.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov

- EXTOXNET, Extension Toxicology Network, "Pesticide Information Profile, Triadimefon," Oregon State University, Corvallis, OR (June 1996). http://extoxnet.orst.edu/pips/triadime.htm
- USEPA, Office of Pesticide Programs, Pesticide ResidueLimits, "Triadimefon," 40 CFR 180.410. http://www.epa.gov/pesticides/food/viewtols.htm

Triadimenol T:0654

Use Type: Fungicide

CAS Number: 55219-65-3

Formula: $C_{14}H_{18}ClN_3O_2$

Synonyms: β-(4-Chlorophenoxy)-α-(1,1-dimethylethyl)-1*H*-1,2,4-triazole-1-ethanol; (1RS,2RS,1RS,2SR)-1-(4-Chlorophenoxy)-3,3-dimethyl-1-(1*H*-1,2,4-triazol-1-yl)butan-2-ol; 2-(4-Chlorophenoxy)-1-tert-butyl-2-(1*H*-1,2,4-triazole-1-yl) ethanol; Ethanol, 2-(4-chlorophenoxy)-1-*tert*-butyl-2-(1*H*-1,2,4-triazole-1-yl)-; 1*H*-1,2,4-Triazole-1-ethanol, β-(4-chlorophenoxy)-α-(1,1-dimethylethyl)-

Trade Names: BAYFIDAN®; BAYFRDAN EW®; BAY KWG 0519®; BAYTAN® SEED TREATMENT; BAYTAN 30® FUNGICIDE; PROTEGE ALLEGIANCE BAYTAN®; SPINNAKER®; SUMMIT®; TRIADIMENOL®; TRIAFOL®; TRIAPHOL®

Chemical class: Azole; Triazole

EPA/OPP PC Code: 127201

California DPR Chemical Code: 2307

HSDB Number: 7733

UN/NA & ERG Number: UN2588 (Pesticide, solid, poisonous, n.o.s.)/151; UN2902 (Pesticide, liquid, poisonous, n.o.s.)/151

RTECS® Number: KK2200000

EC Number: 259-537-6

Uses: Triadimenol is used to control seed- and soil-borne diseases and to provide early season control of foliar diseases. It is applied to seeds of barley, corn, oats, rye, sorghum and wheat and also to fruits, vegetables and ornamentals. Registered for use in EU countries[115]. Registered for use in the U.S.

U.S. Maximum Allowable Residue Levels for Triadimenol ***[40 CFR 180.410 (a)]:*** pineapple 3.0 ppm. All other tolerances were revoked on 7/25/2010.

Human toxicity (long-term)[101]: Intermediate–26.600 ppb, Health Advisory

Fish toxicity (threshold)[101]: Very low–2294.778860 ppb, MATC (Maximum Acceptable Toxicant Concentration)

Regulatory Authority and Advisory Information:

Toxicity (oral) Category 3, CAUTION

Health Advisory: Developmental/Reproductive Toxin, Endocrine disruptor (S!)

AB 2588-Air Toxics "Hot Spots" Chemicals (CAL) as chlorophenoxy pesticides

WGK (German Aquatic Hazard Class): 2-Water polluting

Description: Colorless solid and white to tan powder; Molecular weight = 295.76; Specific gravity (H_2O:1) = 1.22 @ 20 °C[83]; Boiling point = (decomposes); Freezing/Melting point = 115–125 °C; Vapor pressure = 3.12×10^{-10} mmHg @ 20 °C. Henry's Law constant = 1.3×10^{-12} atm-m^3/mol @ 25 °C (est)[83]. Low solubility in water; solubility 100 mg/L.

Incompatibilities: Keep away from strong oxidizers and acidic media, anhydrides, acid halides, active hydrogen compounds.

Determination in Water: Log K_{ow} = >3.0. Values above 3.0 are likely to bioaccumulate in aquatic organisms.

Routes of Entry: Inhalation, ingestion, absorbed through the skin.

Harmful Effects and Symptoms

Short Term Exposure: Poisonous; may be fatal if inhaled, swallowed, or absorbed through skin. Severely irritates eyes, skin and respiratory tract, with burning sensation, pain, redness and swelling. Metabolic stimulant. If inhaled, causes coughing, dilated pupils, headache, profuse perspiration, intense thirst, extreme fatigue, rapid pulse, high fever, clammy, flushed skin, rapid breathing, nausea, vomiting, cyanosis (bluish tint to skin and lips), anxiety and confusion, convulsions, risk of lung edema. If swallowed, face and lips turn bluish. Liver injury with associated jaundice, kidney failure, and cardiac arrhythmias are commonly noted. Nerve damage, which may be delayed, may include swelling of legs and feet, muscle twitch and stupor. Severe exposure can cause death from heart failure. Dust or liquid left in contact with the skin for several hours may be absorbed. This may result in severe delayed symptoms as listed above. These symptoms may last for months or years. Skin irritant and contact dermatitis may develop. LD_{50} (oral, rat, male) = EPA: 689 mg/kg[83]; LD_{50} (dermal, rat) = >5 g/kg.

Long Term Exposure: Workers exposed to chlorophenoxy compounds over a 5 to 10 year period at levels above 10 mg/m^3 complained of weakness, rapid fatigue, headache and vertigo. Liver damage, low blood pressure and slowed heartbeat were also found. Based on animal tests, may affects human reproduction.

Points of Attack: Eyes, skin, respiratory system, central nervous system, cardiovascular system, liver, kidney.

Medical Surveillance: If symptoms develop or overexposure is suspected, liver or kidney function tests may be useful. Evaluation by a qualified allergist, including exposure history and testing, may help diagnose allergy. In addition to comprehensive initial medical and work histories emphasizing reproductive experience and menstrual history, patient should have physical examination and testing of genito-urinary tract, sperm count, motility and morphology. If required, other tests, such as serum testosterone, serum follicle stimulating hormone (FSH), and serum lutenizing hormone (LH), may be indicated.

First Aid: If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least 15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately. Give artificial respiration if victim is not breathing. *Do not* use mouth-to-mouth method if victim ingested or inhaled the substance; give artificial respiration with the aid of a pocket mask equipped with a one-way valve or other proper respiratory medical device. Administer oxygen if breathing is difficult. Remove and isolate contaminated clothing and shoes. In cases of contact with substance, immediately flush skin or eyes with running water for at least 20 minutes. For minor skin contact, avoid spreading material on unaffected skin. Keep victim warm and quiet. Effects of exposure (inhalation, ingestion or skin contact) to substance may be delayed. Ensure that medical personnel are aware of the material(s) involved and take precautions to protect themselves. *Note to physician:* If ingested, remove by lavage or vomiting. Use general supportive measures for central nervous system depression. Use quinidine for myotonia.

Personal Protective Methods: Incompatible with Clay- and Mineral-based absorbents[88]. Applicators and other handlers must wear: Coveralls worn over long-sleeved shirt and long pants; Chemical-resistant gloves such as DuPont™ Tychem® suit fabrics, barrier laminate, or Viton®; Chemical-resistant footwear plus socks; Protective eye wear; Chemical-resistant headgear for overhead exposure; Chemical-resistant apron when cleaning equipment, mixing, or loading[83]. Agricultural Use/Engineering Controls: When handlers use closed systems, enclosed cabs, or aircraft in a manner that meets the requirements listed in the Worker Protection Standard (WPS) for agricultural pesticides, ***40 CFR 170.240(d)(4-6),*** the handler PPE requirements may be reduced or modified as specified in the Worker Protection Standard. Firefighters should wear NIOSH-approved self-contained breathing apparatus and full protective clothing.

Respirator Selection: Follow regulations in OSHA 29CFR1910.134 or European Standard EN149. Use a NIOSH/MSHA- or European Standard EN149-approved respirator; or use an approved supplied-air respirator with a full facepiece operated in the positive-pressure mode, or with a full facepiece, hood, or helmet in the continuous flow mode; or use a NIOSH/MSHA- or European Standard EN149-approved self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive-pressure mode.

Storage: Color Code-Blue: Health Hazard/Poison: Store in a secure poison location. Prior to working with this chemical you should be trained on its proper handling and storage. Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: Pesticides, solid, toxic/poisonous, n.o.s require a shipping label of "poisonous materials" and fall in Hazard Class 6.1. technical name required.

Spill Handling: Evacuate persons not wearing protective equipment from area of spill or leak until clean up is complete. Collect powdered material in the most convenient and safe manner and deposit in sealed containers. Ventilate area after clean up is complete. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable. Soil Adsorption Index (K_{oc}) = 130.

Fire Extinguishing: Hazardous decomposition includes oxides of nitrogen and carbon; amines, hydrazine and hydrogen chloride gas. *On a small fire:* use dry chemical, CO_2 or water spray. *On a large fire:* use water spray, fog or regular foam. Move containers from fire area if you can do it without risk. Dike fire-control water for later disposal; do not scatter the material. Use water spray or fog; do not use straight streams. *Fire involving storage or vehicular tanks:* isolate for 800 meters/0.5 mile in all directions; also, consider initial evacuation for 800 meters/0.5 mile in all directions. Fight fire from maximum distance or use unmanned hose holders or monitor nozzles. Do not get water inside containers. Cool containers with flooding quantities of water until well after fire is out. Withdraw immediately in the case of rising sound from venting safety devices or discoloration of tank. ALWAYS stay away from tanks engulfed in fire. For massive fire, use unmanned hose holders or monitor nozzles; if this is impossible, withdraw from area and let fire burn. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies.

Disposal Method Suggested: Strong acid or alkaline hydrolysis leads to complete degradation of triadimenol. However, large quantities of triadimenol should be incinerated in a unit operating @ 850 °C equipped with off-gas scrubbing equipment. Containers must be disposed of properly by following package label directions or by contacting your local or federal environmental control agency, or by contacting your regional EPA office.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- Pesticide Management Education Program, "Triadimenol (Baytan) Chemical Fact sheet 7/89," Cornell University, Ithaca, NY (July 1989). http://pmep.cce.cornell.edu/profiles/fung-nemat/tcmtb-ziram/triadimenol/fung-prof-triadimenol.html
- USEPA, Office of Pesticide Programs, Pesticide Residue Limits, "Triadimenol,", 40 CFR 180.450. http://www.epa.gov/pesticides/food/viewtols.htm

Triallate T:0655

Use Type: Herbicide
CAS Number: 2303-17-5

Formula: $C_{10}H_{16}Cl_3NOS$
Synonyms: Carbamic acid, diisopropylthio-, *S*-(2,3,3-trichloroallyl) ester; Bis(1-methylethyl)carbamothioic acid *S*-(2,3,3-trichloro-2-propenyl) ester; Carbamothioic acid, bis(1-methylethyl)-, *S*-(2,3,3-trichloro-2-propenyl) ester; Caswell No. 870A; *N*-Diisopropylthiocarbamic acid *S*-2,3,3-trichloro-2-propenyl ester; Diisopropyltrichloroallyl thiocarbamate; NSC 379698; 2-Propene-1-thiol, 2,3,3-trichloro-, diisopropylcarbamate; Tri-allate; Thiocarbamic acid, *N*-diisopropyl-, *S*-2,3,3-Trichloroallyl ester; Tri-allate; 2,3,3-Trichloroallyl *N,N*-diisopropylthiocarbamate; *S*-2,3,3-Trichloroallyl *N,N*-diisopropylthiocarbamate; *S*-(2,3,3-Trichloroallyl) diisopropylthiocarbamate; 2,3,3-Trichloroallyl diisopropylthiocarbamate; *S*-(2,3,3-Trichloro-2-propenyl) bis(1-methylethyl)carbamothioate
Trade Names: AVADEX BW®; BUCKLE®, (triallate+trifluralin); CP-23426®; DIPTHAL®; FAR-GO®[C]; FAR-GO®; FORTRESS®; OVADEX BW®
Chemical class: Thiocarbamate
EPA/OPP PC Code: 078802
California DPR Chemical Code: 49
HSDB Number: 1780
UN/NA & ERG Number: UN2588 (Pesticide, solid, poisonous, n.o.s.)/151; UN2902 (Pesticide, liquid, poisonous, n.o.s.)/151
RTECS® Number: EZ8575000
EC Number: 218-962-7 [*Annex I Index No.:* 006-039-00-X]
Uses: Triallate is a pre-emergent or post-emergent herbicide used to control a variety of annual grasses and wild oats on several grains, oilseed and vegetable crops. Its use has been restricted to use in CO, ID, KS, MN, MT, NE, NV, ND, OR, SD, UT, WA, and WY. Its use on canary grass has been revoked. Not listed for use in EU countries[115]. Registered for use in the U.S.
U.S. Maximum Allowable Residue Levels: for Triallate ***[40 CFR 180.314]:*** barley, grain 0.05 ppm; barley, straw 0.05 ppm; beet, sugar, dried pulp 0.2 ppm; beet, sugar, roots 0.1 ppm; beet, sugar, tops 0.5 ppm; lentil 0.05 ppm; lentil, hay 0.05 ppm; pea 0.05 ppm; pea, field, hay 0.05 ppm; pea, field, vines 0.05 ppm; wheat, grain 0.05 ppm; wheat, straw 0.05 ppm.
Human toxicity (long-term)[101]: High–9.10 ppb, Health Advisory
Fish toxicity (threshold)[101]: Intermediate–54.442630 ppb, MATC (Maximum Acceptable Toxicant Concentration)
Regulatory Authority and Advisory Information:
Carcinogenicity[83]: EPA Group C, Possible human carcinogen
Toxicity (oral) Category 3, CAUTION.
Health Advisory: Mutagen
Potential Ground Water Pollutant [California FAC Section 13145(d)/12811, active]
EPA Hazardous Waste Number (RCRA No.): U389
Superfund/EPCRA 40CFR302.4 RQ: CERCLA, 100 lb(.4.54 kg)
RCRA Universal Treatment Standards: Wastewater (mg/L), 0.003; Non-wastewater (mg/kg), 1.4
EPCRA Section 313 Form R *de minimis* concentration reporting level: 1.0%
European/International Regulations: Hazard Symbol: Xi, Xn, N; risk phrases: R22; R43; R48/22; R50/53; safety phrases: S2; S24; S37; S60; S61 (see Appendix 1)
Description: Colorless crystalline solid or an oily, amber liquid (technical). May be dissolved in a flammable solvent. Commercial product is available as an emulsifiable concentrate. Molecular weight = 304.66; Specific gravity (H_2O:1) = 1.273 @ 25 °C; also reported 1.04 @ 25 °C; Boiling point = 117 °C @ 0.4 mmHg; Freezing/Melting point = 29 °C; Vapor pressure = 1.6×10^{-4} mbar @ 25 °C; Flash point = 89.5 °C(cc);. Practically insoluble in water; solubility = 4 ppm @ 25 °C. Physical and toxicological properties may be affected by carrier solvents in commercial formulations.
Incompatibilities: May react with strong oxidizers such as chlorates, peroxides, nitrates, etc. Readily hydrolyzed by strong acids or alkalies.
Determination in Air: Filter; none; Gravimetric; NIOSH IV[18] [Particulates NOR; #0500 (total), #0600 (respirable)]
Determination in Water: Log K_{ow} = >4.0. Values above 3.0 are likely to bioaccumulate in aquatic organisms.
Harmful Effects and Symptoms
Short Term Exposure: Skin irritant and contact dermatitis may develop. Some thiocarbamates may react with recently ingested alcohol or alcohol-containing products including wine, medications, and cold remedies such as cough-syrups. Concentrated solutions are slightly corrosive to eyes and mucous membranes. Dust inhalation can cause irritation of the respiratory system with sneezing. Eye contact can cause irritation, watering, pain, and inflammation of the eyelids. Dermal contact can cause irritation and minor ulceration. Ingestion can cause nausea, vomiting, fever, muscle twitching, seizure, rapid respiration, slow heart beat. Severe exposure may result in death. LD_{50} (oral, rat) = 1100 mg/kg; LD_{50} (dermal, rat) = >5 g/kg.
Long Term Exposure: Skin sensitizer.
Points of Attack: Respiratory system, central nervous system, cardiovascular system, skin, eyes, spleen, liver, kidney.
Medical Surveillance: Preliminary medical exam to detect chronic diseases of central nervous system, liver, heart, kidneys, lung and skin, as well as endocrinological or immunological disturbances, should protect susceptible individuals. Periodical medical exams of internal organs, skin and eyes are important to avoid chronic occupational intoxications. They should include lab and patch tests when necessary[83]. This chemical is a suspected or known human carcinogen. Exposed persons should contact a physician for advice regarding the possible long term health effects and advice for medical monitoring. Medical observation is recommended for 24 to 48 hours following breathing overexposure, as pulmonary edema may be delayed. Evaluation by a qualified allergist, including exposure history and testing, may help diagnose allergy. Tests of liver, kidney and spleen function.

First Aid: If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least 15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately. If this chemical contacts the skin, remove contaminated clothing and wash immediately with soap and water. Seek medical attention immediately. If this chemical has been inhaled, remove from exposure, begin rescue breathing (using universal precautions) if breathing has stopped, and CPR if heart action has stopped. Transfer promptly to a medical facility. When this chemical has been swallowed, get medical attention. If victim is conscious and able to swallow, have victim drink 4 to 8 ounces of water. Do not induce vomiting. *Note to physician or authorized medical personnel*: Medical observation is recommended for 24 to 48 hours following breathing overexposure, as pulmonary edema may be delayed. As first aid for pulmonary edema, a doctor or authorized paramedic might consider administering a corticosteroid spray. Cigarette smoking may exacerbate pulmonary injury and should be discouraged for at least 72 hours following exposure.

Personal Protective Methods: Reacts with the following absorbent materials: Cellulose-Based; Mineral- and Clay-Based; Dirt/Earth[88]. Wear protective gloves and clothing to prevent any reasonable probability of dermal and/or eye contact. Safety equipment suppliers/manufacturers can provide recommendations on the most protective glove/clothing material for your operation. All protective clothing (suits, gloves, footwear, headgear) should be clean, available each day, and put on before work. Contact lenses should not be worn when working with this chemical. Wear splash-proof chemical goggles and face shield unless full facepiece respiratory protection is worn. Employees should wash immediately with soap when skin is wet or contaminated. Provide emergency showers and eyewash.

Respirator Selection: Wherever and whenever workplace conditions warrant respirator use, a respiratory protection program must be followed that meets one or more of the following government standards: OSHA's 29 CFR 1910.134, ANSI Z88.2, or European Standard EN 149.

Storage: Color Code-Blue: Health Hazard/Poison. Store in a dark, secure poison location. Prior to working with this chemical you should be trained on its proper handling and storage. A regulated, marked area should be established where Aldicarb is handled, used, or stored. Store in tightly closed containers in a cool, well-ventilated area away from strong alkalis (such as sodium hydroxide, sodium bicarbonate, etc.). Stable when stored in glass or polyethylene containers. Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: Pesticides, solid, toxic/poisonous, n.o.s require a shipping label of "poisonous materials" and fall in Hazard Class 6.1. Technical name required.

Spill Handling: For solids, isolate spill or leak area in all directions for at least 25 meters/75 feet. For liquids, isolate spill or leak area in all directions for at least 50 meters /150 feet. Increase, in the downwind direction, as necessary. Do not touch damaged containers or spilled material unless wearing appropriate protective clothing. Stop leak if you can do it without risk. Prevent entry into waterways, sewers, basements or confined areas. Cover with plastic sheet to prevent spreading. Absorb or cover with dry earth, sand or other noncombustible material and transfer to containers. Do not allow water to get inside containers.

Fire Extinguishing: Hazardous decomposition includes toxic oxides of nitrogen, sulfur, and carbon and hydrogen chloride gas. *On a small fire:* use dry chemical, CO_2 or water spray. *On a large fire:* use water spray, fog or regular foam. Move containers from fire area if you can do it without risk. Dike fire-control water for later disposal; do not scatter the material. Use water spray or fog; do not use straight streams. *Fire involving storage or vehicular tanks:* isolate for 800 meters/0.5 mile in all directions; also, consider initial evacuation for 800 meters/0.5 mile in all directions. Fight fire from maximum distance or use unmanned hose holders or monitor nozzles. Do not get water inside containers. Cool containers with flooding quantities of water until well after fire is out. Withdraw immediately in the case of rising sound from venting safety devices or discoloration of tank. ALWAYS stay away from tanks engulfed in fire. For massive fire, use unmanned hose holders or monitor nozzles; if this is impossible, withdraw from area and let fire burn. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies.

Disposal Method Suggested: Do not discharge into drains or sewers. Dispose of waste material as hazardous waste using a licensed disposal contractor to an approved landfill. Consult with environmental regulatory agencies for guidance on acceptable disposal practices. Generators of waste containing this contaminant (≥100 kg/mo) must conform with EPA regulations governing storage, transportation, treatment, and waste disposal. If allowed, incineration with effluent gas scrubbing (carbon dioxide may be released) is recommended. Containers must be disposed of properly by following package label directions or by contacting your local or federal environmental control agency, or by contacting your regional EPA office.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- USEPA, "Reregistration Eligibility Decision (RED) Facts, Triallate," Office of Prevention, Pesticides and Toxic Substances, Washington, DC (March 2001). http://www.epa.gov/REDs/factsheets/triallatefact.pdf

- USEPA, Office of Pesticide Programs, Pesticide Residue Limits, "Triallate," 40 CFR 180.314. http://www.epa.gov/pesticides/food/viewtols.htm

Triasulfuron T:0656

Use Type: Herbicide
CAS Number: 82097-50-5
Formula: $C_{14}H_{16}ClN_5O_5S$
Synonyms: Benzenesulfonamide, 2-(2-chloroethoxy)-*N*-[((4-methoxy-6-methyl-1,3,5-triazin-2-yl)amino) carbonyl]-; 2-(2-Chloroethoxy)-*N*-[((4-methoxy-6-methyl-1,3,5-triazin-2-yl)amino)carbonyl]benzenesulfonamide; 1-[2-(2-Chloroethoxy)phenylsulfonyl]-3-(4-methoxy-6-methyl-1,3,5-triazin-2-yl)urea; 3-(6-Methoxy-4-methyl-1,3,5-triazin-2-yl)-1-[2-(2-chloroethoxy)phenylsulfonyl]urea; Urea, *N*-[2-(2-chloroethoxy)phenylsulfonyl]-*N′*-(6-methoxy-4-methyl-1,3,5-triazinyl-2-yl)-
Trade Names: AMBER®; CGA 131036®; LOGRAN®; RAVE®
Chemical class: Sulfonylurea; Triazine
EPA/OPP PC Code: 128969 (128985 old EPA code number)
California DPR Chemical Code: 5100
UN/NA & ERG Number: UN3077(solid)/171
RTECS® Number: DB1554000
EC Number: [Annex I Index No.: 650-041-00-9]
Uses: Used for the control of annual ryegrass, paradoxa grass and a wide range of broadleaf weeds in wheat and the post-emergence control of wild radishes in wheat, oats and barley. Registered for use in EU countries[115]. Registered for use in the U.S.
U.S. Maximum Allowable Residue Levels for Triasulfuron [40 CFR 180.459]: barley, grain 0.02 ppm; barley, straw 2.0 ppm; cattle, fat 0.1 ppm; cattle, kidney 0.5 ppm; cattle, meat 0.1 ppm; cattle, meat byproducts, ppm; except kidney 0.1 ppm; goat, fat 0.1 ppm; goat, kidney 0.5 ppm; goat, meat 0.1 ppm; goat, meat byproducts, except kidney 0.1 ppm; grass, forage 7.0 ppm; grass, hay 2.0 ppm; hog, fat 0.1 ppm; hog, kidney 0.5 ppm; hog, meat 0.1 ppm; hog, meat byproducts, except kidney 0.1 ppm; horse, fat 0.1 ppm; horse, kidney 0.5 ppm; horse, meat 0.1 ppm; horse, meat byproducts, except kidney 0.1 ppm; milk 0.02 ppm; sheep, fat 0.1 ppm; sheep, kidney 0.5 ppm; sheep, meat 0.1 ppm; sheep, meat byproducts, except kidney 0.1 ppm; wheat, forage 5.0 ppm; wheat, grain 0.02 ppm; wheat, straw 2.0 ppm
Human toxicity (long-term)[101]: Low–70.00 ppb, Health Advisory
Fish toxicity (threshold)[101]: Very low–68600.000680 ppb, MATC (Maximum Acceptable Toxicant Concentration)
Regulatory Authority and Advisory Information:
Carcinogenicity: IARC and NTP have not classified the sulfonylurea herbicides with respect to human carcinogenicity. U.S. EPA considers the sulfonylureas not classifiable, not rated, or noncarcinogenic, *with the exception of* sulfosulfuron (141776-32-1), a likely human carcinogen, and triflusulfuron-methyl (126535-15-7) a Possible human carcinogen[96].
Toxicity (oral) Category 4, Caution
European/International Regulations: Hazard Symbol: N; risk phrases: R50; R53; safety phrases: S2; S60; S61 (see Appendix 1)
Description: White crystalline solid. Molecular weight = 401.85; Specific gravity (H_2O:1) = 1.47 @ 20 °C; Boiling point = (decomposes); Freezing/Melting point = 178 °C. Soluble in water.
Incompatibilities: Slowly hydrolyzes in water, releasing ammonia and forming acetate salt.
Determination in Water: Log K_{ow} = <1.0. Unlikely to bioaccumulate in marine organisms.
Routes of Entry: Inhalation, passing through the skin, ingestion.
Harmful Effects and Symptoms: Human health effects from the sulfonylurea herbicides at low environmental doses or at biomonitored levels from low environmental exposures are unknown. The sulfonylurea herbicides are generally of low toxicity in mammalian studies. Animal studies showed low acute toxicity and little chronic, reproductive, or developmental toxicity or teratogenic effects. Developmental or teratogenic effects tended only to occur at high or maternally toxic doses. At high sublethal, chronic oral doses, such nonspecific effects as weight loss and anemia were observed. Some chemical-specific effects were noted at high doses in animals[96].
Short Term Exposure: Contact with eyes or skin may cause irritation or burns. Inhalation should be avoided; use NIOSH- or CEN (UK)-approved air-purifying respirators for pesticides. May be harmful if swallowed. Dermal contact may cause allergic reaction.
Long Term Exposure: Repeated or prolonged contact may cause skin and lung sensitization, resulting in allergy.
Points of Attack: Skin.
Medical Surveillance: Preliminary medical exam to detect chronic diseases of central nervous system, liver, heart, kidneys, lung and skin, as well as endocrinological or immunological disturbances, should protect susceptible individuals. Periodical medical exams of internal organs, skin and eyes are important to avoid chronic occupational intoxications. They should include lab and patch tests when necessary[83]. Evaluation by a qualified allergist, including exposure history and testing, may help diagnose allergy. Urinary levels of the sulfonylurea herbicides reflect recent exposure. There is very limited information on the biomonitoring of sulfonylurea herbicides or their metabolites. Detection of the metabolites may reflect exposure to more than one particular sulfonylurea herbicide or exposure to environmental degradation products. The urinary metabolites dimethoxypyrimidine and dimethylpyrimidine can be used as nonspecific markers of exposure to the pyrimidinylsulfonylureas, a group that includes bensulfuron-methyl,[41] primisulfuron-methyl, and sulfosulfon. The urinary metabolite methoxymethyl triazine can be used as a nonspecific marker of exposure to the triazinylsulfonylureas, a group that includes chlorosulfuron, prosulfuron, and triasulfuron.
First Aid: If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least

15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately. If this chemical contacts the skin, remove contaminated clothing and wash immediately with soap and water. Seek medical attention immediately. If this chemical has been inhaled, remove from exposure, begin rescue breathing (using universal precautions) if breathing has stopped, and CPR if heart action has stopped. Transfer promptly to a medical facility. When this chemical has been swallowed, get medical attention. Give large quantities of water and induce vomiting. Do not make an unconscious person vomit.

Personal Protective Methods: Wear protective gloves and clothing to prevent any reasonable probability of dermal and/or eye contact. Safety equipment suppliers/manufacturers can provide recommendations on the most protective glove/clothing material for your operation. All protective clothing (suits, gloves, footwear, headgear) should be clean, available each day, and put on before work. Contact lenses should not be worn when working with this chemical. Wear dust-proof chemical goggles and face shield unless full facepiece respiratory protection is worn. Employees should wash immediately with soap when skin is wet or contaminated. Provide emergency showers and eyewash.

Respirator Selection: Wherever and whenever workplace conditions warrant respirator use, a respiratory protection program must be followed that meets one or more of the following government standards: OSHA's 29 CFR 1910.134, ANSI Z88.2, or European Standard EN 149.

Storage: Color Code-Blue: Health Hazard/Poison. Store in a secure poison location. Store in a refrigerator and protect from exposure to oxidizers or moisture[52]. A regulated, marked area should be established where this chemical is handled, used, or stored in compliance with OSHA Standard 1910.1045. Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: Environmentally hazardous substances, solid or liquid, usually fall in Hazard Class 9.

Spill Handling: Evacuate and restrict persons not wearing protective equipment from area of spill or leak until clean up is complete. Dampen spilled material with alcohol to avoid dust. Collect powdered material in the most convenient and safe manner and deposit in sealed containers. Ventilate area of spill or leak after clean up is complete. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable.

Fire Extinguishing: Hazardous decomposition includes oxides of sulfur and nitrogen. As an immediate precautionary measure, isolate spill or leak area in all directions for at least 50 meters/150 feet for liquids and at least 25 meters/75 feet for solids. *Fire involving storage or vehicular tanks:* isolate for 800 meters/0.5 mile in all directions; also, consider initial evacuation for 800 meters/0.5 mile in all directions. *On a small fire:* use dry chemical, CO_2, water spray or regular foam. *On a large fire:* use water spray, fog or regular foam. Do not scatter spilled material with high-pressure streams of water. Move containers from fire area if you can do it without risk. Dike fire-control water for later disposal. *Fire involving tanks:* from a secure, explosion-proof location, use water spray to cool exposed containers. If cooling streams are ineffective (venting sound increases in volume and pitch, tank discolors, or shows any signs of deforming), withdraw immediately to a secure position. Always stay away from tanks engulfed in fire. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode.

Disposal Method Suggested: It is the responsibility of chemical waste generators to determine the toxicity and physical properties of a discarded chemical and to properly identify its classification and certification as a hazardous waste and to determine the disposal method. U.S. EPA guidelines for the classification determination are listed in ***40 CFR*** Parts 261.3. Additionally, waste generators must consult and follow all regional, national, state and local hazardous waste laws to ensure complete and accurate classification and disposal methods. Recycle any unused portion of the material for its approved use or return it to the manufacturer or supplier. Ultimate disposal of the chemical must consider: the material's impact on air quality; potential migration in soil or water; effects on animal, aquatic, and plant life; and conformance with environmental and public health regulations[83].

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- USEPA, Office of Pesticide Programs, Pesticide Residue Limits, “Triasulfuron,” 40 CFR 180.459. http://www.epa.gov/pesticides/food/viewtols.htm

Triazophos T:0658

Use Type: Insecticide

CAS Number: 24017-47-8

Formula: $C_{12}H_{16}N_3O_3PS$

Synonyms: *O,O*-Diethyl *O*-(1-phenyl-1*H*-1,2,4-triazol-3-yl) phosphorothioate; 1-Phenyl-3-(*O,O*-diethyl-thionophophoryl)-1,2,4-triazole;

1-Phenyl-1,2,4-triazolyl-3-(*O,O*-diethylthionophosphate); Phosphorothioic acid, *O,O*-diethyl *O*-(1-phenyl-1*H*-1,2,4-triazol-3-yl) ester

Trade Names: HILAZPOPHOS®; HOE 2960 OJ®; HOE 002960®; HOSTATHION®; SUTATHION®

Chemical class: Organophosphate

EPA/OPP PC Code: 344600

California DPR Chemical Code: 3543

HSDB Number: 6455

UN/NA & ERG Number: UN3018 (liquid)/152

RTECS® Number: TF5635000

EC Number: 245-986-5 [*Annex I Index No.:* 015-140-00-8]

Uses: Triazophos is a broad-spectrum insecticide and acaricide used to control sucking and chewing pests on a variety of crops, including cotton, rice, corn, beets and fruit trees. Not currently registered for use in the U.S. Not approved for use in EU countries[115]. There are more than 30 global suppliers[97].

Regulatory Authority and Advisory Information:

Acute Oral Category: 2, WARNING.

Health Advisory: Nerve Toxin

EPCRA Section 302 Extremely Hazardous Substances: TPQ = 500 lb (227 kg)

EPCRA Section 304 RQ: EHS, 1 lb (0.454 kg)

DOT Inhalation Hazard Chemicals

U.S. DOT Regulated Marine Pollutant (49CFR172.101, Appendix B)

European/International Regulations: Hazard Symbol: T, N; risk phrases: R21; R23/25; R50/53; safety phrases: S1/2; S36/37; S45; S60; S61 (see Appendix 1)

WGK (German Aquatic Hazard Class): 3-Severe hazard to waters

Description: Tan, oily liquid. Commercial product is available in various forms, including as an emulsifiable concentrate. Molecular weight = 313.34; Specific gravity (H_2O:1) = 1.247 @ 20 °C; Boiling point = (decomposes); Freezing/Melting point = 0 to 5 °C; Flash point = 132 °C; Vapor pressure = 1×10^{-5} mmHg @ 25 °C. Henry's Law constant = 3.1×10^{-8} atm-m^3/mol @ 25 °C (est)[83]. Slightly soluble in water; solubility = 40 mg/L @ 25 °C. Physical and toxicological properties may be affected by carrier solvents in commercial formulations.

Incompatibilities: In the presence of strong reducing agents such as hydrides, organophosphates form highly toxic and flammable phosphine gas. Contact with oxidizers can cause the release of toxic oxides of phosphorus. Incompatible with acids and alkalies.

Permissible Exposure Limits in Air: Protective Action Criteria (PAC) Ver. 27[89]

PAC-1: 0.25 mg/m^3

PAC-2: 2.8 mg/m^3

PAC-3: 12 mg/m^3

Determination in Air: OSHA versatile sampler-2; Toluene/Acetone; Gas chromatography/Flame ionization detection; NIOSH IV[18], Method #5600, Organophosphorus Pesticides

Determination in Water: NIOSH Method 1657. The determination of organophosphorus pesticides in municipal and industrial wastewater by gas chromatography. Detection limit = 6.0 ng/L. Log K_{ow} = >3.0. Values above 3.0 are likely to bioaccumulate in aquatic organisms.

Harmful Effects and Symptoms: Organophosphates are highly toxic. Symptoms may develop rapidly, or there may be a delay of several hours following exposure before they become noticeable. The delay tends to be longer in the case of some compounds that dissolve fats, lipids, oils and non-polar solvents such as toluene. Symptoms may increase in severity for more than a single day and last for several days. In severe cases of organophosphate intoxication, respiratory failure may occur.

Short Term Exposure: Eye pupils are small; blurred vision; eye watering; runny nose; cough; shortness of breath; salivation; dizziness; nausea, stomach cramps, diarrhea, and vomiting; increased blood pressure; profuse sweating; hypermotility, hallucinations; irritability; tingling of the skin; drowsiness; slow heartbeat; convulsions; fluid in lungs; loss of consciousness; incontinence; breathing stops; death. Organophosphates inhibit the action of acetylcholinesterase enzymes, and alter the way in which nervous impulses are transmitted. The effects can last for hours, days, or much longer. The action of the enzymes is reestablished after new enzymes are formed. LD_{50} (oral, rat) = 50–82 mg/kg; LD_{50} (dermal, rat) = >2 g/kg.

Long Term Exposure: Cholinesterase inhibitor; cumulative effect is possible. Organophosphates may damage the nervous system with repeated exposure, resulting in convulsions, respiratory failure. May cause liver damage.

Points of Attack: Respiratory system, central nervous system, cardiovascular system, blood cholinesterase.

Medical Surveillance: Medical observation is recommended for 24 to 48 hours following breathing overexposure, as pulmonary edema may be delayed. Cigarette smoking may exacerbate pulmonary injury and should be discouraged for at least 72 hours following exposure. Routine biological monitoring of pesticide applicators and field workers includes testing of plasma and red blood cell acetylcholinesterase levels (for enzyme poisoned by this chemical). These tests are normally accurate only if done within about two hours of exposure. If exposure stops, plasma levels return to normal in 1-2 weeks while red blood cell levels may be reduced for 1-3 months. When acetylcholinesterase enzyme levels are reduced by 25% or more below preemployment levels, risk of poisoning is increased, even if results are in lower ranges of "normal." Reassignment to work not involving organophosphate pesticides is recommended until enzyme levels recover. Do not drink any alcoholic beverages before or during use as it promotes absorption of organophosphates.

First Aid: *Eyes:* Speed in removing material from skin is of extreme importance. Eye contact can cause dangerous amounts of these chemicals to be quickly absorbed through the mucous membrane into the bloodstream. Immediately and gently flush eyes with plenty of warm or cold water (NO hot water) for at least 15 minutes, occasionally lifting the upper and lower eyelids. Get medical aid immediately. *Skin:* Get medical aid. Skin and/or eye contact can cause dangerous amounts of these chemicals to be absorbed into the bloodstream. Wearing the appropriate PPE equipment and respirator for organophosphate pesticides, immediately flush skin with plenty of soap and water for at least 15 minutes while removing contaminated clothing and shoes. Shampoo hair promptly if contaminated. *Ingestion:* Call poison control. Loosen all clothing. Never give anything by mouth to an unconscious person. Get medical aid. Do NOT induce vomiting. * If conscious, alert, and able to swallow, rinse mouth and have victim drink 4 to 8 ounces of water do NOT induce vomiting but immediately administer slurry of activated charcoal (2 oz in 8 oz of water). If victim is *unconscious or having convulsions,* do nothing except keep victim warm. **In some cases you may be specifically instructed by poison control to induce vomiting by way of 2 tablespoons of syrup of ipecac (adult) washed down with a cup of water*. Do NOT give activated charcoal before or with ipecac syrup. *Inhalation:* Get medical aid. Do not contaminate yourself. Wearing the appropriate PPE equipment and respirator for organophosphate pesticides, immediately remove the victim from the contaminated area to fresh air. If the victim is not breathing, administer artificial respiration. Do not use mouth-to-mouth method if victim ingested or inhaled the substance; give artificial respiration with the aid of a pocket mask equipped with a one-way valve or other proper respiratory medical device. If breathing is difficult, administer oxygen through bag/mask apparatus until medical help arrives. Do not leave victim unattended. *Note to physician or authorized medical personnel.* Administer atropine, 2 mg (1/30 gr) intramuscularly or intravenously as soon as any local or systemic signs or symptoms of an intoxication are noted; repeat the administration of atropine every 3 to 8 minutes until signs of atropinization (mydriasis, dry mouth, rapid pulse, hot and dry skin) occur; initiate treatment in children with 0.05 mg/kg of atropine; repeat at 5 to 10 minute intervals. Watch respiration, and remove bronchial secretions if they appear to be obstructing the airway; intubate if necessary. *Notes to physician or authorized medical personnel*: *N*-methylpyridinium-2-aldoxime (2-PAMCI) when used in conjunction with atropine reacts with the phosphorylated cholinesterase, thereby restoring normal activity by removing the phosphorylating group. The combination of these two chemicals is synergistic and must be administered within minutes to a few hours following exposure (depending on the specific agent) to be effective. Give 2-PAMCI (Pralidoxime; Protopam), 2.5 g in 100 ml of sterile water or in 5% dextrose and water, intravenously, slowly, in 15-30 minutes; if sufficient fluid is not available, give 1 g of 2-PAMCI in 3 ml of distilled water by deep intramuscular injection; repeat this every half hour if respiration weakens or if muscle fasciculation or convulsions recur. Also diazepam, an anticonvulsant, might be considered. As first aid for pulmonary edema, a doctor or authorized paramedic might consider administering a corticosteroid spray.

Personal Protective Methods: Incompatible with Clay- and Mineral-based absorbents[88]. Wear protective gloves and clothing to prevent any reasonable probability of dermal and/or eye contact. Safety equipment suppliers/manufacturers can provide recommendations on the most protective glove/clothing material for your operation. One recommendation is the use of DuPont™ Tychem® suit fabrics[88]. All protective clothing (suits, gloves, footwear, headgear) should be clean, available each day, and put on before work. Contact lenses should not be worn when working with this chemical. Wear splash-proof chemical goggles and face shield unless full facepiece respiratory protection is worn. Employees should wash immediately with soap when skin is wet or contaminated. Provide emergency showers and eyewash.

Respirator Selection: SCBA >0.25 mg/m^3. Engineering controls should be used wherever feasible to maintain airborne concentrations of this chemical below the prescribed exposure limit. Respirators and protective equipment are less effective than engineering controls, and should be used only in non-routine or emergency situations which may result in exposure concentrations in excess of the TWA environmental limit. *At any concentrations above the NIOSH REL, or where there is no REL, at any detectable concentration:* SCBAF: Pd,Pp (APF = 10,000) (any NIOSH/MSHA- or European Standard EN 149-approved self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode); or SaF: Pd,Pp: ASCBA (APF = 10,000) (any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary, self-contained breathing apparatus operated in a pressure-demand or other positive-pressure mode).

Storage: Color Code-Blue: Health Hazard/Poison. Store in a secure poison location. Prior to working with this chemical you should be trained on its proper handling and storage. Where possible, automatically transfer material from other storage containers to process containers. Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: Organophosphorus pesticides, solid or liquid (nonflammable), require a "poisonous materials" label. This chemical falls in Hazard Class 6.1.

Spill Handling: First remove all sources of ignition. Evacuate persons not wearing protective equipment from area of spill or leak until clean up is complete. Stay upwind; keep out of low areas. Ventilate area of spill or leak. Remove and isolate contaminated clothing at the site. Do not touch spilled material; stop leak if you can do so without risk. Use water spray to reduce vapors. *Small spills:* absorb with sand or other noncombustible absorbent material and place into containers for later disposal. *Large spills:* dike far ahead of spill for later disposal. Collect powdered material in the most convenient and safe manner and deposit in sealed containers. It may be necessary to contain and dispose of this chemical as a hazardous waste.

If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable. Seek professional environmental engineering assistance from the U.S. EPA Environmental Response Team at (908) 548-8730 (24-hour response line).

Fire Extinguishing: Hazardous decomposition includes hydrogen chloride and oxides of phosphorus, sulfur, and nitrogen. May be fatal if inhaled, ingested or absorbed through skin. Inhalation or contact with some of these materials will irritate or burn skin and eyes. Vapors may cause dizziness or suffocation. *Small fires:* dry chemical, carbon dioxide; water spray; or foam. *Large fires:* water spray, fog, or foam. Stay upwind; keep out of low areas. Ventilate closed spaces before entering them. Firefighting gear (including SCBA) may not provide adequate protection. If exposure occurs, remove and isolate gear immediately and thoroughly decontaminate personnel. Wear positive-pressure breathing apparatus and special protective clothing. Remove and isolate contaminated clothing at the site. Move container from fire area if you can do so without risk. Fight fire from maximum distance. Dike fire-control water for later disposal; do not scatter the material. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies. From a secure, explosion-proof location, use water spray to cool exposed containers. If cooling streams are ineffective (venting sound increases in volume and pitch, tank discolors, or shows any signs of deforming), withdraw immediately to a secure position. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode.

Disposal Method Suggested: Destruction by alkali hydrolysis or incineration. Containers must be disposed of properly by following package label directions or by contacting your local or federal environmental control agency, or by contacting your regional EPA office.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- United States National Library of Medicine, *ChemIDplus Advanced*, Bethesda, MD. http://chem.sis.nlm.nih.gov/chemidplus/rn/24017-47-8

Tribenuron-methyl T:0659

Use Type: Herbicide

CAS Number: 101200-48-0

Formula: $C_{15}H_{17}N_5O_6S$

Synonyms: Benzoic acid, 2-[((((4-methoxy-6-methyl-1,3,5-triazin-2-yl)methylamino)carbonyl)amino)sulfonyl]-, methyl ester; Benzoic acid, 2-[((((4-methoxy-6-methyl-1,3,5-triazin-2-yl)-*N*-methylamino)carbonyl)amino)sulfonyl]-, methyl ester; 2-[((((4-Methoxy-6-methyl-1,3,5-triazin-2-yl)-methylamino)carbonyl)amino)sulfonyl]-, methyl ester; Methyl 2-[((((4-methoxy-6-methyl-1,3,5-triazin-2-yl)methylamino)carbonyl)amino)sulfonyl]benzoate; Sulfmethmeton-methyl

Trade Names: ALLY®; CANVAS®; DPX-L-5300®; EXPRESS®; EXPRESS®-75 DF; HARMONY EXTRA®; INL-5300®; L 5300®; MATRIX®

Chemical class: Sulfonylurea (Triazinyl); Triazine

EPA/OPP PC Code: 128887

California DPR Chemical Code: 2338

HSDB Number: 6851

UN/NA & ERG Number: UN3077(solid)/171; UN2763 (Triazine pesticide, solid, toxic, not otherwise specified)/151

RTECS® Number: DH3565000

EC Number: 401-190-1 [*Annex I Index No.:* 607-177-00-9]

Uses: Used to control annual grasses and broadleaf weeds on barley, blueberries, oats, wheat, flax and rape seed (canola). Registered for use in EU countries[115]. Registered for use in the U.S.

U.S. Maximum Allowable Residue Levels for the residues of the herbicide tribenuron methyl ***[40 CFR 180.451(a)]:*** in or on the following raw agricultural commodities: barley, grain 0.05 ppm; barley, straw 0.10 ppm; canola, seed 0.02 ppm; cotton, gin byproducts 0.02 ppm; cotton, undelinted seed 0.02 ppm; flax, seed 0.02 ppm; oat, grain 0.05 ppm; oat, straw 0.10 ppm; wheat, grain 0.05 ppm; and wheat, straw 0.10 ppm. Tolerances with regional registration, as defined in 180.1(n), are established. ***[40 CFR 180.451(c)]:*** in or on the following raw agricultural commodities: grass, forage, fodder and hay, group (except Bermudagrass); forage 0.10 ppm; and grass, forage, fodder and hay, group (except Bermudagrass); hay 0.10 ppm.

Human toxicity (long-term)[101]: High–5.60 ppb, Health Advisory

Fish toxicity (threshold)[101]: Very low–251188.64315 ppb, MATC (Maximum Acceptable Toxicant Concentration)

Regulatory Authority and Advisory Information:

Carcinogenicity[83]: EPA Group C, Possible human carcinogen

Toxicity (oral) Category 4, Caution

EPCRA Section 313 Form R *de minimis* concentration reporting level: 1.0%

European/International Regulations: Hazard Symbol: Xi; risk phrases: R43; safety phrases: S2; S22; S24; S37 (see Appendix 1)

Description: Off-white to light brown crystalline solid. Slight pungent odor. Molecular weight = 395.40; Specific gravity (H_2O:1) = 1.456 @ 20 °C; Boiling point = (decomposes); Freezing/Melting point = 141 °C. Soluble in water.

Incompatibilities: Incompatible with oxidizers, acids, acid chlorides, acid halides, isocyanates, halogenated organics, peroxides, phenols (acidic), epoxides, anhydrides. Contact with strong reducing agents such as halides may generate explosive a flammable gas.

Permissible Concentration in Water: Federal Drinking Water Guidelines: 6 ppb[93]

Determination in Water: Log K_{ow} = <–0.5. Unlikely to bioaccumulate in marine organisms.

Routes of Entry: Inhalation, passing through the skin and ingestion.

Harmful Effects and Symptoms

Short Term Exposure: May cause skin and severe eye irritation. Moderately poisonous if ingested or inhaled. LD_{50} (oral, rat) = >5 g/kg; LD_{50} (dermal, rat) = >5 g/kg.

Long Term Exposure: May cause lung irritation and damage. May cause skin allergy. Contact with some triazine compounds (such as atrazine) may increase risks of tumors known to be associated with hormonal factors. These have been observed in both animals and human beings, and are consistent with the known effects on the hypothalamic pituitary gonadal axis. Repeated exposure may cause weight loss and reduced red blood cell count. May be mutagenic.

Points of Attack: Liver, lungs, skin.

Medical Surveillance: Preliminary medical exam to detect chronic diseases of central nervous system, liver, heart, kidneys, lung and skin, as well as endocrinological or immunological disturbances, should protect susceptible individuals. Periodical medical exams of internal organs, skin and eyes are important to avoid chronic occupational intoxications. They should include lab and patch tests when necessary[83]. This chemical is a suspected or known human carcinogen. Exposed persons should contact a physician for advice regarding the possible long term health effects and advice for medical monitoring. Urinary levels of the sulfonylurea herbicides reflect recent exposure. There is very limited information on the biomonitoring of sulfonylurea herbicides or their metabolites. Detection of the metabolites may reflect exposure to more than one particular sulfonylurea herbicide or exposure to environmental degradation products. The urinary metabolites dimethoxypyrimidine and dimethylpyrimidine can be used as nonspecific markers of exposure to the pyrimidinylsulfonylureas, a group that includes bensulfuron-methyl[41], primisulfuron-methyl, and sulfosulfon. The urinary metabolite methoxymethyl triazine can be used as a nonspecific marker of exposure to the triazinylsulfonylureas, a group that includes chlorosulfuron, prosulfuron, and triasulfuron[96]. For those with frequent or potentially high exposures, the following is recommended: Lung function tests. Consider chest x-ray following acute overexposure. Evaluation by a qualified allergist. Examination of the nervous system.

First Aid: If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least 15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately. If this chemical contacts the skin, remove contaminated clothing and wash immediately with soap and water. Seek medical attention immediately. If this chemical has been inhaled, remove from exposure, begin rescue breathing (using universal precautions) if breathing has stopped, and CPR if heart action has stopped. Transfer promptly to a medical facility. When this chemical has been swallowed, get medical attention. Give large quantities of water or milk and induce vomiting. Do not make an unconscious person vomit.

Personal Protective Methods: Wear protective gloves and clothing to prevent any reasonable probability of dermal and/or eye contact. Safety equipment suppliers/manufacturers can provide recommendations on the most protective glove/clothing material for your operation. All protective clothing (suits, gloves, footwear, headgear) should be clean, available each day, and put on before work. Contact lenses should not be worn when working with this chemical. Wear dust-proof chemical goggles and face shield unless full facepiece respiratory protection is worn. Employees should wash immediately with soap when skin is wet or contaminated. Provide emergency showers and eyewash.

Respirator Selection: Wherever and whenever workplace conditions warrant respirator use, a respiratory protection program must be followed that meets one or more of the following government standards: OSHA's 29 CFR 1910.134, ANSI Z88.2, or European Standard EN 149.

Storage: Color Code-Blue: Health Hazard/Poison. Store in a secure poison location. Store in a refrigerator and protect from exposure to oxidizers or moisture[52]. A regulated, marked area should be established where this chemical is handled, used, or stored in compliance with OSHA Standard 1910.1045. Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: Environmentally hazardous substances, solid or liquid, usually fall in Hazard Class 9.

Spill Handling: Evacuate and restrict persons not wearing protective equipment from area of spill or leak until clean up is complete. Dampen spilled material with alcohol to avoid dust. Collect powdered material in the most convenient and safe manner and deposit in sealed containers. Ventilate area of spill or leak after clean up is complete. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable.

Fire Extinguishing: Hazardous decomposition includes oxides of sulfur and nitrogen. As an immediate precautionary measure, isolate spill or leak area in all directions for at least 50 meters/150 feet for liquids and at least 25 meters/75 feet for solids. *Fire involving storage or vehicular tanks:* isolate for 800 meters/0.5 mile in all directions; also, consider initial evacuation for 800 meters/0.5 mile in all directions. *On a small fire:* use dry chemical, CO_2, water spray or regular foam. *On a large fire:* use water spray, fog or regular foam. Do not scatter spilled material with high-pressure streams of water. Move containers from fire area if you can do it without risk. Dike fire-control water for later disposal. *Fire involving tanks:* from a secure, explosion-proof location, use water spray to cool exposed containers. If cooling streams are ineffective (venting sound increases in volume and pitch, tank discolors, or shows any signs of deforming), withdraw immediately to a secure position. Always stay away from tanks engulfed in fire. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode.

Disposal Method Suggested: It is the responsibility of chemical waste generators to determine the toxicity and physical properties of a discarded chemical and to properly identify its classification and certification as a hazardous waste and to determine the disposal method. U.S. EPA guidelines for the classification determination are listed in ***40 CFR*** Parts 261.3. Additionally, waste generators must consult and follow all regional, national, state and local hazardous waste laws to ensure complete and accurate classification and disposal methods. Recycle any unused portion of the material for its approved use or return it to the manufacturer or supplier. Ultimate disposal of the chemical must consider: the material's impact on air quality; potential migration in soil or water; effects on animal, aquatic, and plant life; and conformance with environmental and public health regulations[83].

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- Pesticide Management Education Program, "Tribenuron methyl (Express) Herbicide Profile 6/89," Cornell University, Ithaca, NY (June 1989). http://pmep.cce.cornell.edu/profiles/herb-growthreg/sethoxydim-vernolate/tribenuron-methyl/herb-prof-tribenuron-meth.html

Tribufos T:0665

Use Type: Herbicide, Defoliant, Plant growth regulator

CAS Number: 78-48-8

Formula: $C_{12}H_{27}OPS_3$

Synonyms: A13-25812; Butyl phosphorotrithioate; Caswell No. 864; Fosforotritioato de *S,S,S*-tributilo (Spanish); Merphos-oxide; Phosphorotrithioic acid, *S,S,S*-tributyl ester; TBTP; *S,S,S*-Tributyl phosphorotrithioate; *S,S,S*-Tributyl trithiophosphate

Trade Names: B-1776®; BUTIFOS®; BUTIPHOS®[C]; CHEMAGRO® 1776; CHEMAGRO® B-1776; DEGREEN®; DEF®; DEF DEFOLIANT®; DELEAF DEFOLIANT®; EASY OFF®-D; E-Z-OFF® D; FOLEX® 6EC FOS-FALL® A; ORTHO® phosphate defoliant

Chemical class: Organophosphate derivative

EPA/OPP PC Code: 074801

California DPR Chemical Code: 190

HSDB Number: 668

UN/NA & ERG Number: UN2783 (solid)/152; UN2811/154

RTECS® Number: TG5425000

EC Number: 201-120-8

Uses: Tribufos is an organophosphate defoliant used for cotton crops. It is specifically used to defoliate cotton in preparation for machine harvesting. It was first registered in the United States in 1961. Not approved for use in EU countries[115]. Registered for use in the U.S.

U.S. Maximum Allowable Residue Levels for the residues of the defoliant tribuphos [40 CFR 180.272]: in or on food commodities as follows: cattle, fat (negligible residue) 0.02 ppm; cattle, meat byproducts (negligible residue) 0.02 ppm; cattle, meat (negligible residue) 0.02 ppm; cotton, undelinted seed 4 ppm; goat, fat (negligible residue) 0.02 ppm; goat, meat byproducts (negligible residue) 0.02 ppm; goat, meat (negligible residue) 0.02 ppm; milk (negligible residue) 0.002 ppm; sheep, fat (negligible residue) 0.02 ppm; sheep, meat byproducts (negligible residue) 0.02 ppm; and sheep, meat (negligible residue) 0.02 ppm.

Human toxicity (long-term)[101]: High–1.46444 ppb, CHCL (Chronic Human Carcinogen Level)

Fish toxicity (threshold)[101]: Intermediate–13.345590 ppb, MATC (Maximum Acceptable Toxicant Concentration)

Regulatory Authority and Advisory Information:

Carcinogenicity[83]: EPA, Likely human carcinogen in high doses; not likely to be a human carcinogen in low doses

Health Advisory: Nerve Toxin, Developmental/Reproductive Toxin

Acute Oral Category: 2, WARNING

DOT Inhalation Hazard Chemicals

EPCRA Section 313 Form R *de minimis* concentration reporting level: 1.0%

DOT Inhalation Hazard Chemicals

U.S. DOT Regulated Marine Pollutant (49CFR172.101, Appendix B)

Description: Clear, colorless to light yellow liquid. Mercaptan-like odor. Commercial product is available as an emulsifiable concentrate. Molecular weight = 314.54; Specific gravity (H_2O:1) = 1.06 @ 20 °C; Boiling point = 150 °C @ 0.3 @ mmHg; Freezing/Melting point = <–25 °C; Vapor pressure = 1.6×10^{-6} mmHg @ 20 °C; Vapor pressure = 4×10^{-6} mmHg @ 25 °C; Flash point = 195 °C. Henry's Law constant = 3×10^{-7} atm-m^3/mol @ 25 °C (est)[83]. Practically insoluble in water. Physical and toxicological properties may be affected by carrier solvents in commercial formulations.

Incompatibilities: Hydrolyzed slowly in the presence of alkaline materials. In the presence of strong reducing agents such as hydrides, organophosphates form highly toxic and flammable phosphine gas. Contact with oxidizers can cause the release of toxic oxides of phosphorus.

Permissible Exposure Limits in Air: Protective Action Criteria (PAC) Ver. 27[89]

PAC-1: 0.091 mg/m^3
PAC-2: 1 mg/m^3
PAC-3: 1 mg/m^3

Determination in Air: OSHA versatile sampler-2; Toluene/Acetone; Gas chromatography/Flame ionization detection; NIOSH IV[18], Method #5600, Organophosphorus Pesticides

Determination in Water: NIOSH Method 1657. The determination of organophosphorus pesticides in municipal and industrial wastewater by gas chromatography. Detection limit = 6.0 ng/L. Log K_{ow} = >5.5. Values above 3.0 are likely to bioaccumulate in marine organisms.

Harmful Effects and Symptoms: Organophosphates are highly toxic. Symptoms may develop rapidly, or there may be a delay of several hours following exposure before they become noticeable. The delay tends to be longer in the case of some compounds that dissolve fats, lipids, oils and non-polar solvents such as toluene. Symptoms may increase in severity for more than a single day and last for several days. In severe cases of organophosphate intoxication, respiratory failure may occur.

Short Term Exposure: Eye pupils are small; blurred vision; eye watering; runny nose; cough; shortness of breath; salivation; dizziness; nausea, stomach cramps, diarrhea, and vomiting; increased blood pressure; profuse sweating; hypermotility, hallucinations; irritability; tingling of the skin; drowsiness; slow heartbeat; convulsions; fluid in lungs; loss of consciousness; incontinence; breathing stops; death. Organophosphates inhibit the action of acetylcholinesterase enzymes, and alter the way in which nervous impulses are transmitted. The effects can last for hours, days, or much longer. The action of the enzymes is reestablished after new enzymes are formed. LD_{50} (oral, rat) = 150–450 mg/kg; LD_{50} (dermal, rat) = >150 mg/kg.

Long Term Exposure: Cholinesterase inhibitor; cumulative effect is possible. A nerve toxin; tribufos may damage the nervous system with repeated exposure, resulting in convulsions, respiratory failure. May cause liver damage.

Points of Attack: Respiratory system, central nervous system, cardiovascular system, blood cholinesterase.

Medical Surveillance: Preliminary medical exam to detect chronic diseases of central nervous system, liver, heart, kidneys, lung and skin, as well as endocrinological or immunological disturbances, should protect susceptible individuals. Periodical medical exams of internal organs, skin and eyes are important to avoid chronic occupational intoxications. They should include lab and patch tests when necessary[83]. Medical observation is recommended for 24 to 48 hours following breathing overexposure, as pulmonary edema may be delayed. Cigarette smoking may exacerbate pulmonary injury and should be discouraged for at least 72 hours following exposure. This chemical is a suspected or known human carcinogen in high doses. Exposed persons should contact a physician for advice regarding the possible long term health effects and advice for medical monitoring.

First Aid: Speed in removing material from skin is of extreme importance. *Eye:* Contact can cause dangerous amounts of these chemicals to be quickly absorbed through the mucous membrane into the bloodstream. Immediately and gently flush eyes with plenty of warm or cold water (NO hot water) for at least 15 minutes, occasionally lifting the upper and lower eyelids. Get medical aid immediately. *Skin:* Get medical aid. Skin and/or eye contact can cause dangerous amounts of these chemicals to be absorbed into the bloodstream. Wearing the appropriate PPE equipment and respirator for organophosphate pesticides, immediately flush skin with plenty of soap and water for at least 15 minutes while removing contaminated clothing and shoes. Shampoo hair promptly if contaminated. *Ingestion:* Call poison control. Loosen all clothing. Never give anything by mouth to an unconscious person. Get medical aid. Do NOT induce vomiting. * If conscious, alert, and able to swallow, rinse mouth and have victim drink 4 to 8 ounces of water do NOT induce vomiting but immediately administer slurry of activated charcoal (2 oz in 8 oz of water). If victim is *unconscious or having convulsions,* do nothing except keep victim warm. **In some cases you may be specifically instructed by poison control to induce vomiting by way of 2 tablespoons of syrup of ipecac (adult) washed down with a cup of water*. Do NOT give activated charcoal before or with ipecac syrup. *Inhalation:* Get medical aid. Do not contaminate yourself. Wearing the appropriate PPE equipment and respirator for organophosphate pesticides, immediately remove the victim from the contaminated area to fresh air. If the victim is not breathing, administer artificial respiration. Do not use mouth-to-mouth method if victim ingested or inhaled the substance; give artificial respiration with the aid of a pocket mask equipped with a one-way valve or other proper respiratory medical device. If breathing is difficult, administer oxygen through bag/mask apparatus until medical help arrives. Do not leave victim unattended. *Note to physician or authorized medical personnel.* Administer atropine, 2 mg (1/30 gr) intramuscularly or intravenously as soon as any local or systemic signs or symptoms of an intoxication are noted; repeat the administration of atropine every 3 to 8 minutes until signs of atropinization (mydriasis, dry mouth, rapid pulse, hot and dry skin) occur; initiate treatment in children with 0.05 mg/kg of atropine; repeat at 5 to 10 minute intervals. Watch respiration, and remove bronchial secretions if they appear to be obstructing the airway; intubate if necessary. *Notes to physician or authorized medical personnel*: *N*-methylpyridinium-2-aldoxime (2-PAMCI) when used in conjunction with atropine reacts with the phosphorylated cholinesterase, thereby restoring normal activity by removing the phosphorylating group. The combination of these two chemicals is synergistic and must be administered within minutes to a few hours following exposure (depending on the specific agent) to be effective. Give 2-PAMCI (Pralidoxime; Protopam), 2.5 g in 100 ml of sterile water or in 5% dextrose and water, intravenously, slowly, in 15-30 minutes; if sufficient fluid is not available, give 1 g of 2-PAMCI in 3 ml of distilled water by deep intramuscular injection; repeat this every half hour if respiration weakens or if muscle fasciculation or convulsions recur. Also diazepam, an anticonvulsant, might be considered. As first aid for pulmonary edema, a doctor or authorized paramedic might consider administering a corticosteroid spray.

Personal Protective Methods: Wear protective gloves and clothing to prevent any reasonable probability of dermal and/or eye contact. Safety equipment suppliers/manufacturers can provide recommendations on the most protective glove/clothing material for your operation. One recommendation is the use of DuPont™ Tychem® suit fabrics[88]. All protective clothing (suits, gloves, footwear, headgear) should be clean, available each day, and put on before work. Contact lenses should not be worn when working with this chemical. Wear splash-proof chemical goggles and face shield unless full facepiece respiratory protection is worn. Employees should wash immediately with soap when skin is wet or contaminated. Provide emergency showers and eyewash.

Respirator Selection: SCBA >0.091 mg/m^3. Engineering controls should be used wherever feasible to maintain airborne concentrations of this chemical below the prescribed exposure limit. Respirators and protective equipment are less effective than engineering controls, and should be used only in non-routine or emergency situations which may result in exposure concentrations in excess of the TWA environmental limit. *At any concentrations above the NIOSH REL, or where there is no REL, at any detectable concentration:* SCBAF: Pd,Pp (APF = 10,000) (any NIOSH/MSHA- or European Standard EN 149-approved self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode); or SaF: Pd,Pp: ASCBA (APF = 10,000) (any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary, self-contained breathing apparatus operated in a pressure-demand or other positive-pressure mode).

Storage: Color Code-Blue: Health Hazard/Poison. Store in a secure poison location. Prior to working with this chemical you should be trained on its proper handling and storage. Where possible, automatically transfer material from other storage containers to process containers. Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: Organophosphorus pesticides, solid or liquid (nonflammable), require a "poisonous materials" label. This chemical falls in Hazard Class 6.1.

Spill Handling: As an immediate precautionary measure, isolate spill or leak area in all directions for at least 50 meters/150 feet for liquids and at least 25 meters/75 feet for solids. Increase, in the downwind direction, as necessary, the isolation distance shown above. Eliminate all ignition sources (no smoking, flares, sparks or flames in immediate area). Do not touch damaged containers or spilled material unless wearing appropriate protective clothing. Stop leak if you can do it without risk. Prevent entry into waterways, sewers, basements or confined areas. Absorb or cover with dry earth, sand or other noncombustible material and transfer to containers. Do not get water inside containers.

Fire Extinguishing: Hazardous decomposition includes hydrogen chloride and oxides of nitrogen, phosphorus, sulfur, and carbon. May be fatal if inhaled, ingested or absorbed through skin. Inhalation or contact with some of these materials will irritate or burn skin and eyes. Vapors may cause dizziness or suffocation. *Fire involving storage or vehicular tanks:* isolate for 800 meters/0.5 mile in all directions; also, consider initial evacuation for 800 meters/0.5 mile in all directions. *Small fire:* dry chemical, carbon dioxide or water spray. *Large fire:* dry chemical, carbon dioxide, alcohol-resistant foam or water spray. Move containers from fire area if you can do it without risk. Dike fire-control water for later disposal; do not scatter the material. *Fire involving tanks or car/trailer loads:* fight fire from maximum distance or use unmanned hose holders or monitor nozzles. Do not get water inside containers. Cool containers with flooding quantities of water until well after fire is out. Withdraw immediately in the case of rising sound from venting safety devices or discoloration of tank. Always stay away from tanks engulfed in fire. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies.

Disposal Method Suggested: Destruction by alkali hydrolysis or incineration. Containers must be disposed of properly by following package label directions or by contacting your local or federal environmental control agency, or by contacting your regional EPA office.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- USEPA, "Interim Reregistration Eligibility Decision (IRED), Tribufos," Office of Prevention, Pesticides and Toxic Substances, Washington DC (September 2000). http://www.epa.gov/REDs/2145ired.pdf
- USEPA, Office of Pesticide Programs, "Tribufos Facts." (October 2000). http://www.epa.gov/REDs/factsheets/2145iredfact.pdf

Trichlorfon T:0670

Use Type: Insecticide, Anthelmintic

CAS Number: 52-68-6

Formula: $C_4H_8Cl_3O_4P$; $(CH_3O)_2POCHOHCCl_3$

Synonyms: Chlorophos; Chlorophthalm; Chloroxyphos; DETF; Dimethoxy-2,2,2-trichloro-1-hydroxy-ethylphosphine oxide; *O,O*-Dimethyl (1-hydroxy-2,2,2-trichloraethyl)phosphonsaeure ester (German); *O,O*-Dimethyl (1-hydroxy-2,2,2-trichloroethyl)phosphonate; Dimethyl 1-hydroxy-2,2,2-trichloroethylphosphonate; *O,O*-Dimethyl (2,2,2-trichloro-1-hydroxyethyl)phosphonate; Dimethyl (2,2,2-trichloro-1-hydroxyethyl)phosphonate; ENT 19,763; 1-Hydroxy-2,2,2-trichloroethylphosphonic acid dimethyl ester; Hypodermacid; Methyl chlorophos; Metifonate; Metrifonate; Metriphonate; NCI-C54831; Phoschlor; Phosphonic acid, (2,2,2-trichloro-1-hydroxyethyl)-, dimethyl ester; Polfoschlor; 2,2,2-Trichloro-1-hydroxyethyl-phosphonate, dimethyl ester; (2,2,2-Trichloro-1-hydroxyethyl)phosphonic acid dimethyl ester; Trichlorophene; Trichlorphon

Trade Names: AEROL 1 (PESTICIDE)®; AGROFOROTOX®; ANTHON®; BAY 15922®; BAYER 15922®; BAYER L 13/59®; BILARCIL®; BOVINOX®[C]; BRITON®; BRITTEN®; CEKUFON®; CHLORAK®; CHLOROFTALM®; CICLO-SOM®; COMBOT®; COMBOT EQUINE®; DANEX®[C]; DEP®; DEPTHON®; DIMETOX®; DIPTEREX®; DIPTEREX® 50; DIPTEVU®; DITRIFON®; DYLOX®; DYLOX-METASYSTOX-R®; DYREX®; DYVON®; EQUINO-ACID®; EQUINO-AID®; FLIBOL E®; FLIEGENTELLE®; FOROTOX®; FOSCHLOR®; FOSCHLOR R®; FOSCHLOR R-50®; LEIVASOM®; LOISOL®; MASOTEN®[C]; MAZOTEN®; NEGUVON®; NEGUVON A®; PHOSCHLOR R50®; PROXOL®; RICIFON®; RITSIFON®; SATOX 20WSC®; SOLDEP®; SOTIPOX®; TRICHLORPHON FN®; TRINEX®; TUGON®; TUGON FLY BAIT®; TUGON STABLE SPRAY®; VERMICIDE BAYER 2349®; VOLFARTOL®; VOTEXIT®; WEC 50®; WOTEXIT®

Chemical class: Organophosphate

EPA/OPP PC Code: 057901

California DPR Chemical Code: 88

HSDB Number: 881

UN/NA & ERG Number: UN2783/152

RTECS® Number: TA0700000

EC Number: 200-149-3 [*Annex I Index No.:* 015-021-00-0]

Uses: Not approved for use in EU countries[115]. Registered for use in the U.S. except California. Trichlorfon has non-agriculture uses on golf course turf, home lawns and similar venues, and in non-food contact areas of food and meat processing plants. Also on ornamental shrubs and plants, and ornamental and bait fish ponds. Overseas, trichlorfon is used as cattle pour-on, which is classified as a food-use. It is used against insects such as lepidopteran larvae (caterpillars), white grubs, mole crickets, cattle lice, sod webworms, leaf miners, stink bugs, flies, ants, cockroaches, earwigs, crickets, diving beetles, water scavenger beetles, water boatman, backswimmers, water scorpions, giant water bugs and pillbugs. All food and feed uses in the U.S. were voluntarily canceled November 21, 1995. It was used on Brussels sprouts, barley, beets, blueberries, beans (dry and snap), corn, field corn, popcorn, sweet corn, cotton, cow peas, lima beans, tomatoes, cabbage, carrots (including tops), cauliflower, collards, cowpeas, southern peas, black-eyed peas, crowder peas, pumpkins, collards, lettuce and alfalfa, cotton, peanuts, peppers, pumpkins, tobacco, soybeans and treatment to manure.

U.S. Maximum Allowable Residue Levels for the residues of Trichlorfon ***[40 CFR 180.198]:*** in or on the following raw agricultural commodities: cattle, fat 0.1 ppm (negligible residue); cattle, meat byproducts 0.1 ppm (negligible residue); and cattle, meat 0.1 ppm (negligible residue).

Human toxicity (long-term)[101]: Intermediate–14.00 ppb, Health Advisory

Fish toxicity (threshold)[101]: Intermediate–24.99773 ppb, MATC (Maximum Acceptable Toxicant Concentration)

Regulatory Authority and Advisory Information:

Carcinogenicity[83]: EPA, Likely human carcinogen in high doses; Unlikely human carcinogen in low doses; IARC: IARC: Group 3, unclassifiable as to human carcinogenicity; ACGIH A4 Not classifiable as a human carcinogen.

Toxicity (oral) Category 2, WARNING.

Health Advisory: Nerve Toxin, Tumorigen; Mutagen, Developmental/Reproductive Toxin, Skin irritant/sensitizer

Clean Water Act: Section 311 Hazardous Substances/RQ 40CFR117.3 (same as CERCLA, see below)

Superfund/EPCRA 40CFR302.4 RQ: CERCLA, 100 lb (45.4 kg)

Dropped from Extremely Hazardous Substance (EPA-SARA) in 1988

EPCRA Section 313 Form R *de minimis* concentration reporting level: 1.0%

U.S. DOT 49CFR172.101, Inhalation Hazard Chemical as organophosphates

U.S. DOT Regulated Marine Pollutant (49CFR172.101, Appendix B)

European/International Regulations: Hazard Symbol: Xn, Xi, N; risk phrases: R22; R43; R50/53; safety phrases: S2; S24; S37; S60; S61 (see Appendix 1)

WGK (German Aquatic Hazard Class): 3-Severe hazard to waters

Description: Trichlorfon is a white to pale yellow or pink crystalline or waxy solid. Faint, ether-like odor. Molecular weight = 257.44; Specific gravity (H_2O:1) = 1.73 @ 25 °C; Boiling point = (decomposes) >100 °C @ 0.1 mmHg; Freezing/Melting point = 77–84 °C; Vapor pressure = 8×10^{-6} mmHg @ 20 °C. LEL (Lower Explosive Limit) = 7500 ppm. Henry's Law constant = 1.7×10^{-11} atm-m^3/mol @ 25 °C (est)[83]. Hazard Identification (based on NFPA-704 M Rating System): Health 2, Flammability 1, Reactivity 0. Highly soluble in water; solubility = 15.4 g/100 ml @ 25 °C.

Incompatibilities: Decomposed by alkali materials. Forms explosive mixture with air. Alkaline materials, e.g., lime, lime sulfur, etc. Corrosive to iron and steel. In the presence of strong reducing agents such as hydrides, organophosphates form highly toxic and flammable phosphine gas. Contact with oxidizers can cause the release of toxic oxides of phosphorus. Corrosive to some metals.

Permissible Exposure Limits in Air: OSHA PEL: None
NIOSH REL: None
ACGIH TLV®[1]: 1 mg/m^3 (intermittent) TWA, sensitizer, not classifiable as a human carcinogen; BEI$_A$ issued for acetylcholinesterase inhibiting pesticides.
Protective Action Criteria (PAC) Ver. 27[89]
PAC-1: 1.2 mg/m^3
PAC-2: 13 mg/m^3
PAC-3: 57 mg/m^3

Determination in Air: OSHA versatile sampler-2; Toluene/Acetone; Gas chromatography/Flame photometric detection for sulfur, nitrogen, or phosphorus; NIOSH Method IV Method #5600, Organophosphorus pesticides[18].

Determination in Water: NIOSH Method 1657. The determination of organophosphorus pesticides in municipal and industrial wastewater by gas chromatography. Detection limit = 6.0 ng/L. Log K$_{ow}$ = <0.6. Unlikely to bioaccumulate in marine organisms.

Routes of Entry: Inhalation, ingestion and dermal contact.

Harmful Effects and Symptoms: Organophosphates are highly toxic. Symptoms may develop rapidly, or there may be a delay of several hours following exposure before they become noticeable. The delay tends to be longer in the case of some compounds that dissolve fats, lipids, oils and non-polar solvents such as toluene. Symptoms may increase in severity for more than a single day and last for several days. In severe cases of organophosphate intoxication, respiratory failure may occur.

Short Term Exposure: Probable oral lethal dose (human) 50-500 mg/kg, between 1 teaspoon and 1 ounce for a 150 lb (70 kg) person. Toxicity relatively low among organophosphate insecticides, although a potent acetylcholinesterase inhibitor. Skin sensitivity has been reported. Symptoms of exposure: muscle weakness, twitching, respiratory depression, sweating, vomiting, diarrhea, chest and abdominal distress, sometimes pulmonary edema, excessive salivation, headache, giddiness, vertigo and weakness, runny nose and sensation of tightness in chest (inhalation), blurring of vision, tearing, ocular pain, loss of muscle coordination, and slurring of speech. Delayed pulmonary edema may occur after inhalation. LD$_{50}$ (oral, rat) = 212 mg/kg; LD$_{50}$ (dermal, rat) = >5 g/kg.

Long Term Exposure: Cholinesterase inhibitor; cumulative effect is possible. Neurotoxic; chemical may damage the nervous system with repeated exposure, resulting in convulsions, respiratory failure. May cause liver and kidney damage. May cause reproductive and fetal effects. Skin sensitizer.

Points of Attack: Respiratory system, lungs, central nervous system, cardiovascular system, skin, eyes, plasma and red blood cell cholinesterase. Reproductive cells. Kidney and liver.

Medical Surveillance: Medical observation is recommended for 24 to 48 hours following breathing overexposure, as pulmonary edema may be delayed. Routine biological monitoring of pesticide applicators and field workers includes testing of plasma and red blood cell acetylcholinesterase levels (for enzyme poisoned by this chemical). These tests are normally accurate only if done within about two hours of exposure. If exposure stops, plasma levels return to normal in 1-2 weeks while red blood cell levels may be reduced for 1-3 months. When acetylcholinesterase enzyme levels are reduced by 25% or more below preemployment levels, risk of poisoning is increased, even if results are in lower ranges of "normal." Reassignment to work not involving organophosphate pesticides is recommended until enzyme levels recover. Do not drink any alcoholic beverages before or during use as it promotes absorption of organophosphates. Evaluation by a qualified allergist, including exposure history and testing, may help diagnose allergy. In addition to comprehensive initial medical and work histories emphasizing reproductive experience and menstrual history, patient should have physical examination and testing of genito-urinary tract, sperm count, motility and morphology. If required, other tests, such as serum testosterone, serum follicle stimulating hormone (FSH), and serum lutenizing hormone (LH), may be indicated.

First Aid: **Treatment for organophosphate poisoning consists of thorough decontamination, cardiorespiratory support, and administration of the antidotes atropine and pralidoxime. In cases of severe poisoning, diazepam, an anticonvulsant, should also be administered. Antidotes should be administered as prevention even if the diagnosis is in doubt**. Speed in removing material from eyes and skin is of extreme importance. *Eyes:* Eye contact can cause dangerous amounts of these chemicals to be quickly absorbed through the mucous membrane into the bloodstream. Immediately and gently flush eyes with plenty of warm or cold water (NO hot water) for at least 15 minutes, occasionally lifting the upper and lower eyelids. Get medical aid immediately. *Skin:* Get medical aid. Dermal contact can cause dangerous amounts of these chemicals to be absorbed into the bloodstream. Wearing the appropriate PPE equipment and respirator for organophosphate pesticides, immediately flush skin with plenty of soap and water for at least 15 minutes while removing contaminated clothing and shoes. Shampoo hair promptly if contaminated. The removed, contaminated clothing and shoes should be double-bagged and left in Hot Zone for later disposal by hazardous materials experts. Skin may also be decontaminated with diluted hypochlorite solution. *Inhalation:* Get medical aid. Do not contaminate yourself. Wearing the appropriate PPE equipment and respirator for organophosphate pesticides, immediately remove the victim from the contaminated area to fresh air. If the victim is not breathing, administer artificial respiration. Do not use mouth-to-mouth method if victim ingested or inhaled the substance; give artificial respiration with the aid of a pocket mask equipped with a one-way valve or other proper respiratory medical device. If breathing is difficult, administer oxygen through bag/mask apparatus until medical help arrives. Do not leave victim unattended. *Ingestion:* Call poison control. Loosen all clothing. Never give anything by mouth to an unconscious person. If victim is *unconscious or having convulsions,* do nothing except keep victim warm.

Get medical aid. Transfer promptly to a medical facility. In cases of ingestion, **do not induce vomiting**. If the victim is alert and asymptomatic, administer a slurry of activated charcoal at a dose of 1 g/kg (infant, child, and adult dose). A soda can and straw may be of assistance when offering charcoal to a child. *In some cases you may be specifically instructed by poison control to induce vomiting by way of 2 tablespoons of syrup of ipecac (adult) washed down with a cup of water*. Do NOT give activated charcoal before or with ipecac syrup. *Note to physician or authorized medical personnel:* Treat cases of respiratory compromise, coma, or excessive pulmonary secretions with respiratory support using protocols and techniques available and within the scope of training. Some cases may necessitate procedures such as endotracheal intubation or cricothyrotomy by properly trained and equipped personnel. When possible, atropine (see *Antidotes*, below) should be given under medical supervision. Patients who are comatose, hypotensive, or having seizures or cardiac arrhythmias should be treated according to advanced life support protocols. *Antidotes:* Two antidotes are administered to treat organophosphate poisoning. Atropine is a competitive antagonist of acetylcholine at muscarinic receptors and is used to control the excessive bronchial secretions which are often responsible for death. Pralidoxime relieves both the nicotinic and muscarine effects of organophosphate poisoning by regenerating acetylcholinesterase and can reduce both the bronchial secretions and the muscle weakness associated with poisoning. The initial intravenous dose of atropine in adults should be determined by the severity of symptoms: An initial adult dose of 1.0 to 2.0 mg or pediatric dose of 0.01 mg/kg (minimum 0.01 mg) should be administered intravenously. If intravenous access cannot be established, atropine may also be given intramuscularly, subcutaneously or via endotracheal tube. Doses should be repeated every 15 minutes until excessive secretions and sweating have been controlled. Once bronchial secretion has been controlled, atropine administration should be repeated whenever the secretions begin to recur. In seriously poisoned patients, very large doses may be required. Alterations of pulse rate and pupillary size should not be used as indicators of treatment adequacy. Pralidoxime should be administered as early in poisoning as possible as its efficacy may diminish when given more than 24 to 36 hours after exposure. Doses are as follows: adult 1.0 g; pediatric 25 to 50 mg/kg. The drug should be administered intravenously over 30 to 60 minutes, but in a life-threatening situation one-half of the total dose can be given per minute for a total administration time of 2 minutes. Treatment should begin to take effect within 40 minutes with a reduction in symptoms and the amount of atropine necessary to control bronchial secretion. The initial dose can be repeated in 1 hour and then every 8 to 12 hours until the patient is clinically well and no longer requires atropine. If intravenous access cannot be established, pralidoxime may also be given intramuscularly. Early administration of diazepam in addition to the combined atropine and pralidoxime treatment may help prevent the onset of seizures and potential brain and cardiac morphologic damage following high-level organophosphate poisoning.

Respirator Selection: Wherever and whenever workplace conditions warrant respirator use, a respiratory protection program must be followed that meets one or more of the following government standards: OSHA's 29 CFR 1910.134, ANSI Z88.2, or European Standard EN 149.

Storage: Color Code-Blue: Health Hazard/Poison. Store in a secure poison location. Prior to working with this chemical, you should be trained on its proper handling and storage. Store in tightly closed containers in a cool, well-ventilated area away from strong bases. Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: Organophosphorus pesticides, solid or liquid (nonflammable), require a "poisonous materials" label. This chemical falls in Hazard Class 6.1.

Spill Handling: First remove all sources of ignition. Evacuate persons not wearing protective equipment from area of spill or leak until clean up is complete. Stay upwind; keep out of low areas. Ventilate area of spill or leak. Remove and isolate contaminated clothing at the site. Do not touch spilled material; stop leak if you can do so without risk. Use water spray to reduce vapors. *Small spills:* absorb with sand or other noncombustible absorbent material and place into containers for later disposal. *Large spills:* dike far ahead of spill for later disposal. Collect powdered material in the most convenient and safe manner and deposit in sealed containers. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable. Seek professional environmental engineering assistance from the U.S. EPA Environmental Response Team at (908) 548-8730 (24-hour response line).

Fire Extinguishing: Hazardous decomposition includes hydrogen chloride and oxides of phosphorus, sulfur, and nitrogen. May be fatal if inhaled, ingested or absorbed through skin. Inhalation or contact with some of these materials will irritate or burn skin and eyes. Vapors may cause dizziness or suffocation. *Small fires:* dry chemical, carbon dioxide; water spray; or foam. *Large fires:* water spray, fog, or foam. Stay upwind; keep out of low areas. Ventilate closed spaces before entering them. Firefighting gear (including SCBA) may not provide adequate protection. If exposure occurs, remove and isolate gear immediately and thoroughly decontaminate personnel. Wear positive-pressure breathing apparatus and special protective clothing. Remove and isolate contaminated clothing at the site. Move container from fire area if you can do so without risk. Fight fire from maximum distance. Dike fire-control water for later disposal; do not scatter the material. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies. From a secure, explosion-proof location, use water spray to cool exposed containers. If cooling streams are ineffective (venting sound increases in volume and pitch, tank discolors, or shows any signs of deforming), withdraw immediately to a secure position. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode.

Disposal Method Suggested: Destruction by alkali hydrolysis or incineration. Containers must be disposed of properly by following package label directions or by contacting your local or federal environmental control agency, or by contacting your regional EPA office.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- USEPA, "Reregistration Eligibility Decision (RED) for Trichlorfon," Office of Prevention, Pesticides and Toxic Substances, Washington DC (January 1997). http://www.epa.gov/REDs/0104.pdf
- New Jersey Department of Health and Senior Services, "Hazardous Substance Fact Sheet, Trichlorfon," Trenton, NJ (March 1998). http://www.state.nj.us/health/eoh/rtkweb/1882.pdf
- Sax, N. I., Ed., "Dangerous Properties of Industrial Materials Report," 7, No. 2, 95-101 (1987)
- USEPA, "Chemical Profile: Trichlorophon," Washington DC, Chemical Emergency Preparedness Program (October 31, 1985)
- Agency for Toxic Substances and Disease Registry, U.S. Department of Health and Human Services, Public Health Service, "Managing Hazardous Materials Incidents," Atlanta, GA (June 2003)

Triclopyr T:0794

Use Type: Herbicide

CAS Number: 55335-06-3

Formula: $C_7H_4Cl_3NO_3$

Synonyms: Acetic acid, [(3,5,6-trichloro-2-pyridinyl)oxy]-; Triclopyr, triethylamine salt; 3,5,6-Trichloro-2-pyridinyloxyacetic acid

Trade Names: [*Note:* See the following record, Triclopyr, triethylamine salt, for trade names containing the salt of triclopry] ACCESS®; CROSSBOW®, (triclopyr+2,4-D ester); ET®; GARLON®; GRAZON® Triclopyr; PATHFINDER®; REDEEM®; RELY®; REMEDY®; RIVERDALE TAHOE® Nufarm (Australia); TURFLON®

Chemical class: Chloropyridinyl

EPA/OPP PC Code: 116001

California DPR Chemical Code:

HSDB Number: 7060

UN/NA & ERG Number: UN3082 (liquid)/171

RTECS® Number: AJ9000000

EC Number: 259-597-3

Uses: Triclopry is a systemic herbicide used on rice, range land and pasture, rights-of-way, forestry and grasslands, including home lawns, for control of broadleaf weeds and woody plants. Triclopry is usually available as a triclopyr butoxyethyl ester (BEE) or as a triclopry triethylamine salt (TEA). Registered for use in the U.S. Some products may be classified as Restricted Use Pesticides (RUP). Registered for use in EU countries[115].

U.S. Maximum Allowable Residue Levels for Triclopyr and its metabolites 3,5,6,-trichloro-2-pyridinol and 2-methoxy-3,5,6-trichloropyridine ***[40 CFR 180.417 (a)(1)]:*** for the combined residues of the herbicide in or on the following raw agricultural commodities: fish 3.0 ppm; grass, forage 500 ppm; grass, forage, hay 500 ppm; shellfish 3.5 ppm. ***[40 CFR 180.417 (a)(2)]:*** in or on the following agricultural commodities: egg 0.05 ppm; meat, fat, and meat byproducts, except kidney and liver, of cattle, goat, hog, horse and sheep 0.05 ppm; meat, fat, and meat byproducts, except kidney, of poultry 0.1 ppm; milk 0.01 ppm; liver and kidney of cattle, goat, hog, horse and sheep 0.5 ppm; rice, grain 0.3 ppm; rice, straw 10.0 ppm.

Human toxicity (long-term)[101]: Very low–350.00 ppb, Health Advisory

Fish toxicity (threshold)[101]: Very low–23713.98000 ppb, MATC (Maximum Acceptable Toxicant Concentration)

Regulatory Authority and Advisory Information:

Carcinogenicity[83]: EPA Group D, Not classifiable as a human carcinogen

Toxicity (oral) Category 3, CAUTION

European/International Regulations: Hazard Symbol: Xn, Xi, N; risk phrases: R22; R36; R43; R52; R63; safety phrases: S2; S24; S37; S60; S61 (see Appendix 1)

Description: White to colorless, feathery solid. Molecular weight = 256.48. Freezing/Melting point = 148–150 °C; Specific gravity (H_2O:1) = 1.34 @ 20 °C; Boiling point = (decomposes); Freezing/Melting point = 149.5 °C; Vapor pressure = 1.3×10^{-6} mmHg @ 25 °C. Highly soluble in water; solubility = 440 mg/L @ 24 °C.

Incompatibilities: Decomposes in temperatures >280 °C. May react with strong oxidizers such as chlorates, peroxides, nitrates, etc.

Permissible Concentration in Water: Federal Drinking Water Guidelines: 500 ppb[14]

Determination in Water: Log K_{ow} = <2.5. Unlikely to bioaccumulate in marine organisms

Routes of Entry: Inhalation, ingestion, dermal and/or eye contact.

Harmful Effects and Symptoms

Short Term Exposure: Harmful if swallowed. May cause irritation to the eyes, skin and respiratory tract. May be an eye irritant and a skin sensitizer. LD_{50} (oral, rat) = EPA: 729 mg/kg; LD_{50} (dermal, rabbit) = >2 g/kg.

Long Term Exposure: May cause heart, kidney and liver problems. Skin sensitizer.

Points of Attack: Heart, liver, kidneys, skin.

Medical Surveillance: Preliminary medical exam to detect chronic diseases of central nervous system, liver, heart, kidneys, lung and skin, as well as endocrinological or immunological disturbances, should protect susceptible individuals. Periodical medical exams of internal organs, skin and eyes are important to avoid chronic occupational intoxications. They should include lab and patch tests when necessary[83]. Heart, liver, and kidney function tests. Evaluation by a qualified allergist, including exposure history and testing, may help diagnose allergy.

First Aid: If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least 15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately. If this chemical contacts the skin, remove contaminated clothing and wash immediately with soap and water. Seek medical attention immediately. If this chemical has been inhaled, remove from exposure, begin rescue breathing (using universal precautions) if breathing has stopped, and CPR if heart action has stopped. Transfer promptly to a medical facility. When this chemical has been swallowed, get medical attention. Give large quantities of water and induce vomiting. Do not make an unconscious person vomit. Do not induce vomiting when formulations containing petroleum solvents are ingested.

Personal Protective Methods: Incompatible with Clay- and Mineral-based absorbents[88]. Applicators and other handlers must wear: Coveralls worn over long-sleeved shirt and long pants; Chemical-resistant gloves such as DuPont™ Tychem® suit fabrics, barrier laminate, or Viton®; Chemical-resistant footwear plus socks; Protective eye wear; Chemical-resistant headgear for overhead exposure; Chemical-resistant apron when cleaning equipment, mixing, or loading.

Respirator Selection: Wherever and whenever workplace conditions warrant respirator use, a respiratory protection program must be followed that meets one or more of the following government standards: OSHA's 29 CFR 1910.134, ANSI Z88.2, or European Standard EN 149.

Storage: Color Code-Blue: Health Hazard/Poison: Store in a tightly closed container in a dry, well-ventilated and secure poison location. Prior to working with this chemical you should be trained on its proper handling and storage. Where possible, automatically transfer material from other storage containers to process containers. Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Spill Handling: If you spill this chemical, first remove all sources of ignition. You should then dampen the solid spill material with 60-70% methanol, then transfer the dampened material to a suitable container. Use absorbent paper dampened with methanol to pick up any remaining material. Your contaminated clothing and absorbent paper should be sealed in a vapor-tight plastic bag for eventual disposal. Solvent-wash contaminated surfaces with 60-70% methanol followed by washing with a soap and water solution. Do not reenter the contaminated area until the safety officer (or other responsible person) has verified that the area has been properly cleaned.

Shipping: This material may be classified as an environmentally hazardous substance. It falls in Hazard Class 9.

Fire Extinguishing: Hazardous decomposition includes oxides of nitrogen, chlorinated pyridine, phosgene, and hydrogen chloride gas. As an immediate precautionary measure, isolate spill or leak area in all directions for at least 50 meters/150 feet for liquids and at least 25 meters/75 feet for solids. *Fire involving storage or vehicular tanks:* isolate for 800 meters/0.5 mile in all directions; also, consider initial evacuation for 800 meters/0.5 mile in all directions. *On a small fire:* use dry chemical, CO_2, water spray or regular foam. *On a large fire:* use water spray, fog or regular foam. Do not scatter spilled material with high-pressure streams of water. Move containers from fire area if you can do it without risk. Dike fire-control water for later disposal. *Fire involving tanks:* from a secure, explosion-proof location, use water spray to cool exposed containers. If cooling streams are ineffective (venting sound increases in volume and pitch, tank discolors, or shows any signs of deforming), withdraw immediately to a secure position. Always stay away from tanks engulfed in fire. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode.

Disposal Method Suggested: It is the responsibility of chemical waste generators to determine the toxicity and physical properties of a discarded chemical and to properly identify its classification and certification as a hazardous waste and to determine the disposal method. U.S. EPA guidelines for the classification determination are listed in ***40 CFR*** Parts 261.3. Additionally, waste generators must consult and follow all regional, national, state and local hazardous waste laws to ensure complete and accurate classification and disposal methods.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- USEPA, “Reregistration Eligibility Decision (RED), Triclopry,” Office of Prevention, Pesticides and Toxic Substances, Washington DC (October 1998). http://www.epa.gov/REDs/2710red.pdf
- EXTOXNET, Extension Toxicology Network, “Pesticide Information Profile, Triclopry,” Oregon State University, Corvallis, OR (June 1996). http://extoxnet.orst.edu/pips/triclopy.htm

Triclopyr, triethylammonium salt T:0796

Use Type: Herbicide
CAS Number: 57213-69-1
Formula: $C_7H_4Cl_3NO_3$
Synonyms: Acetic acid, [(3,5,6-trichloro-2-pyridinyl) oxy]-, compounded with *N,N*-diethylethanamine (1:1); Caswell No. 882 J; *N,N*-Diethyletha namine compounded with [(3,5,6-trichloro-2-pyridinyl)oxy]acetic acid (1:1); (3,5,6-Trichloro-2-pyridinyl)oxyacetic acid, triethylamine salt; 3,5,6-Trichloro-2-pyridinyloxyacetic acid, TEA salt; [(3,5,6-Trichloro-2-pyridinyl)oxy] acetic acid compounded with *N,N*-diethylethanamine (1:1); [(3,5,6-Trichloro-2-pyridyl)oxy]acetic acid, compound with triethylamine (1:1); Triclopyr triethylamine; Triethylammonium triclopyr; Triethylamine triclopyr; TTEA
Trade Names: BRUSH-B-GON®; CONFRONT®; CROSSBOW®; DOWELANCO® BRUSH AND WEED; DTDA/DMA-TEA-DMA® SELECTIVE HERBICIDE; GARLON-3A®; GRANDSTAND®; MON® 78736; REDEEM® R & P; RENOVATE®; RIVERDALE DTDA® SELECTIVE HERBICIDE; RIVERDALE HORSEPOWER®; TRICLOPRY-EZ-JECT®; TURFLON® AMINE; XRM-5202®; WEEDEX®
Chemical class: Chloropyridinyl; Pyridine compound
EPA/OPP PC Code: 116002
California DPR Chemical Code: 2131
UN/NA & ERG Number: UN3077(solid)/171
RTECS® Number: AJ8974000
EC Number: 260-625-1
Uses: A systemic herbicide used on rice, range land and pasture, rights-of-way, forestry and grasslands, including home lawns, for control of broadleaf weeds and woody plant. Registered for use in EU countries[115]. Registered for use in the U.S.
Regulatory Authority and Advisory Information:
Carcinogenicity[83]: EPA Group D, Not classifiable as a human carcinogen
Potential Ground Water Pollutant [California FAC Section 13145(d)/12811, active] butoxyethyl ester and triethylamine salt
EPCRA Section 313 Form R *de minimis* concentration reporting level: 1.0%
European/International Regulations: Hazard Symbol: Xi, Xn, H, N; risk phrases: R11; R20/21/22; R35; R41; R43; R51/52/53; safety phrases: S2; S26; S35; S39 (see Appendix 1)
Description: A clear, fluffy solid. Molecular weight = 257.66. Vapor pressure = unknown. Hazard Identification (based on NFPA-704 M Rating System): Health 1, Flammability 0, Reactivity 0.
Incompatibilities: Flammable. Keep away from strong oxidizers and strong acids.
Routes of Entry: Inhalation, ingestion, dermal and/or eye contact.
Harmful Effects and Symptoms
Short Term Exposure: Harmful if swallowed. May cause irritation to the eyes, skin and respiratory tract. May be a sever eye irritant. May be a skin sensitizer. LD_{50} (oral, rat) = >2 g/kg; LD_{50} (dermal, rat) = >2 g/kg.
Long Term Exposure: Triclopyr may cause heart, kidney and liver problems. Repeated exposure may cause skin sensitization.
Points of Attack: Heart, liver, kidneys, skin.
Medical Surveillance: Preliminary medical exam to detect chronic diseases of central nervous system, liver, heart, kidneys, lung and skin, as well as endocrinological or immunological disturbances, should protect susceptible individuals. Periodical medical exams of internal organs, skin and eyes are important to avoid chronic occupational intoxications. They should include lab and patch tests when necessary[83]. Heart, liver, and kidney function tests. Evaluation by a qualified allergist, including exposure history and testing, may help diagnose allergy.
First Aid: If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least 15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately. If this chemical contacts the skin, remove contaminated clothing and wash immediately with soap and water. Seek medical attention immediately. If this chemical has been inhaled, remove from exposure, begin rescue breathing (using universal precautions) if breathing has stopped, and CPR if heart action has stopped. Transfer promptly to a medical facility. When this chemical has been swallowed, get medical attention. Give large quantities of water and induce vomiting. Do not make an unconscious person vomit. Do not induce vomiting when formulations containing petroleum solvents are ingested.
Personal Protective Methods: Incompatible with Clay- and Mineral-based absorbents[88] Applicators and other handlers must wear: Coveralls worn over long-sleeved shirt and long pants; Chemical-resistant gloves such as DuPont™ Tychem® suit fabrics, barrier laminate, or Viton®; Chemical-resistant footwear plus socks; Protective eye wear; Chemical-resistant headgear for overhead exposure; Chemical-resistant apron when cleaning equipment, mixing, or loading.
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Storage: Color Code-Blue: Health Hazard/Poison: Store in a tightly closed container in a dry, well-ventilated and secure poison location. Prior to working with this chemical you should be trained on its proper handling and storage. Where possible, automatically transfer material from other storage containers to process containers. Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.
Spill Handling: If you spill this chemical, first remove all sources of ignition. You should then dampen the solid

spill material with 60-70% methanol, then transfer the dampened material to a suitable container. Use absorbent paper dampened with methanol to pick up any remaining material. Your contaminated clothing and absorbent paper should be sealed in a vapor-tight plastic bag for eventual disposal. Solvent-wash contaminated surfaces with 60-70% methanol followed by washing with a soap and water solution. Do not reenter the contaminated area until the safety officer (or other responsible person) has verified that the area has been properly cleaned.

Shipping: This material may be classified as an environmentally hazardous substance. It falls in Hazard Class 9.

Fire Extinguishing: Hazardous decomposition includes oxides of nitrogen, chlorinated pyridine, phosgene, and hydrogen chloride gas. As an immediate precautionary measure, isolate spill or leak area in all directions for at least 50 meters/150 feet for liquids and at least 25 meters/75 feet for solids. *Fire involving storage or vehicular tanks:* isolate for 800 meters/0.5 mile in all directions; also, consider initial evacuation for 800 meters/0.5 mile in all directions. *On a small fire:* use dry chemical, CO_2, water spray or regular foam. *On a large fire:* use water spray, fog or regular foam. Do not scatter spilled material with high-pressure streams of water. Move containers from fire area if you can do it without risk. Dike fire-control water for later disposal. *Fire involving tanks:* from a secure, explosion-proof location, use water spray to cool exposed containers. If cooling streams are ineffective (venting sound increases in volume and pitch, tank discolors, or shows any signs of deforming), withdraw immediately to a secure position. Always stay away from tanks engulfed in fire. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode.

Disposal Method Suggested: It is the responsibility of chemical waste generators to determine the toxicity and physical properties of a discarded chemical and to properly identify its classification and certification as a hazardous waste and to determine the disposal method. U.S. EPA guidelines for the classification determination are listed in ***40 CFR*** Parts 261.3. Additionally, waste generators must consult and follow all regional, national, state and local hazardous waste laws to ensure complete and accurate classification and disposal methods.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- United States National Library of Medicine, *ChemIDplus Advanced*, Bethesda, MD. http://chem.sis.nlm.nih.gov/chemidplus/rn/57213-69-1

Trifluralin T:0840

Use Type: Herbicide

CAS Number: 1582-09-8

Formula: $C_{10}H_9F_3N_3O_4$; $C_3H_7N\text{-}C_6H_2(NO_2)_2CF_3$

Synonyms: Benzenamine, 2,6-dinitro-*N,N*-dipropyl-4-(trifluoromethyl-); Benzeneamine, 2,6-dinitro-*N,N*-dipropyl-4-(trifluoromethylaniline); 2,6-Dinitro-*N,N*-dipropyl-4-(trifluoromethyl)benzenamine; 2,6-Dinitro-*N,N*-di-*N*-propyl-α,α,α-trifluro-*p*-toluidine; 4-(Di-*N*-propylamino)-3,5-dinitro-1-trifluoromethylbenzene; *N,N*-Di-*N*-propyl-2,6-dinitro-4-trifluoromethylaniline; *N,N*-Dipropyl-4-trifluoromethyl-2,6-dinitroaniline; Ethane, trifluoro-; 2,6-dinitro-*N,N*-dipropyl-4-(trifluoromethyl)aniline; NCI-C00442; Synfloran; *p*-Toluidine, α,α,α-trifluoro-2,6-dinitro-*N,N*-dipropyl-; α,α,α-Trifluoro-2,6-dinitro-*N,N*-dipropyl-4-toluidine; α,α,α-Trifluoro-2,6-dinitro-*N,N*-dipropyl-*p*-toluidine; Trifluralina (Spanish); Trifluraline

Trade Names: AGREFLAN®; AGRIFLAN® 24; ASHLADE TRIMARAN®; AUTUMN KITE®; BROADSTRIKE®; BUCKLE®; CALLIFORT®; CAMPBELL'S TRIFLURON®; CHANDOR®; COMMENCE®; CRISALIN®; DEVRINOL T®; DIGERMIN®; ELANCOLAN®; FLINT®; FLORA®; FLURENESE®; FLUTRIX®; FREEDOM®; GORDON’S WEEDER®; HERBIFLURIN®; IPERSAN®; JANUS®; L-36352®; LILLY 36,352®; LINNET®; MARKSMAN®; MARKSMAN 2, TRIGARD®; M. T. F®; NITRAN®; OLITREF®; ONSLAUGHT®; PREMERLIN 600 CE®; SINFLOWAN®; SOLO®; SU SEGURO CARPIDOR®; TEAM®; TREFANOCIDE®; TREFICON®; TREFLAN®; TREFLANOCIDE®; TRIFARMON®; TRIFLURALINA® 600; TRIFLUREX®; TRIFUREX®; TRIGARD®; TRIKEPIN®; TRILIN®; TRILIN® 10G; TRIM®; TRIMARAN®; TRIPART TRIFLURALIN 48 EC; TRISTAR®; TRUST®; TURFLAN®; URANUS® (trifluralin + linuron)

Chemical class: 2,6-Dinitroaniline

EPA/OPP PC Code: 036101

California DPR Chemical Code: 597

HSDB Number: 1003

UN/NA & ERG Number: UN1596 (Dinitroanilines)/153; UN3077(solid)/171

RTECS® Number: XU9275000

EC Number: 216-428-8 [*Annex I Index No.:* 609-046-00-1]

Uses: Trifluralin is a selective, pre-emergence herbicide used to control many annual grasses and broadleaf weeds in a large variety of tree fruit, nut, vegetable, and grain crops, including soybeans, sunflowers, cotton, and alfalfa. It is also used on rights-of-way, on set-aside land (i.e., arable land temporarily taken out of use). A general use pesticide (GUP). Not approved for use in EU countries[115]. Registered for use in the U.S.

U.S. Maximum Allowable Residue Levels for Trifluralin [40 CFR 180.207(a)]: alfalfa, forage 3.0 ppm; alfalfa, hay 2.0 ppm; almond, hulls 0.05 ppm; asparagus 0.05 ppm; barley, grain 0.05 ppm; barley, hay 0.05 ppm; barley, straw

0.05 ppm; bean, mung, sprouts 2.0 ppm; carrot, roots 1.0 ppm; celery 0.05 ppm; corn, field, forage 0.05 ppm; corn, field, grain 0.05 ppm; corn, field, stover 0.05 ppm; cotton, gin byproducts 0.05 ppm; cotton, undelinted seed 0.05 ppm; endive 0.05 ppm; flax, seed 0.05 ppm; fruit, citrus, group 10, 0.05 ppm; fruit, stone, group 12, 0.05 ppm; grape 0.05 ppm; hop, dried cones 0.05 ppm; mustard, seed 0.05 ppm; nut, tree, group 14, 0.05 ppm; okra 0.05 ppm; peanut 0.05 ppm; peanut, hay 0.05 ppm; peppermint, oil 2.0 ppm; peppermint, tops 0.05 ppm; rapeseed, seed 0.05 ppm; safflower, seed 0.05 ppm; sorghum, grain, forage 0.05 ppm; sorghum, grain, grain 0.05 ppm; sorghum, grain, stover 0.05 ppm; spearmint, oil 2.0 ppm; spearmint, tops 0.05 ppm; sugarcane, cane 0.05 ppm; sunflower, seed 0.05 ppm; vegetable, brassica, leafy group 5, 0.05 ppm; vegetable, bulb, group 3, 0.05 ppm; vegetable, cucurbit, group 9, 0.05 ppm; vegetable, foliage of legume, group 7, 0.05 ppm; vegetable, fruiting, group 8, 0.05 ppm; vegetable, leaves of root and tuber, group 2, 0.05 ppm; vegetable, legume, group 6, 0.05 ppm; vegetable, root and tuber, group 1, except carrot 0.05 ppm; wheat, grain 0.05 ppm; wheat, straw 0.05 ppm.

Human toxicity (long-term)[101]: High–5.00 ppb, Health Advisory

Fish toxicity (threshold)[101]: High–1.57645 ppb, MATC (Maximum Acceptable Toxicant Concentration)

Regulatory Authority and Advisory Information:

Carcinogenicity[83]: EPA Group C, Possible human carcinogen; EU GHS Category 2: Suspected human carcinogen.

Health Advisory: Mutagen (S!), Developmental/Reproductive Toxin (S!), Endocrine disruptor (S!)

Acute Oral Category: 4, Caution

Clean Air Act: Hazardous Air Pollutants (Title I, Part A, Section 112)

Safe Drinking Water Act: Priority List (55 FR 1470)

EPCRA Section 313 Form R *de minimis* concentration reporting level: 1.0%

European/International Regulations (*containing <0.5 ppm NPDA*): Hazard Symbol: Xi, N; risk phrases: R40; R43; R50/53; safety phrases: S2; S36/37; S46; S60; S61 (see Appendix 1)

WGK (German Aquatic Hazard Class): 2-Hazard to waters

Description: Trifluralin is an orange crystalline solid or powder. A combustible solid. Commercial product is available as granules or as an emulsifiable concentrate. Molecular weight = 335.32; Specific gravity (H_2O:1) = 1.34 @ 22 °C; Boiling point = (decomposes) 139–140 °C; Freezing/Melting point = 46–47 °C; Vapor pressure = 1.9×10^{-4} mmHg @ 29 °C; Flash point = >85 °C. Hazard Identification (based on NFPA-704 M Rating System): Health 2, Flammability 1, Reactivity 0. Practically insoluble in water; solubility = <0.1 mg/mL @ 22.5 °C[88]. Physical and toxicological properties may be affected by carrier solvents in commercial formulations.

Incompatibilities: Dust may form explosive mixture with air. Store in temperatures above 4.4 °C. Fluorocarbons can react violently with barium, potassium, sodium. Dintroanilines must be kept away from excessive heat, shock and friction sources that might cause an explosive reaction.

Permissible Exposure Limits in Air: Protective Action Criteria (PAC) Ver. 27[89]

PAC-1: 2.3 mg/m^3

PAC-2: 26 mg/m^3

PAC-3: 78 mg/m^3

Permissible Concentration in Water: Federal Drinking Water Guidelines: EPA 10 μg/L; State Drinking Water Guidelines: Arizona 2 μg/L; Maine 45 μg/L; Florida 4.5 μg/L; Wisconsin 7.5 μg/L. Canadian Drinking Water Standards: IMAC 0.045 mg/L

Determination in Water: Method: ASTM D5812; Procedure: gas chromatography with electron capture detector; Analyte: trifluralin; Matrix: finished drinking water; Detection limit: 0.05 $\propto$g/L. Log K_{ow} = >5.0. Values above 3.0 are likely to bioaccumulate in marine organisms.

Routes of Entry: Inhalation, skin and/or eye contact.

Harmful Effects and Symptoms

Short Term Exposure: Inhalation can cause irritation of the respiratory tract with cough, phlegm, and/or tightness in the chest. The vapor can cause eye and skin irritation. Dermal contact can cause irritation and rash which can be exacerbated by sunlight. The majority of reported trifluralin exposure cases were occupational in nature. Other reported symptoms include respiratory depression, abdominal cramps, nausea, diarrhea, headache, lethargy and parasthesia following dermal or inhalation exposure. LD_{50} (oral, rat) = >5 g/kg; LD_{50} (dermal, rat) = >2 g/kg.

Long Term Exposure: May cause cancer; skin sensitization; tumors. High or repeated exposure may affect the liver and kidneys and may cause anemia. May cause reproductive and fetal effects. Fluorides may cause bone disease (pain and tenderness of the bones); mottled teeth in children.

Points of Attack: Reproductive cells. Reproductive cells. Skin, eyes, liver, kidneys, and blood.

Medical Surveillance: Evaluation by a qualified allergist, including exposure history and testing, may help diagnose allergy. Preliminary medical exam to detect chronic diseases of central nervous system, liver, heart, kidneys, lung and skin, as well as endocrinological or immunological disturbances, should protect susceptible individuals. Periodical medical exams of internal organs, skin and eyes are important to avoid chronic occupational intoxications. They should include lab and patch tests when necessary[83]. This chemical is a suspected or known human carcinogen. Exposed persons should contact a physician for advice regarding the possible long term health effects and advice for medical monitoring. Kidney and liver function tests. Complete blood count. In addition to comprehensive initial medical and work histories emphasizing reproductive experience and menstrual history, patient should have physical examination and testing of genito-urinary tract, sperm count, motility and morphology. If required, other tests, such as serum testosterone, serum follicle stimulating hormone (FSH), and serum lutenizing hormone (LH), may be indicated.

First Aid: If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least

15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately. Give artificial respiration if victim is not breathing. *Do not* use mouth-to-mouth method if victim ingested or inhaled the substance; give artificial respiration with the aid of a pocket mask equipped with a one-way valve or other proper respiratory medical device. Administer oxygen if breathing is difficult. Remove and isolate contaminated clothing and shoes. In cases of contact with substance, immediately flush skin or eyes with running water for at least 20 minutes. For minor skin contact, avoid spreading material on unaffected skin. Keep victim warm and quiet. Effects of exposure (inhalation, ingestion or skin contact) to substance may be delayed. Ensure that medical personnel are aware of the material(s) involved and take precautions to protect themselves.

Personal Protective Methods: Dinitroanilines react with cellulose-based and expanded polymeric absorbents[88]. Wear protective gloves and clothing to prevent any reasonable probability of dermal and/or eye contact. Safety equipment suppliers/manufacturers can provide recommendations on the most protective glove/clothing material for your operation. All protective clothing (suits, gloves, footwear, headgear) should be clean, available each day, and put on before work. Contact lenses should not be worn when working with this chemical. Wear dust-proof chemical goggles and face shield unless full facepiece respiratory protection is worn. Employees should wash immediately with soap when skin is wet or contaminated. Provide emergency showers and eyewash.

Respirator Selection: SCBA >2.3 mg/m^3. *At concentrations above the NIOSH REL, or where there is no REL, at any detectable concentration:* SCBAF:Pd,Pp (APF = 10,000) (any self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode); or SaF:Pd,Pp:ASCBA (APF = 10,000) (any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary self-contained positive-pressure breathing apparatus). *Escape*: GmFOv100 (APF = 50) [any air-purifying, full facepiece respirator (gas mask) with a chin-style, front- or back-mounted organic vapor canister having an N100, R100, or P100 filter]; or SCBAE (any appropriate escape-type, self-contained breathing apparatus).

Storage: Color Code-Blue: Health Hazard/Poison: Store in a secure poison location. Prior to working with this chemical you should be trained on its proper handling and storage. Store in a cool, dry place and protect from prolonged exposure to light. Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: Dinitroanilines require a label of "poisonous materials." They usually fall into Hazard Group 6.1. Formulation may fit "environmentally hazardous substances, solid", usually falling in Hazard Class 9.

Spill Handling: Evacuate persons not wearing protective equipment from area of spill or leak until clean up is complete. Dampen spilled material with alcohol to avoid dust, then transfer material to a suitable container. Use absorbent dampened with alcohol to pick up remaining material. Wash surfaces well with soap and water. Collect waste material in the most convenient and safe manner and deposit in sealed containers. Ventilate area after clean up is complete. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable. Soil Adsorption Index (K_{oc}) = 8000

Fire Extinguishing: Hazardous decomposition includes oxides of nitrogen and carbon and hydrogen fluoride. *On a small fire:* use dry chemical, alcohol-resistant foam, CO_2 or water spray. *On a large fire:* use water spray, fog or regular foam. Move containers from fire area if you can do it without risk. Dike fire-control water for later disposal; do not scatter the material. Use water spray or fog; do not use straight streams. *Fire involving storage or vehicular tanks: isolate* for 800 meters/0.5 mile in all directions; also, consider initial evacuation for 800 meters/0.5 mile in all directions. Fight fire from maximum distance or use unmanned hose holders or monitor nozzles. Do not get water inside containers. Cool containers with flooding quantities of water until well after fire is out. Withdraw immediately in the case of rising sound from venting safety devices or discoloration of tank. ALWAYS stay away from tanks engulfed in fire. For massive fire, use unmanned hose holders or monitor nozzles; if this is impossible, withdraw from area and let fire burn. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies.

Disposal Method Suggested: Dissolve or mix the material with a combustible solvent and burn in a chemical incinerator equipped with an afterburner and scrubber. All federal, state, and local environmental regulations must be observed. Trifluralin does contain fluorine, and therefore incineration presents the increased hazard of HF in the off-gases. Prior to incineration, fluorine-containing compounds should be mixed with slaked lime plus vermiculite, sodium carbonate or sand-soda ash mixture (90:10).

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov

- EXTOXNET, Extension Toxicology Network, “Pesticide Information Profile, Trifluralin,” Oregon State University, Corvallis, OR (June 1996). http://extoxnet.orst.edu/pips/triflura.htm
- USEPA, Office of Pesticide Programs, Pesticide Residue Limits, “Trifluralin,” 40 CFR 180.207. http://www.epa.gov/pesticides/food/viewtols.htm
- USEPA, “Reregistration Eligibility Decision (RED), Trifluralin,” Office of Prevention, Pesticides and Toxic Substances, Washington DC (April 1996). http://www.epa.gov/REDs/0179.pdf
- New Jersey Department of Health and Senior Services, “Hazardous Substance Fact Sheet, Trifluralin,” Trenton, NJ (September 2010). http://www.state.nj.us/health/eoh/rtkweb/1918.pdf
- Sax, N. I., Ed., “Dangerous Properties of Industrial Materials Report,” 1, No. 2, 70-71 (1980)
- Pohanish, R. P., “Rapid Guide to Hazardous Chemicals in the Environment,” Van Nostrand Reinhold, New York, NY (1997)
- USEPA, “Health Advisory: Trifluralin,” Washington DC, Office of Drinking Water (August 1987)

Triforine T:0846

Use Type: Fungicide

CAS Number: 26644-46-2

Formula: $C_{10}H_{14}Cl_6N_4O_2$

Synonyms: *N,N′*-[1,4-Piperazinediylbis(2,2,2-trichloroethylidene)] bisformamide

Trade Names: CELA50®; CW524®; DENARIN® FUNGINEX®; SAPROL®; TRIFORIN®; W524®

Chemical class: Piperazine, trichloromethylformamide derivative

EPA/OPP PC Code: 107901

California DPR Chemical Code: 1905

HSDB Number: 6743

UN/NA&ERG Number: UN3077 (solid)/171; UN3082 (liquid)/171

RTECS® Number: TK9200000

EC Number: 272-872-0

Uses: Triforine is a systemic fungicide with protectant, eridicant, and curative activity. It is locally systemic, is quickly absorbed by the plant and should be applied on or before an infection occurs. Triforine is used for control of black spot, brown rot, scab, petal blight, rust and other diseases on fruits such as apples, peaches, plumbs, nectarines, apricots, and strawberry; in hops, vegetables, cereals, and ornamentals such as roses and chrysanthemums. Triforine breaks down rapidly in the environment. Not approved for use in EU countries[115]. Registered for use in the U.S.

U.S. Maximum Allowable Residue Levels for the fungicide triforine [40 CFR 180.382(a)]: in or on the following food commodities: almond, hulls 0.20 ppm; almond 0.01 ppm; apple 0.01 ppm; apricot 8.0 ppm; bell pepper 5.0 ppm; blueberry 0.1 ppm; cantaloupe 1.0 ppm; cherry 3.0 ppm; cranberry 0.1 ppm; cucumber 0.5 ppm; eggplant 1.0 ppm; hop, dried cone 60 ppm; hop, spent 60 ppm; nectarine 8.0 ppm; peach 8.0 ppm; plum 3.0 ppm; plum, prune, fresh 3.0 ppm; strawberry 2.0 ppm; and watermelon 1.0 ppm. ***Regional registrations are established [40 CFR 180.382(c)]:*** in or on the following food commodities: asparagus 0.01 ppm.

Regulatory Authority and Advisory Information:

Carcinogenicity[83]: EPA, Suggestive evidence of carcinogenicity, but not sufficient to assess human carcinogenic potential; likely to be carcinogenic to humans

Toxicity (oral) Category 4, Caution

EPCRA Section 313 Form R *de minimus* concentration reporting level: 1.0%.

European/International Regulations: Hazard Symbol: Xi, N; risk phrases: R50/53; safety phrases: S2; S61 (see Appendix 1)

WGK (German Aquatic Hazard Class): No value assigned.

Description: Colorless (white) to tan crystalline solid or powder. Commercial product is available as an emulsifiable concentrate. Some commercial liquids may be dissolved in a hydrocarbon solvent. Molecular weight = 434.96; Specific gravity (H_2O:1) = 1.01 @ 20 °C; Boiling point = (decomposes); Freezing/Melting point = 155 °C; Vapor pressure = 1.7×10^{-7} mmHg @ 25 °C. Henry's Law constant = 3.8×10^{-9} atm-m^3/mol @ 25 °C (est)[83]. Low solubility in water; solubility 25 mg/L @ 20C. Physical and toxicological properties may be affected by carrier solvents in commercial formulations.

Incompatibilities: Combustible solid; dust forms explosive mixture with air. Decomposed in strong acid to trichloroacetaldehyde and piperazine salts, and in strongly alkaline media to chloroform and piperazine[88]. May react with strong oxidizers such as chlorates, peroxides, nitrates, etc.

Determination in Water: Log K_{ow} = <2.5. Unlikely to bioaccumulate in marine organisms.

Routes of Entry: Inhalation, ingestion, dermal and/or eye contact.

Harmful Effects and Symptoms

Short Term Exposure: This material can irritate the eyes, skin and respiratory tract. It may cause eye (corneal) damage. LD_{50} (oral, rat) = >1.5 g/kg; LD_{50} (dermal, rat) = >10 g/kg.

First Aid: If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least 15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately. If this chemical contacts the skin, remove contaminated clothing and wash immediately with soap and water. Seek medical attention immediately. If this chemical has been inhaled, remove from exposure, begin rescue breathing (using universal precautions) if breathing has stopped, and CPR if heart action has stopped. Transfer promptly to a medical facility. When this chemical has been swallowed, get medical attention. Give large quantities of water or milk and induce vomiting. Do not make an unconscious person vomit.

Personal Protective Methods: Applicators and other handlers must wear: Coveralls worn over long-sleeved shirt and long pants; Chemical-resistant gloves such as DuPont™

Tychem® suit fabrics, barrier laminate, or Viton®; Chemical-resistant footwear plus socks; Protective eye wear; Chemical-resistant headgear for overhead exposure; Chemical-resistant apron when cleaning equipment, mixing, or loading[83]. Agricultural Use/Engineering Controls: When handlers use closed systems, enclosed cabs, or aircraft in a manner that meets the requirements listed in the Worker Protection Standard (WPS) for agricultural pesticides, ***40 CFR 170.240(d)(4-6),*** the handler PPE requirements may be reduced or modified as specified in the Worker Protection Standard. Firefighters should wear NIOSH-approved self-contained breathing apparatus and full protective clothing. Smoking, eating, and drinking before washing should be absolutely prohibited when any pesticide is being handled or used.

Respirator Selection: Wherever and whenever workplace conditions warrant respirator use, a respiratory protection program must be followed that meets one or more of the following government standards: OSHA's 29 CFR 1910.134, ANSI Z88.2, or European Standard EN 149.

Storage: Color Code-Blue: Health Hazard/Poison: Store in a tightly closed container in a dry, well-ventilated and secure poison location. Prior to working with this chemical you should be trained on its proper handling and storage. Where possible, automatically transfer material from other storage containers to process containers. Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: Environmentally hazardous substances, solid or liquid, usually fall in Hazard Class 9.

Spill Handling: Dampen the spilled solid material with water. Clean up with dampened absorbent paper and transfer material to a suitable trash container. Seal the absorbent paper in a vapor-tight plastic bag for eventual disposal. Wash all contaminated surfaces with a soap and water solution. Do not reenter the contaminated area until and expert verifies that the area has been properly cleaned.

Fire Extinguishing: Heat of decomposition releases toxic oxides of nitrogen and carbon and hydrogen chloride gas. As an immediate precautionary measure, isolate spill or leak area in all directions for at least 50 meters/150 feet for liquids and at least 25 meters/75 feet for solids. *Fire involving storage or vehicular tanks:* isolate for 800 meters/0.5 mile in all directions; also, consider initial evacuation for 800 meters/0.5 mile in all directions. *On a small fire:* use dry chemical, CO_2, water spray or regular foam. *On a large fire:* use water spray, fog or regular foam. Do not scatter spilled material with high-pressure streams of water. Move containers from fire area if you can do it without risk. Dike fire-control water for later disposal. *Fire involving tanks:* from a secure, explosion-proof location, use water spray to cool exposed containers. If cooling streams are ineffective (venting sound increases in volume and pitch, tank discolors, or shows any signs of deforming), withdraw immediately to a secure position. Always stay away from tanks engulfed in fire. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode.

Disposal Method Suggested: It is the responsibility of chemical waste generators to determine if a discarded chemical is classified as a hazardous waste. See 40 CFR Parts 261.3 for U.S. EPA guidelines for the classification determination. Additionally, in order to ensure complete and accurate classification, waste generators must consult state and local hazardous waste regulations.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- United States National Library of Medicine, ChemIDplus Advanced, Bethesda, MD. http://chem.sis.nlm.nih.gov/chemidplus/rn/26644-46-2

Triticonazole T:0975

Use Type: Fungicide, Seed disinfectant

CAS Number: 131983-72-7

Formula: $C_{17}H^{20}ClN_3O$

Synonyms:(+/-)-(E)-5-(4-Chlorobenzylidene)-2,2-dimethyl-1-(1H-1,2,4-triazol-1-ylmethyl)cyclopentanol; (RS)-(E)-5-(4-Chlorobenzylidene)-2,2-dimethyl-1-(1H-1,2,4-triazol-1-ylmethyl)cyclopentanol; (5E)-5-[(4-Chlorophenyl)methylene]-2,2-dimethyl-1-(1H-1,2,4-triazol-1-ylmethyl)cyclopentanol; Cyclopentanol, 5-4-chlorophenyl)methylene-2,2-dimethyl-1-(1H-1,2,4-triazol-1-ylmethyl)-

Trade names: ALIOS®; CHARTER F2 FUNGICIDE SEED TREATMENT®; CHARTER FUNGICIDE SEED TREATMENT®; CHARTER PB FUNGICIDE SEED TREATMENT®; FUNGUS CLEAR ULTRA®; KINTO®; PREMIS 25 FS®; REAL®; RESERVE FUNGICIDE®; STAMINA F3 HL FUNGICIDE SEED TREATMENT®; STAMINA F3 RTU FUNGICIDE SEED TREATMENT®; TRITICONAZOLE CONCENTRATE FUNGICIDE®; TRITICONAZOLE 3 SC FUNGICIDE®; TRITICONAZOLE SC FUNGICIDE®; TRITICONAZOLE HL FUNGICIDE SEED TREATMENT®; TRITICONAZOLE 70 WDG FUNGICIDE®; TRITICONAZOLE TECHNICAL FUNGICIDE®

Chemical Class: Azole; Triazole

EPA/OPP PC Code: 125620

California DPR Chemical Code: 5799

HSDB Number: 7944

UN/NA & ERG Number: UN3077/17; 3082/171

RTECS® Number: GY4705000

EC Number: 603-543-7 [*Annex I Index No.:* 613-282-00-0]

Uses: Used as a biocide in water-treatment facilities. Turf and seed protectant and treatment for grains, cereals, forage, fodder, straw, corn, barley, wheat to prevent rusts, powdery mildew and other pathogens. Registered for use in EU countries[115]. Registered for use in the U.S.

U.S. Maximum Allowable Residue Levels for the fungicide triticonazole from the treatment of seed prior to planting ***[40 CFR 180.583]:*** in or on raw agricultural commodities as follows: grain, cereal, forage, fodder and straw, group 16, except rice 0.10 ppm; grain, cereal, group 15, except rice 0.01 ppm.

Regulatory Authority and Advisory Information:

Toxicity (oral) Category 3, CAUTION

May be toxic to aquatic organisms

European/International Regulations: Hazard Symbol: Xn, N; risk phrases: R51/53; safety phrases: S2; S13; s20/21; S39/25; S57; S61 (see Appendix 1)

Description: White powder. Liquid suspension may be greenish. Odorless. Commercial product can be a soluble concentrate that may be mixed with water and used as a spray. Molecular weight = 317.81; Specific gravity (H_2O:1) = 1.22 @ 20 °C; Boiling point = (decomposes); Freezing/Melting point = 137–140 °C; Vapor pressure = 3.4×10^{-9} mmHg @ 25 °C (est.)[83]; Henry's Law constant = 1.5×10^{-10} atm-m^3/mol @ 25 °C (est)[83]; Hazard Identification (based on NFPA-704 M Rating System): Health 1, Flammability 0, Reactivity 0. Practically insoluble in water; solubility <19 mg/L. Physical and toxicological properties may be affected by carrier solvents in commercial formulations.

Incompatibilities: Incompatible with strong oxidizers, alkaline and acid materials.

Permissible Exposure Limits in Air:

Determination in Air: Adequate enforcement methodology (liquid chromatography/mass spectrometry (LC/MS), and liquid chromatography/mass spectrometry (LC/MS/MS) methods (Method 148.02) is available to enforce the tolerance expression. [75 FR 4287](1/27/2010)

Permissible Concentration in Water:

Determination in Water: Log K_{ow} = >3.0. Values above 3.0 are likely to bioaccumulate in aquatic organisms.

Routes of Entry: Inhalation, dermal and/or eye contact.

Harmful Effects and Symptoms

Short Term Exposure: May cause irritation of the eyes, skin, and respiratory tract. Some liquid formulations can be absorbed through the unbroken skin and have caused substantial but temporary eye problems. Harmful if ingested or inhaled. LD_{50} (oral, rat) = >2 g/kg; LD_{50} (dermal, rat) = >2000 mg/kg[83].

Long Term Exposure: May have major organ effects. In chronic animal (rats, dogs) studies triticonazole caused liver and/or adrenal effects[Bayer MSDS].

Points of Attack: Possibly liver and adrenal glands.

Medical Surveillance:

First Aid: If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least 15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately. If this chemical contacts the skin, remove contaminated clothing and wash immediately with soap and water. Seek medical attention immediately. If this chemical has been inhaled, remove from exposure, begin rescue breathing (using universal precautions) if breathing has stopped, and CPR if heart action has stopped. Transfer promptly to a medical facility. When this chemical has been swallowed, get medical attention. Give large quantities of water and induce vomiting. Do not make an unconscious person drink or vomit.

Note to physician: If ingested, remove by lavage or vomiting. Use general supportive measures for central nervous system depression. Use quinidine for myotonia.

Personal Protective Methods: Incompatible with Clay- and Mineral-based absorbents[88]. Applicators and other handlers must wear: Coveralls worn over long-sleeved shirt and long pants; Chemical-resistant gloves such as DuPont™ Tychem® suit fabrics, barrier laminate, or Viton®; Chemical-resistant footwear plus socks; Protective eye wear; Chemical-resistant headgear for overhead exposure; Chemical-resistant apron when cleaning equipment, mixing, or loading[83]. Agricultural Use/Engineering Controls: When handlers use closed systems, enclosed cabs, or aircraft in a manner that meets the requirements listed in the Worker Protection Standard (WPS) for agricultural pesticides, ***40 CFR 170.240(d)(4-6),*** the handler PPE requirements may be reduced or modified as specified in the Worker Protection Standard. Firefighters should wear NIOSH-approved self-contained breathing apparatus and full protective clothing.

Respirator Selection: Follow regulations in OSHA 29CFR1910.134 or European Standard EN149. Use a NIOSH/MSHA- or European Standard EN149-approved respirator; or use an approved supplied-air respirator with a full facepiece operated in the positive-pressure mode, or with a full facepiece, hood, or helmet in the continuous-flow mode; or use a NIOSH/MSHA- or European Standard EN149-approved self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive-pressure mode.

Storage: Color Code-Blue: Health Hazard/Poison: Store in a secure poison location. Prior to working with this chemical you should be trained on its proper handling and storage. Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: Environmentally hazardous substances, solid or liquid, usually fall in Hazard Class 9.

Spill Handling: Evacuate persons not wearing protective equipment from area of spill or leak until clean up is complete. Collect powdered material in the most convenient and safe manner and deposit in sealed containers. Ventilate area after clean up is complete. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable. Soil Adsorption Index (K_{oc}) = 130.

Fire Extinguishing: Hazardous decomposition includes oxides of nitrogen and carbon and hydrogen chloride gas. Use water spray; fog, carbon dioxide, or regular foam extinguishers. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies. From a secure, explosion-proof location, use water spray to cool exposed containers. If cooling streams are ineffective (venting sound increases in volume and pitch, tank discolors, or shows any signs of deforming), withdraw immediately to a secure position. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode.

Disposal Method Suggested: Strong acid or alkaline hydrolysis leads to complete degradation of triticonazole. However, large quantities of triticonazole should be incinerated in a unit operating @ 850 °C equipped with off-gas scrubbing equipment. Containers must be disposed of properly by following package label directions or by contacting your local or federal environmental control agency, or by contacting your regional EPA office.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- United States National Library of Medicine, ChemIDplus Advanced, Bethesda, MD. http://chem.sis.nlm.nih.gov/chemidplus/rn/131983-72-7

U

Urea U:0110

Use Type: Fertilizer, Fungicide
CAS Number: 57-13-6
Formula: CH_4N_2O; H_2NCONH_2
Synonyms: Carbamide; Carbamide resin; Carbamimidic acid; Carbonyl diamide; Carbonyldiamine; Isourea; NCI-C02119; Pseudourea
Trade Names: PRESPERSION, 75 UREA®; SUPERCEL 3000®; UREAPHIL®; UREOPHIL®; UREVERT®; VARIOFORM II®
Chemical class: Inorganic carbamide
EPA/OPP PC Code: 085702
California DPR Chemical Code: 662
HSDB Number: 163
UN/NA & ERG Number: Not regulated
RTECS® Number: YR6250000
EC Number: 200-315-5
Uses: Used in fertilizers and animal feeds, as a fungicide, in the manufacture of resins and plastics, as a stabilizer in explosives and in medicines, and others. Urea is used to protect against frost and is used in some pesticides as an inert ingredient as a stabilizer, as an inhibitor and as an intensifier for herbicides. Registered for use in EU countries[115]. Registered for use in the U.S.
U.S. Maximum Allowable Residue Levels for Urea (40 CFR 180.920 and 40CFR 180.950): Urea is exempt from requirements for a tolerance. **[*40 CFR 180.1117*]:** An exemption from the requirement of a tolerance is established for residues of the frost protectant urea in or on the following raw agricultural commodities when used before harvest in the production of: alfalfa, almonds, apples, apricots, artichokes, asparagus, avocados, beans, bell peppers, blackberries, blueberries, broccoli, brussels sprouts, boysenberries, caneberries, canola, cantaloupes, carrots, cauliflower, casaba, celery, cherries, chili peppers, chinese cabbage (bok choy, napa), cooking peppers, corn, cotton, crenshaw, cucumbers, figs, grapefruit, grapes, honeydew melon, hops, kiwifruit, kohlrabi, lemons, lentils, lettuce, limes, macadamia nuts, musk melon, nectarines, olives, onions, oranges, peaches, pears, peanuts, peas, persian melon, pistachios, plums, potatoes, pumpkin, prunes, radish, raspberries, rice, safflower, sorghum, spinach, spinach (New Zealand), squash (winter and summer), strawberries, sugar beets, sunflower, sweet pepper, table beets, tangerines, tomatoes, walnuts, watermelon, and zucchini.
Regulatory Authority and Advisory Information: Health Advisory: Mutagen, Reproductive Toxin, Skin irritant/sensitizer
WGK (German Aquatic Hazard Class): 1-Low hazard to waters
Description: Urea is a white crystalline solid. Odorless. Molecular weight = 60.06; Specific gravity (H_2O:1) = 1.335 @ 20 °C; Boiling point = (decomposes); Freezing/Melting point = 133 °C; pH = 7.2 (10% solution); Vapor pressure = 1.32×10^{-5} @ 20 °C. Hazard Identification (based on NFPA-704 M Rating System): Health 1, Flammability 0, Reactivity 0. Highly soluble in water.
Incompatibilities: Will develop an odor of ammonia in the presence of moisture. Violent reaction with strong oxidizers, chlorine (may form explosive material with chlorinating substances), permanganates, dichromates, nitrites, inorganic chlorides, chlorites, perchlorates and hypochlorites (may form an explosive material, chlorine nitride). Contact with hypochlorites can result in the formation of explosive compounds. Amides react with azo and diazo compounds to generate toxic gases. Flammable gases are formed by the reaction of organic amides with strong reducing agents. Amides are very weak bases (weaker than water). Mixing amides with dehydrating agents such as phosphorus pentoxide or thionyl chloride generates the corresponding nitrile. The combustion of these compounds generates mixed oxides of nitrogen (NOx). This compound is decomposed by strong base or acid[88].
Permissible Exposure Limits in Air: AIHA WEEL: 10 mg/m^3 TWA
Protective Action Criteria (PAC) Ver. 27[89]
PAC-1: 10 mg/m^3
PAC-2: 10 mg/m^3
PAC-3: 1700 mg/m^3
Permissible Concentration in Water: No data.
Determination in Water: Log K_{ow} = <– 2.0. Negative; unlikely to bioaccumulate in marine organisms.
Routes of Entry: Inhalation, ingestion, eye and/or dermal contact.
Harmful Effects and Symptoms
Short Term Exposure: *Inhalation:* Causes irritation of the respiratory tract. Dust may cause difficult breathing especially if the person has asthma. *Skin:* May cause irritation, burning or stinging. *Eyes:* Causes irritation. *Ingestion:* May cause gastrointestinal irritation with nausea, vomiting, and diarrhea. Acute effects: Eye, Brain, Hematological (unspecified); Kidney; Nervous system toxin; Central nervous system; Respiratory toxin (acute effects other than severe or moderate irritation); Respiratory irritant – acute, severe, or moderate but not mild irritant effects; Blood toxin (methemoglobinemia); Skin irritant (moderate)[DOE]. LD_{50} (oral, rat) = >8000 mg/kg; LD_{50} (dermal, rat) = >8000 mg/kg.
Long Term Exposure: Prolonged dermal contact may cause dermatitis. May cause cardiac disturbances. Some toxic effects have been seen in sheep with impaired liver function. Tumorigen.

Points of Attack: Skin. Possible heart and liver problems.

Medical Surveillance: Evaluation by a qualified allergist, including exposure history and testing, may help diagnose allergy.

First Aid: If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least 15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately. If this chemical contacts the skin, remove contaminated clothing and wash immediately with soap and water. Seek medical attention immediately. If this chemical has been inhaled, remove from exposure, begin rescue breathing (using universal precautions) if breathing has stopped, and CPR if heart action has stopped. Transfer promptly to a medical facility. When this chemical has been swallowed, get medical attention. Give large quantities of water and induce vomiting. Do not make an unconscious person vomit.

Personal Protective Methods: Wear protective gloves and clothing to prevent any reasonable probability of dermal and/or eye contact. One suggested materia is DuPont™ Tychem® suit fabric[88]. Safety equipment suppliers/manufacturers can provide recommendations on the most protective glove/clothing material for your operation. All protective clothing (suits, gloves, footwear, headgear) should be clean, available each day, and put on before work. Contact lenses should not be worn when working with this chemical. Wear dust-proof chemical goggles and face shield unless full facepiece respiratory protection is worn. Employees should wash immediately with soap when skin is wet or contaminated. Provide emergency showers and eyewash.

Respirator Selection: SCBA > 10 mg/m^3. Follow regulations in OSHA 29CFR1910.134 or European Standard EN149. Use a NIOSH/MSHA- or European Standard EN149-approved respirator; or use an approved supplied-air respirator with a full facepiece operated in the positive-pressure mode, or with a full facepiece, hood, or helmet in the continuous-flow mode; or use a NIOSH/MSHA- or European Standard EN149-approved self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive-pressure mode.

Storage: Store urea in a refrigerator and and protect it from moisture. Keep away from strong oxidizers, chlorine, permanganates, dichromates, nitrites, inorganic chlorides, chlorites, perchlorates; hypochlorites can form explosive compounds.

Spill Handling: First remove all sources of ignition. Evacuate persons not wearing protective equipment from area of spill or leak until cleanup is complete. Collect powdered material in the most convenient and safe manner and deposit in sealed containers. Ventilate area after cleanup is complete. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable. Do not reenter the contaminated area until an expert verifies that the area has been properly cleaned. Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: Not regulated. STN: 49-601-31, Hazardous substance, liquid or solid, n.o.s[83].

Fire Extinguishing: This chemical is a combustible solid. Use dry chemical, carbon dioxide; water spray; or foam extinguishers. Hazardous decomposition includes nitrogen oxides. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies. From a secure, explosion-proof location, use water spray to cool exposed containers. If cooling streams are ineffective (venting sound increases in volume and pitch, tank discolors, or shows any signs of deforming), withdraw immediately to a secure position. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full face-pieces and are operated in a pressure-demand or other positive-pressure mode.

Disposal Method Suggested: Controlled incineration in equipment containing a scrubber or thermal unit to reduce nitrogen oxide emissions[83].

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network(r), Bethesda, MD. http://toxnet.nlm.nih.gov.
- USEPA, Office of Pesticide Programs, Pesticide Residue Limits, "Urea," 40 CFR 180.920 and 40CFR 180.950. http://www.epa.gov/pesticides/food/viewtols.htm.
- New York State Department of Health, "Chemical Fact Sheet: Urea," Albany, NY, Bureau of Toxic Substance Assessment (April 1986).

Urea sulfate U:0115

Use Type: Herbicide, Plant growth regulator

CAS Number: 21351-39-3

Formula: $CH_4N_2O{\cdot}H_2O_4S$

Synonyms: Monocarbamide dihydrogen sulfate; Monourea sulfuric acid adduct; Urea sulfuric acid monoadduct; Sulfuric acid, monourea adduct; Urea dihydrogen sulfate; Urea, sulfate (1:1)

Trade Names: ENQUIK®; N-TAC DESSICANT®; SUPERQUIK®; WILTHIN®

Chemical class: Unclassified

EPA/OPP PC Code: 128961

California DPR Chemical Code: 2270

UN/NA & ERG Number: UN1760/154

RTECS® Number: YU1975000

EC Number: 244-343-6

Uses: Mainly used on cotton, wine grapes, apples, asparagus and rights-of-way. Not listed for use in EU countries[115]. Registered for use in the U.S.

Regulatory Authority and Advisory Information: Toxicity (oral) Category 2, WARNING

U.S. EPA Hazardous Waste Number (RCRA No.): D002 (Corrosive)

Description: A yellow to pink or greenish liquid. Molecular weight = 158.134; Specific gravity (H_2O:1) = 1.132 @ 20 °C; Boiling point = ~ 100 °C; Freezing/Melting point = 5.8 °C; Flash point = >200 °C. Hazard Identification (based on NFPA-704 M Rating System): Health 2-3 (depending on dilution), Flammability 0, Reactivity 2; Water reactive. Soluble in water; dangerously reactive.

Incompatibilities: To avoid dangerous spattering, do not add water to this material. This material reacts with water and other forms of moisture, releasing corrosive sulfuric acid. Incompatible with strong oxidizers such as hypochlorites and sulfides, alkaline materials. Corrosive to aluminum, mild steel, copper and zinc and other metals; contact may form flammable gases such as hydrogen. When heated to temperature 110 °C, this material will decompose, releasing oxides of nitrogen, carbon and sulfur.

Permissible Concentration in Water: Runoff from spills or fire control may cause water pollution from point of rel; ease. Although this material may not be a listed marine pollutant, it may be a toxic hazard to aquatic organisms, fish, wildlife and cattle. Avoid spills or release to waterways. Highly soluble. Will disperse with current.

Harmful Effects and Symptoms

Short Term Exposure: Skin and eye contact can cause burns and permanent damage. Inhaling this chemical can cause severe respiratory tract irritation. High levels of exposure may cause pulmonary edema, a medical emergency that may be delayed for several hours. Harmful if swallowed; may cause burns to the digestive tract, mouth, throat and stomach. Dermal contact may cause allergic reaction. LD_{50} (oral, rat) = 300–350 mg/kg; LD_{50} (dermal, rat) = >2 g/kg.

Long Term Exposure: Repeated or prolonged contact may cause skin and lung sensitization, resulting in allergies and possible lung disease.

Points of Attack: Skin, lungs.

Medical Surveillance: Preliminary medical exam to detect chronic diseases of central nervous system, liver, heart, kidneys, lung and skin, as well as endocrinological or immunological disturbances, should protect susceptible individuals. Periodical medical exams of internal organs, skin and eyes are important to avoid chronic occupational intoxications. They should include lab and patch tests when necessary[83]. Medical observation is recommended for 24 to 48 hours following breathing overexposure, as pulmonary edema may be delayed. Evaluation by a qualified allergist, including exposure history and testing, may help diagnose allergy.

First Aid: Move victim to fresh air. Call 911 or emergency medical service. Give artificial respiration if victim is not breathing. Do not use mouth-to-mouth method if victim ingested or inhaled the substance; give artificial respiration with the aid of a pocket mask equipped with a one-way valve or other proper respiratory medical device. Administer oxygen if breathing is difficult. Remove and isolate contaminated clothing and shoes. In the cases of contact with substance, immediately flush skin or eyes with running water for at least 20 minutes. For minor skin contact, avoid spreading material on unaffected skin. Keep victim warm and quiet. Effects of exposure (inhalation, ingestion or skin contact) to substance may be delayed. Ensure that medical personnel are aware of the material(s) involved and take precautions to protect themselves.

Personal Protective Methods: Wear protective gloves and clothing to prevent any reasonable probability of dermal and/or eye contact. One suggested materia is DuPont™ Tychem® suit fabric[88]. Safety equipment suppliers/manufacturers can provide recommendations on the most protective glove/clothing material for your operation. All protective clothing (suits, gloves, footwear, headgear) should be clean, available each day, and put on before work. Contact lenses should not be worn when working with this chemical. Wear dust-proof chemical goggles and face shield unless full facepiece respiratory protection is worn. Employees should wash immediately with soap when skin is wet or contaminated. Provide emergency showers and eyewash.

Respirator Selection: Follow regulations in OSHA 29CFR1910.134 or European Standard EN149. Use a NIOSH/MSHA- or European Standard EN149-approved respirator; or use an approved supplied-air respirator with a full facepiece operated in the positive-pressure mode, or with a full facepiece, hood, or helmet in the continuous-flow mode; or use a NIOSH/MSHA- or European Standard EN149-approved self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive-pressure mode.

Storage: Color Code-White: Corrosive or Contact Hazard; Store separately in a corrosion resistant location. Prior to working with this chemical you should be trained on its proper handling and storage. Store in tightly closed containers in a cool, well-ventilated area away from incompatible materials listed above. Metal containers involving the transfer of this chemical should be grounded and bonded. Drums must be equipped with self-closing valves, pressure vacuum bungs, and flame arresters. Use only non-sparking tools and equipment, especially when opening and closing containers of this chemical. If this material contains a flammable carrier, sources of ignition, such as smoking and open flames, are prohibited where this chemical is used, handled, or stored in a manner that could create a potential fire or explosion hazard. Wherever this chemical is used, handled, manufactured, or stored, use explosion-proof electrical equipment and fittings. Store urea in a refrigerator and and protect it from moisture. Keep away from strong oxidizers, chlorine, permanganates, dichromates, nitrites, inorganic chlorides, chlorites, perchlorates; hypochlorites can form explosive compounds.

Spill Handling: Wear safety goggles, full work clothing and impervious gloves and boots. If vapors are present, wear a NIOSH- or CEN (UK)-approved respiratory protection.

As an immediate precautionary measure, isolate spill or leak area in all directions for at least 50 meters/150 feet for liquids and at least 25 meters/75 feet for solids. Increase, in the downwind direction, as necessary, the isolation distance shown above. If you spill this chemical, you should dampen the solid spill material with water, then transfer the dampened material to a suitable container. Use absorbent paper dampened with water to pick up any remaining material. If you spill a liquid, the floor area may be slippery. Contain spills with inert material such as dry earth or dry sand. Scoop into containers and seal up for proper disposal in accordance with all local, state, and federal laws. Seal your contaminated clothing and the absorbent paper in a vapor-tight plastic bag for eventual disposal. Wash all contaminated surfaces with a strong soap and water solution. Do not reenter the contaminated area until the Safety Officer (or other responsible person) has verified that the area has been properly cleaned.

Fire Extinguishing: Hazardous decomposition includes oxides of nitrogen and carbon; ammonia and amines, hydrogen chloride gas and organic chloride fumes. Also, *deadly and flammable phosgene gas* may be released. *Fire involving storage or vehicular tanks:* isolate for 800 meters/0.5 mile in all directions; also, consider initial evacuation for 800 meters/0.5 mile in all directions. *Small fire:* dry chemical, carbon dioxide or water spray. *Large fire:* dry chemical, carbon dioxide, alcohol-resistant foam or water spray. Move containers from fire area if you can do it without risk. Dike fire-control water for later disposal; do not scatter the material. *Fire involving storage or vehicular tanks:* fight fire from maximum distance or use unmanned hose holders or monitor nozzles. Do not get water inside containers. Cool containers with flooding quantities of water until well after fire is out. Withdraw immediately in the case of rising sound from venting safety devices or discoloration of tank. Always stay away from tanks engulfed in fire. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full face-pieces and are operated in a pressure-demand or other positive-pressure mode. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies.

Shipping: Corrosive liquid, acidic, organic, n.o.s. (Urea Sulfate). It falls into Class 8 and Packing Group II or III (depending on dilution). DOT "corrosive to aluminum." Not regulated if transported by motor vehicle or railcar in packaging that will not react dangerously or be degraded by this material [See 49 CFR §173.154(d)].

Disposal Method Suggested: Do not contaminate waterways by discharge of waste effluents or equipment washwaters. Ensure disposal complies with government requirements and local regulations. If possible, container contents should be completely used and the containers rinsed three times prior to discard. Rinse material should be treated as a corrosive material. Generators of waste containing this contaminant (≥100 kg/mo) must conform with EPA regulations governing storage, transportation, treatment, and waste disposal. It is the responsibility of chemical waste generators to determine the toxicity and physical properties of a discarded chemical and to properly identify its classification and certification as a hazardous waste and to determine the disposal method. U.S. EPA guidelines for the classification determination are listed in 40 CFR Parts 261.3. Additionally, waste generators must consult and follow all regional, national, state and local hazardous waste laws to ensure complete and accurate classification and disposal methods.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network(r), Bethesda, MD. http://toxnet.nlm.nih.gov.
- United States National Library of Medicine, ChemIDplus Advanced, Bethesda, MD. http://chem.sis.nlm.nih.gov/chemidplus/rn/21351–39–3.

V

Vernolate V:0145

Use Type: Herbicide
CAS Number: 1929-77-7
Formula: $C_{10}H_{21}NOS$
Synonyms: Carbamic acid, dipropylthio-, *S*-propyl ester; Carbamothioic acid, dipropyl-, *S*-propyl ester; Dipropylthiocarbamic acid-*S*-propyl ester; PPTC; Propyl-*N,N*-dipropylthiolcarbamate; *S*-Propyl dipropylthiocarbamate; *S*-Propyl dipropyl (thiocarbamate); *N*-Propyl-di-*N*-propylthiolcarbamate
Trade Names: R-1607®; REWARD®[C]; SURPASS®[C]; SURPASS®-E[C]; VERNAM®[C]; VERNAM®-E[C]; VERNAM®-G[C]; VOMZLATE®
Chemical class: Thiocarbamate
EPA/OPP PC Code: 041404
California DPR Chemical Code: 1987
HSDB Number: 1028
UN/NA & ERG Number: UN3077(solid)/171
RTECS® Number: FA4725000
EC Number: 217-681-7 [*Annex 1 Index No.* 006-066-00-7]
Uses: Vernolate is a selective herbicide used to control a variety of weeds as their seeds germinate. These weeds include annual broadleaf weeds, annual grasses, perennial grasses, nut sedges and seedling Johnson grass. Agricultural crop use sites include soybeans, peanuts, groundnuts, soya beans, maize, tobacco, and sweet potatoes. A U.S. EPA restricted Use Pesticide (RUP) as dipropylthiocarbamic acid-*S*-propyl ester. Not currently registered for use in the U.S. Not approved for use in EU countries[115]. There are more than 15 global suppliers[97].
Human toxicity (long-term)[101]: High–7.00 ppb, Health Advisory
Fish toxicity (threshold)[101]: Low–344.93242 ppb, MATC (Maximum Acceptable Toxicant Concentration)
Regulatory Authority and Advisory Information: Health Advisory: Mutagen
Acute Oral Category: 3, CAUTION
Potential Ground Water Pollutant [California FAC Section 13145(d)/12811, inactive]
EPA Hazardous Waste Number (RCRA No.): U385
RCRA 40CFR268.48; 61FR15654, Universal Treatment Standards: Wastewater (mg/L), 0.003; Non-wastewater (mg/kg), 1.4
European/International Regulations: Hazard Symbol: Xn; N; risk phrases: R22; safety phrases: S2; S22; S51/53; S61
Description: Clear, colorless liquid. Faint, aromatic or garlic-like odor. Molecular weight 203.35; Specific gravity (H_2O:1) = 0.953 @ 20°C; Boiling point = 149°C @ 30 mmHg; Vapor pressure = 1.04×10^{-2} mmHg @ 25°C. Henry's Law constant = 3.9×10^{-5} atm-m^3/mol @ 25°C (est)[83]. Soluble in water; solubility = 95 ppm @ 20°C; 107 mg/L @ 25°C.
Incompatibilities: Esters react with acids to liberate heat along with alcohols and acids. Strong oxidizing acids may cause a vigorous reaction that is sufficiently exothermic to ignite the reaction products. Heat is also generated by the interaction of esters with caustic solutions. Flammable hydrogen is generated by mixing esters with alkali metals and hydrides. As an ester, it will hydrolyze to form sulfur dioxide and alcohols; reaction is more rapid under basic conditions. It may react exothermically with acids to generate alcohols. Heat will be generated by interaction with basic or caustic solutions. Flammable hydrogen is generated by mixing with alkali metals and hydrides.
Permissible Concentration in Water: State Drinking Water Guidelines: Florida 7 μg/L. Runoff from spills or fire control may cause water pollution.
Determination in Water: Method: EPA-TSC-NERL 507; Procedure: Determination of Nitrogen- and Phosphorus-Containing Pesticides in Water by Gas Chromatography with a Nitrogen-Phosphorus Detector; Analyte: Vernolate; Matrix: ground water and finished drinking water; Detection limit: 0.055 μg/L. Log K_{ow} = >3.5. Values above 3.0 may be able to bioaccumulate in marine organisms.
Harmful Effects and Symptoms
Short Term Exposure: Some thiocarbamates may react with recently ingested alcohol or alcohol-containing products including wine, medications, and cold remedies such as cough-syrups. Concentrated solutions are slightly corrosive to eyes and mucous membranes. Dust inhalation can cause irritation of the respiratory system with sneezing. Eye contact can cause irritation, watering, pain, and inflammation of the eyelids. Dermal contact can cause irritation and minor ulceration. Ingestion can cause nausea, vomiting, fever, muscle twitching, seizure, rapid respiration, slow heart beat. Severe exposure may result in death. LD_{50} (oral, rat) = >1000 mg/kg; LD_{50} (dermal, rat) = >5 g/kg.
Points of Attack: Respiratory system, central nervous system, cardiovascular system, skin, eyes.
Medical Surveillance: Preliminary medical exam to detect chronic diseases of central nervous system, liver, heart, kidneys, lung and skin, as well as endocrinological or immunological disturbances, should protect susceptible individuals. Periodical medical exams of internal organs, skin and eyes are important to avoid chronic occupational intoxications. They should include lab and patch tests when necessary[83]. Medical observation is recommended for 24 to 48 hours following breathing overexposure, as pulmonary edema may be delayed. Cigarette smoking may exacerbate pulmonary injury and should be discouraged for at least 72 hours following exposure. Before employment and at regular times after that, the following are recommended:

If symptoms develop or overexposure occurs, repeat the above tests as soon as possible and get an exam of the nervous system. Also consider complete blood count and chest x-ray following acute overexposure.

First Aid: If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least 15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately. If this chemical contacts the skin, remove contaminated clothing and wash immediately with soap and water. Seek medical attention immediately. If this chemical has been inhaled, remove from exposure, begin rescue breathing (using universal precautions) if breathing has stopped, and CPR if heart action has stopped. Transfer promptly to a medical facility. When this chemical has been swallowed, get medical attention. If victim is conscious and able to swallow, have victim drink 4 to 8 ounces of water. Do not induce vomiting. *Note to physician or authorized medical personnel*: Medical observation is recommended for 24 to 48 hours following breathing overexposure, as pulmonary edema may be delayed. As first aid for pulmonary edema, a doctor or authorized paramedic might consider administering a corticosteroid spray. Cigarette smoking may exacerbate pulmonary injury and should be discouraged for at least 72 hours following exposure.

Personal Protective Methods: Reacts with the following absorbent materials: Cellulose-Based; Mineral- and Clay-Based; Dirt/Earth[88]. Wear protective gloves and clothing to prevent any reasonable probability of dermal and/or eye contact. Safety equipment suppliers/manufacturers can provide recommendations on the most protective glove/clothing material for your operation. All protective clothing (suits, gloves, footwear, headgear) should be clean, available each day, and put on before work. Contact lenses should not be worn when working with this chemical. Wear splash-proof chemical goggles and face shield unless full facepiece respiratory protection is worn. Employees should wash immediately with soap when skin is wet or contaminated. Provide emergency showers and eyewash.

Respirator Selection: Wherever and whenever workplace conditions warrant respirator use, a respiratory protection program must be followed that meets one or more of the following government standards: OSHA's 29 CFR 1910.134, ANSI Z88.2, or European Standard EN 149.

Storage: Color Code-Blue: Health Hazard/Poison. Store in a dark, secure poison location. Prior to working with this chemical you should be trained on its proper handling and storage. Store in tightly closed containers in a cool, well-ventilated area away from strong alkalis (such as sodium hydroxide, sodium bicarbonate, etc.). Stable when stored in glass or polyethylene containers. Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: Environmentally hazardous substances, solid or liquid, usually fall in Hazard Class 9 and Packing Group III.

Spill Handling: For solids, isolate spill or leak area in all directions for at least 25 meters/75 feet. For liquids, isolate spill or leak area in all directions for at least 50 meters/150 feet. Increase, in the downwind direction, as necessary. Do not touch damaged containers or spilled material unless wearing appropriate protective clothing. Stop leak if you can do it without risk. Prevent entry into waterways, sewers, basements or confined areas. Cover with plastic sheet to prevent spreading. Absorb or cover with dry earth, sand or other non-combustible material and transfer to containers. Do not allow water to get inside containers.

Fire Extinguishing: Hazardous decomposition includes oxides of nitrogen, sulfur, and carbon. As an immediate precautionary measure, isolate spill or leak area in all directions for at least 50 meters/150 feet for liquids and at least 25 meters/75 feet for solids. *Fire involving storage or vehicular tanks:* isolate for 800 meters/0.5 mile in all directions; also, consider initial evacuation for 800 meters/0.5 mile in all directions. *On a small fire:* use dry chemical, CO_2, water spray or regular foam. *On a large fire:* use water spray, fog or regular foam. Do not scatter spilled material with high-pressure streams of water. Move containers from fire area if you can do it without risk. Dike fire-control water for later disposal. *Fire involving tanks:* from a secure, explosion-proof location, use water spray to cool exposed containers. If cooling streams are ineffective (venting sound increases in volume and pitch, tank discolors, or shows any signs of deforming), withdraw immediately to a secure position. Always stay away from tanks engulfed in fire. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode.

Disposal Method Suggested: Dissolve or mix the material with a combustible solvent and burn in a chemical incinerator equipped with an afterburner and scrubber. Do not discharge into drains or sewers. Dispose of waste material as hazardous waste using a licensed disposal contractor to an approved landfill. Consult with environmental regulatory agencies for guidance on acceptable disposal practices. Generators of waste containing this contaminant (≥100 kg/mo) must conform with EPA regulations governing storage, transportation, treatment, and waste disposal. If allowed, incineration with effluent gas scrubbing (carbon dioxide may be released) is recommended. Containers must be disposed of properly by following package label directions or by contacting your local or federal environmental control agency, or by contacting your regional EPA office. All federal, state, and local environmental regulations must be observed.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov.
- USEPA, “Reregistration Eligibility Decision (RED) Facts, Vernolate”. Office of Prevention, Pesticides and Toxic Substances, Washington DC (March 1999). http://www.epa.gov/REDs/factsheets/2735fact.pdf.
- EXTOXNET, Extension Toxicology Network, “Pesticide Information Profile, Vernolate,” Oregon State University, Corvallis, OR (September 1995). http://extoxnet.orst.edu/pips/vernolat.htm.

Vinclozolin V:0147

Use Type: Fungicide
CAS Number: 50471-44-8; 83792-61-4 (M2)
Formula: $C_{12}H_9Cl_2NO_3$; $C_{11}H_{11}Cl_2NO_2$ (M2)
Synonyms: Caswell No. 323C; (RS)-3-(3,5-Dichlorophenyl)-5-ethenyl-5-methyl-2,4-oxazolidinedione; 3-(3,5-Dichlorophenyl)-5-ethenyl-5-methyl-2,4-oxazolidinedione; 3-(3,5-Dichlorophenyl)-5-ethenyl-5-methyl-2,4-oxazolidinedione; (RS)-3-(3,5-Dichlorophenyl)-5-methyl-5-vinyl-1,3-oxazolidine-2,4-dione; *N*-3,5-Dichlorophenyl-5-methyl-5-vinyl-1,3-oxazolidine-2,4-dione; 2,4-Oxazolidinedione, 3-(3,5-dichlorophenyl)-5-ethenyl-5-methyl-; 2,4-Oxazolidinedione, 3-(3,5-dichlorophenyl)-5-methyl-5-vinyl-
Trade Names: BAS-352-F®; BAS-35204-F®; CURALAN®; FLOTILLA®; FUMITE RONALIN®; MASCOT® contact turf fungicide; ORNALIN®[C]; POWERDRIVE®; RONILAN®; RONILAN-DF®; RONALINE-FL®; TOUCHE®; VINCHLOZOLINE®; VINCLOZOLINE®; VORLAND®
Chemical class: Dicarboximide; Oxazole; Halogenated dicarboximide
EPA/OPP PC Code: 113201
California DPR Chemical Code: 2129
HSDB Number: 6747
UN/NA & ERG Number: UN3077(solid)/171
RTECS® Number: RP8530000
EC Number: 256-599-6 [*Annex I Index No.:* 607-307-00-4]
Uses: Vinclozolin is a non-systemic fungicide which has been used on vines (such as grapes), strawberries, raspberries, chicory grown for Belgian endive, lettuce, kiwi, canola, succulent beans, and dry bulb onions. Import tolerances have been established to permit. Not approved for use in EU countries[115]. Registered for use in the U.S.
U.S. Maximum Allowable Residue Levels for Vinclozolin [Revoked tolerances subject to the channel of trade provisions. The following table lists commodities with residues resulting from lawful use that are subject to the channels of trade provisions of section 408(l)(5) of the Federal Food, Drug, and Cosmetics Act (FFDCA)] [40 CFR 180.380 (e)]: cucumber 1.0 ppm; fruit, stone, except plum, prune, fresh 25.0 ppm; pepper, bell 3.0 ppm; strawberry 10.0 ppm. All other uses were revoked in 2008.
Fish toxicity (threshold)[101]: Low–396.87174000 ppb, MATC (Maximum Acceptable Toxicant Concentration)
Regulatory Authority and Advisory Information:
Carcinogenicity[83]: EPA Group C, Possible human carcinogen; EU GHS Category 2: Suspected human carcinogen
California Proposition 65 Chemical: Carcinogen and developmental toxin (8/20/1999).
Health Advisory: Mutagen, Developmental/Reproductive Toxin, Endocrine disruptor (S!)
Acute Oral Category: 4, Caution
Potential Ground Water Pollutant [California FAC Section 13145(d)/12811, active]
EPCRA Section 313 Form R *de minimis* concentration reporting level: 1.0%
European/International Regulations: Hazard Symbol: Xi, N; risk phrases: R40; R43; R51/53; R60; R61; safety phrases: S2; S45; S53; S61 (see Appendix 1)
Description: Vinclozolin and Vinclozolin (M2) are colorless or white crystalline solids or powder. Mild aromatic odor. Vinclozolin is formulated as a 50% extruded granule (EG) sold only in water-soluble packets and as a 50% dry flowable (DF) formulation for open pour[83]. Molecular weight = 286.11; Specific gravity (H_2O:1) = 1.51 @ 20°C; Freezing/Melting point = 108°C; Specific gravity (H_2O:1) = 1.51; Boiling point = 131°C @ 0.5 mmHg; Vapor pressure = 1.25×10^{-5} mmHg @ 20°C; Flash point = 177.5°C (est.). Henry's Law constant = 1.07×10^{-8} atm-m^3/mol @ 25°C (est)[83]. Practically insoluble in water; solubility = 2.6 mg/L @ 20°C[83].
Incompatibilities: Hydrolysis may occur under alkaline conditions. Incompatible with strong oxidizers and alkalies. Amides are incompatible with strong reducing agents and with azo and diazo compounds, generating flammable and toxic gases. Amides are very weak bases but react with strong bases, forming salts and reacting like an acid. The combustion of these compounds generates mixed oxides of nitrogen.
Determination in Water: Log K_{ow} = >3.0. Values above 3.0 may be able to bioaccumulate in marine organisms.
Determination in Air: Filter; none; Gravimetric; NIOSH IV[18] [Particulates NOR; #0500 (total), #0600 (respirable)]
Routes of Entry: Inhalation of dust or aerosols, ingestion, dermal and/or eye contact.
Harmful Effects and Symptoms
Short Term Exposure: May irritate eye, skin, and respiratory tract. Harmful if ingested. LD_{50} (oral, rat) => 5 g/kg; LD_{50} (dermal, rat) = >5 g/kg.
Long Term Exposure: Possible reproduction and developmental effects. Skin sensitizer.
Points of Attack: May attack prostate gland. Reproductive cells. Skin.
Medical Surveillance: This chemical is a suspected or known human carcinogen. Exposed persons should contact a physician for advice regarding the possible long term health effects and advice for medical monitoring. In

addition to comprehensive initial medical and work histories emphasizing reproductive experience and menstrual history, patient should have physical examination and testing of genito-urinary tract, sperm count, motility and morphology. If required, other tests, such as serum testosterone, serum follicle stimulating hormone (FSH), and serum lutenizing hormone (LH), may be indicated. Tests of renal and prostate function. Evaluation by a qualified allergist, including exposure history and testing, may help diagnose allergy.

First Aid: If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least 15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately. If this chemical contacts the skin, remove contaminated clothing and wash immediately with soap and water. Seek medical attention immediately. If this chemical has been inhaled, remove from exposure, begin rescue breathing (using universal precautions) if breathing has stopped, and CPR if heart action has stopped. Transfer promptly to a medical facility. When this chemical has been swallowed, get medical attention. Give large quantities of water and induce vomiting. Do not make an unconscious person vomit.

Storage: Color Code-Blue: Health Hazard/Poison: Store in a tightly closed container in a dry, well-ventilated and secure poison location. Prior to working with this chemical you should be trained on its proper handling and storage. Where possible, automatically transfer material from other storage containers to process containers. Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: Environmentally hazardous substances, solid or liquid, usually fall in Hazard Class 9.

Spill Handling: As an immediate precautionary measure, isolate spill or leak area in all directions for at least 25 meters (75 feet) for solids. For spills increase, in the downwind direction, as necessary, the isolation distance shown above. Do not touch or walk through spilled material. Stop leak if you can do it without risk. Prevent dust cloud. *Small dry spill:* with clean shovel place material into clean, dry container and cover loosely; move containers from spill area. *Large spill:* cover powder spill with plastic sheet or tarp to minimize spreading. Prevent entry into waterways, sewers, basements or confined areas.

Fire Extinguishing: Hazardous decomposition includes oxides of nitrogen, and carbon and hydrogen chloride. As an immediate precautionary measure, isolate spill or leak area in all directions for at least 50 meters/150 feet for liquids and at least 25 meters/75 feet for solids. *Fire involving storage or vehicular tanks:* isolate for 800 meters/0.5 mile in all directions; also, consider initial evacuation for 800 meters/0.5 mile in all directions. *On a small fire:* use dry chemical, CO_2, water spray or regular foam. *On a large fire:* use water spray, fog or regular foam. Do not scatter spilled material with high-pressure streams of water. Move containers from fire area if you can do it without risk. Dike fire-control water for later disposal. *Fire involving tanks:* from a secure, explosion-proof location, use water spray to cool exposed containers. If cooling streams are ineffective (venting sound increases in volume and pitch, tank discolors, or shows any signs of deforming), withdraw immediately to a secure position. Always stay away from tanks engulfed in fire. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full facepieces and are operated in a pressure-demand or other positive-pressure mode.

Disposal Method Suggested: Do not discharge effluent containing this product into lakes, streams, ponds estuaries, oceans or other waters unless in accordance with the requirements of a National Pollutant Discharge Elimination System (NPDES) permit and the permitting authority has been notified in writing prior to discharge. It is the responsibility of chemical waste generators to determine the toxicity and physical properties of a discarded chemical and to properly identify its classification and certification as a hazardous waste and to determine the disposal method. U.S. EPA guidelines for the classification determination are listed in 40 CFR Parts 261.3. Additionally, waste generators must consult and follow all regional, national, state and local hazardous waste laws to ensure complete and accurate classification and disposal methods.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- USEPA, Office of Pesticide Programs, Pesticide Residue Limits, "Vinclozolin," 40 CFR 180.380. http://www.epa.gov/pesticides/food/viewtols.html
- USEPA, "Reregistration Eligibility Decision (RED),Vinclozolin," Office of Prevention, Pesticides and Toxic Substances, Washington DC. http://www.epa.gov/REDs/2740red.pdf
- EXTOXNET, Extension Toxicology Network, "Pesticide Information Profile, Vinclozolin,." Oregon State University, Corvallis, OR (June 1996)

W

Warfarin W:0100

Use Type: Rodenticide
CAS Number: 81-81-2; 129-06-6 (sodium salt)
Formula: $C_{19}H_{16}O_4$; $C_{19}H_{15}O_4$. Na (sodium salt)
Synonyms: 3-(α-Acetonylbenzyl)-4-hydroxycoumarin; 2H-1-Benzopyran-2-one,4-hydroxy-3-(3-oxo-1-phenylbutyl)-; Coumadin; Coumarin, 3-(α-acetonylbenzyl) -4-hydroxy-; 4-Hydroxy-3-(3-oxo-1-phenylbutyl) coumarin; Kumander; Kypfarin; 3-(α-Phenyl-β-acetylethyl)-4-hydroxycoumarin; 3-(1'-Phenyl-2'-acetylethyl)-4-hydroxycoumarin; Prothromadin; Toxic chemical category code, N874
Sodium: 3-(α-Acetonylbenzyl)-4-hydroxy-coumarin sodium salt; Coumadin sodium; 4-Hydroxy-3-(3-oxo-1-phenylbutyl)-2H-1-benzopyran-2-one sodium salt; Marevan (sodium salt); Prothrombin; Sodium coumadin; Sodium warfarin
Trade Names: ARAB RAT DETH®; ATROMBINE-K®; BRUMIN®; COMPOUND 42®; D-CON®; CORAX®; DETHMORE®; EAGLES-7®; EASTERN STATES DUOCIDE®; GROVEX SEWER BAIT®; HOPKINS BAR BAIR®; HOPKINS COV-R-TOX®; HOPKINS RODEX®; KILLGERM SEWARIN P®; KILMOL®; LIQUA-TOX®; MAR-FIN®; MOUSE PAK®; PLUSBAIT®; RAT-A-WAY®; RAT-B-GON®; RAT-O-CIDE®; RAT-GARD®; RAT & MICE BAIT®; RATRON®; RATS-NO-MORE®; RATTUNAL®; RAX®; RCR SQUIRREL KILLER®; RENTOKIL®; RENTOKIL BIOTROL®; RODEX BLOX®; RODENTEX®; RODETH®; RODEX®; ROUGH & READY MOUSE MIX®; SAKARAT®; SOLFARIN®; SOREXA PLUS®; SOREX CR1®; SEWARIN®; SPRAY-TROL BRANCH®; TWIN LIGHT RAT AWAY®; RODEN-TROL®; WARFARAT®; WARF COMPOUND®; VAMPIRINIP®
Sodium Salt: ATHROMBIN®; LIQUA-TOX®; PANWARFIN®; RATSUL SOLUBLE®; TINTORANE®; VARFINE®; WARAN®; WARCOUMIN®; WARFILONE®
Chemical class: Coumarin
EPA/OPP PC Code: 086002 (warfarin); 086003 (sodium salt)
California DPR Chemical Code: 621 (warfarin); 1184 (sodium salt)
HSDB Number: 1786; None found for the sodium salt
UN/NA & ERG Number: UN3027/151
RTECS® Number: GN4550000; GN4725000 (sodium salt)
EC Number: 201-377-6 [*Annex I Index No.:* 607-056-00-0]; 204-929-4 (sodium salt)
Uses: Warfarin and its sodium salt is an anticoagulant rodenticide used for controlling rats and house mice in and around homes, animal and agricultural premises, and commercial and industrial sites. It is effective in very low dosages. About a week is required before a marked reduction in the rodent population is noticeable. Rodents do not become bait-shy after once tasting warfarin; they continue to consume it until its anti-clotting properties have produced death through internal hemorrhaging. It can be used year-after-year wherever a rodent problem exists. Warfarin and its sodium salt are only slightly dangerous to humans and domestic animals when used as directed, but care must be taken with young pigs, which are especially susceptible. The sodium salt is also used to treat people with blood hypercoagulation problems. Registered for use in EU countries[115]. Registered for use in the U.S.

Regulatory Authority and Advisory Information:
California Proposition 65 Chemical: Listed; Developmental/Reproductive Toxin (7/1/1987)
Toxicity (oral) Category 1, DANGER–POISON.
Health Advisory: Reproductive and Developmental Hazard; Endocrine disruptor (S!)
EPA Hazardous Waste Number (RCRA No.): U248, warfarin salts when present at concentrations <0.3%; P001, warfarin salts when present at concentrations >0.3%.
Superfund/EPCRA 302 Extremely Hazardous Substances: TPQ = 500/10,000 lb (227/4,540 kg) warfarin and warfarin sodium
Superfund/EPCRA 40CFR302.4 RQ: CERCLA, 100 lb (45.4 kg)
EPCRA Section 313 Form R *de minimis* concentration reporting level: 1.0%
U.S. DOT Regulated Marine Pollutant (49CFR172.101, Appendix B)
European/International Regulations (*81-81-2*): Hazard Symbol: T, N; risk phrases: R61; R48/25; R52/53; safety phrases: S2; S45; S53; S61 (see Appendix 1)
WGK (German Aquatic Hazard Class): No value assigned*
Sodium salt:
EPCRA Section 313 Form R *de minimis* concentration reporting level: 1.0%
Superfund/EPCRA 302 Extremely Hazardous Substances: TPQ = 100/10,000 lb (45.4/4,540 kg)
EPA Hazardous Waste Number (RCRA No.): U248, warfarin salts when present at concentrations <0.3%; P001, warfarin salts when present at concentrations greater than 0.3%
U.S. DOT Regulated Marine Pollutant (49CFR172.101, Appendix B)
European/International Regulations (*81-81-2*): Hazard Symbol: T, N; Risk phrases: R61; R48/25; R52/53; safety phrases: S2; S45; S53; S61 (see Appendix 1).

Description: Warfarin is a colorless, odorless crystalline solid. Although warfarin is often available commercially as the sodium salt, the following physical properties primarily refer to the pure substance. Molecular weight = 308.32; 330.33 (sodium salt); Specific gravity (H_2O:1) = 1.347 @ 20 °C; Boiling point = (decomposes); Freezing/Melting point =161.11 °C; Vapor pressure = 0.09 mmHg @ 21.7 °C[9]. LEL (Lower Explosive Limit) = 65.000 ppm (sodium salt). Henry's Law constant = 3×10^{-9} atm-m^3/mol @ 25 °C (est)[83]. Practically insoluble in water; solubility = 0.002%[NIOSH].

Incompatibilities: Strong oxidizers; strong acids; strong bases. Dust mixtures with air may cause explosion.

Permissible Exposure Limits in Air: IDLH = 100 mg/m^3
warfarin 81-81-2
OSHA PEL: 0.1 mg/m^3 TWA
NIOSH REL: 0.1 mg/m^3 TWA
ACGIH TLV®[1]: 0.1 mg/m^3 TWA
NIOSH IDLH: 100 mg/m^3
DFG MAK 0.5 mg/m^3, inhalable fraction TWA; Peak Limitation Category II(2).
Protective Action Criteria (PAC), Ver. 27[89]
PAC-1: 1.8 mg/m^3
PAC-2: 20 mg/m^3
PAC-3: 350 mg/m^3
Protective Action Criteria (PAC) (sodium salt) Ver. 27[89]
PAC-1: 0.82 mg/m^3
PAC-2: 9 mg/m^3
PAC-3: 9 mg/m^3

Determination in Air: Use NIOSH Analytical Method (IV) #5002.

Determination in Water: Log K_{ow} = <3.0. Values above 3.0 are likely to bioaccumulate in aquatic organisms.

Permissible Concentration in Water: Runoff from spills or fire control may cause water pollution.

Routes of Entry: Ingestion, inhalation, skin and/or eye contact. Absorbed through the unbroken skin; dermal contact should be avoided.

Harmful Effects and Symptoms: The onset of the symptoms of poisoning may be delayed for a few days following ingestion. Typical symptoms of poisoning include increased bleeding. Coagulation problems may be detected by laboratory analyses only. Large exposures may cause excessive bleeding from minor cuts or abrasions, bleeding from the gums and/or blood in feces. Massive internal bleeding may result in shock. A victim with anemia and/or liver disease may have more severe and persistent poisoning that may be extremely difficult to control.

Short Term Exposure: Warfarin is classified as very toxic, and may cause hemorrhage at even low levels. Probable oral lethal dose in humans is 50–500 mg/kg, between 1 teaspoon and 1 ounce for a 150 lb person. Warfarin sodium is a powerful anticoagulant. Hemorrhage is the most common sign and may be manifested by hemorrhagic skin rashes and lip, nose, and upper airway bleeding. Upper airway pain, difficulty in speaking and swallowing, and dyspnea (shortness of breath) may occur. Back pain may be noted. Other symptoms of warfarin exposure begin a few days or weeks after ingestion. They include epistaxis (nose bleed), bleeding gums, pallor, and sometimes hematomas around joints and on buttocks, blood in urine and feces; hematoma on arms, legs; bleeding lips, mucous membrane hemorrhage; petechial rash; abnormal hematologic indices. Later, paralysis due to cerebral hemorrhage, and finally hemorrhagic shock and death may occur. Acute effects: *Warfarin*: Eye, other than irritation; Hematological effects – acute, unspecified; Gastrointestinal tract; Heart, cardiovascular system; Kidney; Liver; Nervous system toxin; Narcotic; Respiratory toxin other than severe or moderate irritation. *Warfarin (sodium salt):* Hematological, unspecified; Central nervous system; Blood toxin – anemia; Narcotic. LD_{50} (oral, rat) = 1500 μg/kg; LD_{50} (dermal, rat) = >1 g/kg.

Long Term Exposure: Anemia can result from severe or repeated bleeding. Repeated exposure may affect the liver and kidneys. Material is believed to be teratogenic in humans. There is limited evidence that warfarin may decrease fertility in females. Animal tests indicates that warfarin may cause malformations in human babies. Chronic effects: *Warfarin*: Brain; *Warfarin (sodium salt)*: Hematological effects, unspecified; Bone; Gastrointestinal tract; Heart, Cardiovascular system; Kidney; Liver.

Points of Attack: Blood and cardiovascular system; brain, blood, bone, heart, kidney, liver.

Medical Surveillance: Persons with who are taking anticoagulants or are suffering from bleeding disorders must be protected from exposure. Consider the points of attack in preplacement and periodic physical examinations. Blood test for prothrombin time. Complete blood count. Persons taking “blood thinning” medications are at increased risk.

First Aid: *Emergency life-support procedures:* Acute exposure to warfarin may require decontamination and life support for the victims. Emergency personnel should wear protective clothing appropriate to the type and degree of contamination. Air-purifying or supplied-air respiratory equipment should also be worn, as necessary. Rescue vehicles should carry supplies such as plastic sheeting and disposable plastic bags to assist in preventing spread of contamination. *Inhalation exposure:* Move victims to fresh air. Emergency personnel should avoid self-exposure to warfarin. Evaluate vital signs including pulse and respiratory rate, and note any trauma. If no pulse is detected, provide CPR. If not breathing, provide artificial respiration. If breathing is labored, administer oxygen or other respiratory support. Obtain authorization and/or further instructions from the local hospital for administration of an antidote or performance of other invasive procedures. RUSH to a health care facility. *Dermal/eye exposure:* Remove victims from exposure. Emergency personnel should avoid self-exposure to warfarin. Evaluate vital signs including pulse and respiratory rate, and note any trauma. If no pulse is detected, provide CPR. If not breathing, provide artificial respiration. If breathing is labored, administer oxygen or other respiratory support. Remove contaminated clothing as soon as possible. If eye exposure has occurred, eyes must be flushed with lukewarm water for at least 15 minutes. Wash exposed skin areas twice with soap and water. Obtain authorization and/or further instructions from the local hospital for administration of an antidote or performance of other invasive procedures. RUSH to a health care facility. *Ingestion exposure:* Evaluate vital signs including pulse and respiratory rate, and note any trauma. If no pulse is detected, provide CPR. If not breathing, provide artificial respiration. If breathing is labored, administer oxygen or other respiratory support. Obtain authorization and/or further instructions from the local hospital for administration of an antidote or performance of other invasive procedures. Vomiting may be induced with syrup of ipecac. If elapsed time since ingestion of warfarin is unknown or suspected to be greater than 30 minutes, do not induce vomiting and RUSH to a health care facility. ipecac should not be administered to children under 6 months of age. ***Warning:*** Syrup of ipecac should be administered only if victims are alert, have an active gag-reflex, and show no signs of impending seizure or coma. If ANY uncertainty exists, RUSH to a health care facility. The following dosages of ipecac are recommended: children up to 1 year old, 10 mL (1/3 oz); children 1 to 12 years old, 15 mL (1/2 oz); adults, 30 mL (1 oz). Ambulate (walk) the victims and give large quantities of water. If vomiting has not occurred after 15 minutes, ipecac may be re-administered. Continue to ambulate and give water to the victims. If vomiting has not occurred within 15 minutes after second administration of ipecac, administer activated charcoal. Activated charcoal may be administered if victims are conscious and alert. Use 15 to 30 g (1/2 to 1 oz) for children, 50 to 100 g (1-3/4 to 3-1/2 oz) for adults, with 125 to 250 mL (1/2 to 1 cup) of water. Promote excretion by administering a saline cathartic or sorbitol to conscious and alert victims. Children require 15 to 30 g (1/2 to 1 oz) of cathartic; 50 to 100 g (1-3/4 to 3-1/2 oz) is recommended for adults. RUSH to a health care facility[83].

Personal Protective Methods: Applicators and other handlers must wear: Coveralls worn over long-sleeved shirt and long pants; Chemical-resistant gloves such as DuPont™ Tychem® suit fabrics, barrier laminate, or Viton®; Chemical-resistant footwear plus socks; Protective eye wear; Chemical-resistant headgear for overhead exposure; Chemical-resistant apron when cleaning equipment, mixing, or loading[83]. Agricultural Use/Engineering Controls: When handlers use closed systems, enclosed cabs, or aircraft in a manner that meets the requirements listed in the Worker Protection Standard (WPS) for agricultural pesticides, 40 CFR 170.240(d)(4-6), the handler PPE requirements may be reduced or modified as specified in the Worker Protection Standard. Firefighters should wear NIOSH-approved self-contained breathing apparatus and full protective clothing.

Respirator Selection: *Up to 0.5 mg/m^3*: Qm (APF = 25) (any quarter-mask respirator). *Up to 1 mg/m^3:* 95XQ (APF = 10) [any particulate respirator equipped with an N95, R95, or P95 filter (including N95, R95, and P95 filtering facepieces) except quarter-mask respirators. The following filters may also be used: N99, R99, P99, N100, R100, P100]; or Sa (APF = 10) (any supplied-air respirator). *Up to 2.5 mg/m^3:* Sa:Cf (APF = 25) (any supplied-air respirator operated in a continuous-flow mode); or PaprHie (APF = 25) (any powered, air-purifying respirator with a high-efficiency particulate filter). *Up to 5 mg/m^3:* 100F (APF = 50) (any air-purifying, full facepiece respirator with an N100, R100, or P100 filter); or SaT: Cf (APF = 50) (any supplied-air respirator that has a tight-fitting face-piece and is operated in a continuous-flow mode); or PaprTHie (APF = 50) (any powered, air-purifying respirator with a tight-fitting facepiece and a high-efficiency particulate filter); or SCBAF (APF = 50) (any self-contained breathing apparatus with a full facepiece); or SaF (APF = 50) (any supplied-air respirator with a full facepiece). *Up to 100 mg/m^3:* Sa: Pd,Pp (APF = 1000) (any supplied-air respirator operated in a pressure-demand or other positive-pressure mode). *Emergency or planned entry into unknown concentrations or IDLH conditions:* SCBAF: Pd,Pp (APF = 10,000) (any NIOSH/MSHA- or European Standard EN 149-approved self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode); or SaF: Pd,Pp: ASCBA (APF = 10,000) (any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary, self-contained breathing apparatus operated in a pressure-demand or other positive-pressure mode). *Escape:* 100F (APF = 50) (any air-purifying, full facepiece respirator with an N100, R100, or P100 filter); or SCBAE (any appropriate escape-type, self-contained breathing apparatus).

Storage: Color Code-Blue: Health Hazard/Poison. Store in a secure poison location. Prior to working with this chemical you should be trained on its proper handling and storage. Store in tightly closed containers in a cool, well-ventilated area away from oxidizers. Where possible, automatically transfer material from other storage containers to process containers. Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: Coumarin derivative pesticides, solid, toxic, require a shipping label of "poisonous materials." Hazard Class is 6.1.

Spill Handling: First remove all sources of ignition. Evacuate persons not wearing protective equipment from area of spill or leak until cleanup is complete. Collect powdered material in the most convenient and safe manner and deposit in sealed containers. Ventilate area after cleanup is complete. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your local or federal environmental protection agency for specific recommendations. If employees are required to clean up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable. Do not touch spilled material. Eating and smoking should not be permitted in areas where it is handled, processed or stored. *Small spills:* sweep onto paper or other suitable material. Place in an appropriate container and burn in a safe place. *Large quantities:* may be destroyed by dissolving in a flammable solvent (e.g., alcohol) and atomizing in a combustion chamber.

Fire Extinguishing: Warfarin is combustible; however, no flash point can be found. Extinguish fire using agent suitable for type of surrounding fire. Use alcohol-resistant foam, carbon dioxide; or dry chemical. Wear full protective clothing and self-contained breathing apparatus when engaged in fire-fighting. Hazardous decomposition includes oxides of sodium (warfarin sodium). If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies. From a secure, explosion-proof location, use water spray to cool exposed containers. If cooling streams are ineffective (venting sound increases in volume and pitch, tank discolors, or shows any signs of deforming), withdraw immediately to a secure position. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full face-pieces and are operated in a pressure-demand or other positive-pressure mode.

Disposal Method Suggested: Consult with environmental regulatory agencies for guidance on acceptable disposal practices. Generators of waste containing this contaminant (≥100 kg/mo) must conform with EPA regulations governing storage, transportation, treatment, and waste disposal. If allowed, consider incineration.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov.
- EXTOXNET, Extension Toxicology Network, September 1995. Pesticide Information Profile, Warfarin. Oregon State University, Corvallis, OR. http://extoxnet.orst.edu/pips/warfarin.htm.
- USEPA, June 1991. Reregistration Eligibility Decision (RED) Fact Sheet, Warfarin. Office of Pesticides and Toxic Substances, Washington DC. http://www.epa.gov/REDs/factsheets/0011fact.pdf.
- New Jersey Department of Health and Senior Services, May 1998. Hazardous Substance Fact Sheet, Warfarin. Trenton, NJ. http://www.state.nj.us/health/eoh/rtkweb/2012.pdf.
- USEPA, November 30, 1987. Chemical Profile: Warfarin. Chemical Emergency Preparedness Program, Washington DC.
- USEPA, November 30, 1987. Chemical Profile: Warfarin Sodium. Chemical Emergency Preparedness Program, Washington DC.

Z

Zilkonium chloride Z:0090

Use Type: Biocide, Algaecide, Fungicide
CAS Number: 8001-54-5
Formula: $C_6H_5CH_2N(CH_3)_2RCl$; R = mixture of alkyls
Synonyms: Alkyl dimethyl benzyl ammonium chloride [50% (C_{12}), 30% (C_{14}), 17% (C_{16}), 3% (C_{18})]; Alkyl dimethylbenzyl ammonium chloride; Alkyldimethyl(phenylmethyl) quaternary ammonium chlorides; Benzalkonium chloride; BTC; Pheneene germicidal solution and tincture; Quaternary ammonium compounds, alkylbenzyldimethyl, chlorides; Zephiran chloride
Trade Names: AMMONYX®; ARQUAD DMMCB-75®; BARQUAT® MB-50; BARQUAT® MB-80; BAYCLEAN®; BIO-QUAT 50-24®; CATAMINE® AB; CONSAN®; DRAPOLENE®; GARDIQUAT®-1450; HYAMINE®-3500; INTEXAN® LB-50; KATAMINE® AB; NEO GERM-I-TOL®; ONYX BTC; OSVAN; RODALON®; SENTINEL®; TRITON® K-60; VIKROL® RQ
Chemical class: Quarternary ammonium salt; Benzalkonium chloride compounds
California DPR Chemical Code: 5069
EPA/OPP PC Code: 069106, 069109
HSDB Number: 234 as Benzalkonium chloride compounds
UN/NA & ERG Number: UN3267/153
RTECS® Number: BO3150000
EC Number: 264-151-6 [*Annex I Index No.:* 612-140-00-5]
Uses: Used as an algaecide to control slime mold, algae, fish pathogens, and mollusks in ponds, canals and bodies of water. Also widely used in deodorants, detergents, sanitizers and germicides for applications in food plants, laundries, and operating rooms. Not listed for use in EU countries[115]. Registered for use in the U.S. but not California.
U.S. Maximum Allowable Residue Levels for Quaternary ammonium compounds, alkyl (C12-C18) benzyldimethyl, chlorides are included on this list. [40 CFR 180.940(a)]: Residues of the following chemical substances are exempted from the requirement of a tolerance when used in accordance with good manufacturing practice as ingredients in an antimicrobial pesticide formulation, provided that the substance is applied on a semi-permanent or permanent food-contact surface (other than being applied on food packaging) with adequate draining before contact with food. (a) The following chemical substances when used as ingredients in an antimicrobial pesticide formulation may be applied to: Food-contact surfaces in public eating places, dairy-processing equipment, and food-processing equipment and utensils. Limit: When ready for use, the end-use concentration of all quaternary chemicals in the solution is not to exceed 200 ppm of active quaternary compound. ***[40 CFR 180.940(c)]*** Residues of the following chemical substances are exempted from the requirement of a tolerance when used in accordance with good manufacturing practice as ingredients in an antimicrobial pesticide formulation, provided that the substance is applied on a semi-permanent or permanent food-contact surface (other than being applied on food packaging) with adequate draining before contact with food. (c) Chemical substances when used as ingredients in an antimicrobial pesticide formulation may be applied to food-processing equipment and utensils. Limits: When ready for use, the end-use concentration of this specific quaternary compound is not to exceed 200 ppm within the end-use total concentration that is not to exceed 400 ppm active quaternary compound.
Regulatory Authority and Advisory Information: Health Advisory: Mutagen, Developmental/Reproductive Toxin, Skin irritant/sensitizer
European/International Regulations: Hazard Symbol: Xn, H, N; risk phrases: R21/22; R34; R50; safety phrases: S2; S36/37/39; S45; S61 (see Appendix 1)
Description: White to yellowish-white amorphous powder; or clear, colorless liquid or off-white paste. Colorless. Aromatic odor, bitter taste. This material is probably combustible. Molecular weight = 424.15; Specific gravity (H_2O:1) = 0.977 @ 20°C; Freezing/Melting point = 34.5°C; Hazard Identification (based on NFPA-704M Rating System): Health 3, Flammability 0, Reactivity 0. Very soluble in water; forms an alkaline solution.
Incompatibilities: Corrosive; hygroscopic. Keep away from moisture, strong oxidizers; acids. When heated to decomposition or on contact with acids or acid fumes, may produce highly toxic chloride fumes. Deadly phosgene gas may be formed. In the presence of moisture, may cause pitting of some metals.
Routes of Entry: Inhalation, dermal and/or eye contact.
Harmful Effects and Symptoms
There have been nearly 2700 incidents reported to the Opp incident data system (ids) and the California Department of Pesticide Regulation from 1982 to 2004 associated with exposure to end-use products containing quaternary ammonium compounds: Most of the incidents are related to dermal, ocular and inhalation irritation. Allergic-type reaction has also been reported in some incidents[83].
Short Term Exposure: Corrosive. Can severely irritate skin, eyes and respiratory tract. Central nervous system poison can cause depression, seizures, shock, and coma and respiratory collapse. Ingestion can cause abdominal pain, vomiting and diarrhea. Ingestion of concentrated solutions may produce burns of the mouth, throat, and stomach; necrosis and peritonitis of the G.I. tract may occur. Inhalation can cause difficult breathing and possibly

result in pulmonary edema, a medical emergency that can be delayed for hours. Severe exposure can cause lung damage and possible respiratory muscle paralysis. Low blood oxygen (hypoxemia) may occur. Dermal contact may cause allergic contact dermatitis. High levels of exposure may cause respiratory failure and/or cardiovascular collapse. It also may cause renal failure. LD_{50} (oral, rat) = 240 mg/kg.
Long Term Exposure: Neurotoxic. May damage the central nervous system. This material is toxic to the kidneys, liver, heart, gastrointestinal tract. Prolonged or continuous lung exposure may cause occupational asthma. May cause contact dermatitis; allergy.
Points of Attack: Kidney, liver, heart, central nervous system, lungs, gastrointestinal tract; skin.
Medical Surveillance: Medical observation is recommended for 24 to 48 hours following breathing overexposure, as pulmonary edema may be delayed. Evaluation by a qualified allergist, including exposure history and testing, may help diagnose allergy. Exposed persons should contact a physician for advice regarding the possible long term health effects and advice for medical monitoring.
First Aid: Eyes: First check the victim for contact lenses and remove if present. Flush victim's eyes with water or normal saline solution for 20 to 30 minutes while simultaneously calling a hospital or poison control center. Do not put any ointments, oils, or medication in the victim's eyes without specific instructions from a physician. *Immediately* transport the victim after flushing eyes to a hospital even if no symptoms (such as redness or irritation) develop. Skin: *Immediately* flood affected skin with water while removing and isolating all contaminated clothing. Gently wash all affected skin areas thoroughly with soap and water. If symptoms such as redness or irritation develop, *immediately* call a physician and be prepared to transport the victim to a hospital for treatment. Inhalation: *Immediately* leave the contaminated area; take deep breaths of fresh air. If symptoms (such as wheezing, coughing, shortness of breath, or burning in the mouth, throat, or chest) develop, call a physician and be prepared to transport the victim to a hospital. Provide proper respiratory protection to rescuers entering an unknown atmosphere. Whenever possible, self-contained breathing apparatus (SCBA) should be used; if not available, use a level of protection greater than or equal to that advised under Protective Clothing. Ingestion: *Do not induce vomiting.* If the victim is conscious and not convulsing, give 1 or 2 glasses of water to dilute the chemical and *immediately* call a hospital or poison control center. Be prepared to transport the victim to a hospital if advised by a physician. If the victim is convulsing or unconscious, do not give anything by mouth, ensure that the victim's airway is open and lay the victim on his/her side with the head lower than the body. *Do not induce vomiting. Immediately* transport the victim to a hospital[NTP].
Personal Protective Methods: Smoking, eating, and drinking before washing should be absolutely prohibited when any pesticide is being handled or used. Applicators and other handlers must wear: Coveralls worn over long-sleeved shirt and long pants; Chemical-resistant gloves such as DuPont™ Tychem® suit fabrics, barrier laminate, or Viton®; Chemical-resistant footwear plus socks; Protective eye wear; Chemical-resistant headgear for overhead exposure; Chemical-resistant apron when cleaning equipment, mixing, or loading[83]. Agricultural Use/ Engineering Controls: When handlers use closed systems, enclosed cabs, or aircraft in a manner that meets the requirements listed in the Worker Protection Standard (WPS) for agricultural pesticides, ***40 CFR 170.240(d)(4-6)***, the handler PPE requirements may be reduced or modified as specified in the Worker Protection Standard.
Respirator Selection: Where the neat (undiluted) test chemical is weighed and diluted, wear a NIOSH-approved half-face respirator equipped with an organic vapor/acid gas cartridge (specific for organic vapors, HCl, acid gas and SO_2) with a dust/mist filter[88].
Storage: Color Code-White: Corrosive or Contact Hazard; Store refrigerated and separately in a corrosion-resistant location. Prior to working with this chemical you should be trained on its proper handling and storage. Store in tightly closed containers in a cool, well-ventilated area away from incompatible materials listed above. Metal containers involving the transfer of this chemical should be grounded and bonded. Drums must be equipped with self-closing valves, pressure vacuum bungs, and flame arresters. Use only non-sparking tools and equipment, especially when opening and closing containers of this chemical. If this material contains a flammable carrier, sources of ignition, such as smoking and open flames, are prohibited where this chemical is used, handled, or stored in a manner that could create a potential fire or explosion hazard. Wherever this chemical is used, handled, manufactured, or stored, use explosion-proof electrical equipment and fittings. Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.
Shipping:: Corrosive liquid, basic, organic, n.o.s. materials require a label of "CORROSIVE MATERIAL." It falls in Hazard Class 8 and Packing Group I, II or III, depending on concentration. Technical name required.
Spill Handling: Wear safety goggles, full work clothing and impervious gloves and boots. If vapors are present, wear a NIOSH- or CEN (UK)-approved respiratory protection. As an immediate precautionary measure, isolate spill or leak area in all directions for at least 50 meters/150 feet for liquids and at least 25 meters/75 feet for solids. Increase, in the downwind direction, as necessary, the isolation distance shown above. If you spill this chemical, you should dampen the solid spill material with water, then transfer the dampened material to a suitable container. Use absorbent paper dampened with water to pick up any remaining material. If you spill a liquid, the floor area may be slippery. Contain spills with inert material such as dry earth or dry sand. Scoop into containers and seal up for proper disposal in accordance with all local, state, and federal laws. Seal your contaminated clothing and the

absorbent paper in a vapor-tight plastic bag for eventual disposal. Wash all contaminated surfaces with a strong soap and water solution. Do not reenter the contaminated area until the Safety Officer (or other responsible person) has verified that the area has been properly cleaned.

Fire Extinguishing: When heated to decomposition the material may produce highly toxic amine, ammonia, hydrogen chloride, and organic chloride fumes; toxic and flammable phosgene gas may be released. Use dry chemical, alcohol-resistant foam, carbon dioxide, or water fog. In fire use water spray to knock down fumes. *Fire involving storage or vehicular tanks:* isolate for 800 meters/0.5 mile in all directions; also, consider initial evacuation for 800 meters/0.5 mile in all directions. For emergency situations, wear a positive-pressure, pressure-demand, full facepiece self-contained breathing apparatus (SCBA) or pressure-demand supplied air respirator with escape SCBA and a fully encapsulating, chemical-resistant suit. Heated vapors may travel to source of ignition and flash back.

Disposal Method Suggested: High-temperature incineration. In accordance with 40CFR165, follow recommendations for the disposal of pesticides and pesticide containers. Must be disposed properly by following package label directions or by contacting your local or federal environmental control agency, or by contacting your regional EPA office.

References:

- United States National Library of Medicine, National Institutes of Health, Hazardous Substance Data Bank (HSDB), Toxicology Data Network®, Bethesda, MD. http://toxnet.nlm.nih.gov
- ESIS (European Chemical Substance Information system)

Zinc phosphide Z:0150

Use Type: Rodenticide

CAS Number: 1314-84-7

Formula: P_2Zn_3; Zn_3P_2

Alert: Metallic phosphides on clothes, skin, or hair can react with water or moisture to generate phosphine gas. Vomitus containing phosphides can also off-gas phosphine. Phosphine is extremely flammable and explosive; it may ignite spontaneously on contact with air.

Synonyms: Fosfuro de zinc (Spanish); Phosvin

Trade Names: BAKER BRAND®[C]; BLUE-OX®; E-Z FLO®[C]; GOPHA-RID®; HOPKINS®; KILRAT®; MOLETOX II®; MOUS-CON®; MR. KILL RAT®; MR RAT GUARD®; NOTT ZINC PHOSPHIDE 93®; RATOL®; ROBAN II AG®[C]; RUMETAN®; ZINC-TOX®; ZP®

Chemical class: Inorganic toxic metals

EPA/OPP PC Code: 088601

California DPR Chemical Code: 626

HSDB Number: 1059

UN/NA & ERG Number: UN1714/139

RTECS® Number: ZH4900000

EC Number: 215-244-5 [*Annex I Index No.:* 015-006-00-9]

Uses: A U.S. EPA restricted Use Pesticide (RUP). Registered for use in EU countries[115]. Zinc phosphide reacts with the acidic conditions in the gut to form phosphine gas, which interferes with cell respiration. The rodenticide may be used to control many species of rodents, including mice, ground squirrels, prairie dogs, voles, moles, rats, muskrats, nutria and gophers. It may be used as an indoor or outdoor spot treatment for rodents as well as around burrows or underground in orchards, vineyards, various food crops, range lands, and non-crop areas. Zinc phosphide is formulated as a bait/solid, dust, granular, pellet/tablet or wettable powder and is also applied as a broadcast treatment by ground or aerial applications.

U.S. Maximum Allowable Residue Levels for Zinc phosphide [40 CFR 180.225(a)(1)]: Note: The following residue limits are for phosphine compounds that produce phosphine gas: ***[40 CFR 180.284(a)]:*** alfalfa, forage 0.2 ppm; alfalfa, hay 0.2 ppm; barley, grain 0.05 ppm; barley, hay 0.2 ppm; barley, straw 0.2 ppm; bean, dry, seed 0.05 ppm; beet, sugar, roots 0.05 ppm; beet, sugar, tops 0.2 ppm; grape 0.01 ppm; grass (rangeland) 0.1 ppm; potato 0.05 ppm; sugarcane, cane 0.01 ppm; timothy, hay 0.5 ppm; timothy, forage 0.5 ppm; wheat, forage 0.05 ppm; wheat, grain 0.05 ppm; wheat, hay 0.05 ppm; wheat, straw 0.05 ppm. ***[40 CFR 180.284(c)]:*** artichoke, globe 0.01 ppm; beet, sugar, roots 0.04 ppm; beets, sugar, tops 0.02 ppm.

Regulatory Authority and Advisory Information:

Toxicity (oral) Category 1, DANGER–POISON (human, fatal <1 teaspoon/5 g)

EPA chronic reference dose (cRfD) for zinc phosphide is = 0.0001 mg/kg/day

Clean Water Act: Section 311 Hazardous Substances/RQ 40CFR117.3 (same as CERCLA, see below); 40CFR401.15 Section 307 Toxic Pollutants; Section 313 Water Priority Chemicals (57FR41331, 9/9/92)

Safe Drinking Water Act: SMCL, 5 mg/L; Priority List (55 FR 1470) as zinc

EPA Hazardous Waste Number (RCRA No.): P122 (concentrations equal to 10% or more); U249 (concentrations of 10% or less)

Superfund/EPCRA 302 Extremely Hazardous Substances: TPQ = 500 lb (227kg)

Superfund/EPCRA 40CFR302.4 RQ: CERCLA, 100 lb (45.4 kg), when present at concentrations greater than 10%

AB 2588-Air Toxics “Hot Spots” Chemicals (CAL) as zinc compounds

EPCRA Section 313 (Category N982, Zinc compounds) Form R *de minimis* concentration reporting level: 1.0%

European/International Regulations: Hazard Symbol: T+, H, F, N; risk phrases: R15/29; R28; R32; R50/53; safety phrases: S1/2; S3/9/14; S28; S30; S36/37; S43; S45; S60; S61 (see Appendix 1)

WGK (German Aquatic Hazard Class): 3-Severe hazard to waters.

Description: Zinc phosphide is a dark gray to black crystalline solid, powder or paste. Mild garlic odor. Flammable solid. Molecular weight = 258.1; Specific gravity

(H_2O:1) = 4.55 @ 13°C; Boiling point = 1100°C; Freezing/Melting point = 420°C; Vapor pressure = 1×10^{-7} mmHg @ 25 °C. Hazard Identification (based on NFPA-704M Rating System): Health 3, Flammability 3, Reactivity 1, Practically insoluble in water; slowly decomposes, releasing toxic and flammable fumes of phosphine gas.

Incompatibilities: Reacts with water. See above. A strong reducing agent; violent reaction with strong oxidizers. Decomposes on contact with water and acids and when heated, releasing spontaneously flammable phosphine as well as toxic fumes of phosphorus and oxides of zinc. Incompatible with carbon dioxide, halogenated agents. Slightly corrosive to some metals. Contact with metals may evolve flammable hydrogen gas. Containers may explode when heated or if contaminated with water[ERG].

Permissible Exposure Limits in Air:

NIOSH[2] IDLH = 50 ppm.

OSHA[2] PEL = 0.3 ppm TWA

Protective Action Criteria (PAC) Ver. 27[89]

PAC-1: 0.091 ppm

PAC-2: $\mathbf{1}_{\mathbf{A}}$ ppm

PAC-3: $\mathbf{1.8}_{\mathbf{A}}$ ppm

Subscript "**A**" signifies 60-minute AEGL (Acute Emergency Guideline Level) values.

Permissible Concentration in Water: Canadian Drinking Water Standards: AO ≤ 5.0 mg[Zn]/L. The USEPA[6] recommends that drinking water should contain not >5 milligrams per liter of water (5 mg/L) because of taste.

Determination in Water: Water slowly decomposes zinc phosphide, releasing phosphine poisonous and flammable gas.

Routes of Entry: Inhalation, ingestion, eye and/or dermal and/or eye contact. Absorbed through the unbroken skin.

Harmful Effects and Symptoms

The vomitus, feces, and sometimes the breath may have a decaying fish odor. Warning: Highly toxic phosphine gas may evolve from vomitus and feces of victim. Acute symptoms of oral ingestion include nausea, abdominal pain, tightness in the chest, excitement, agitation, and chills. Signs of severe poisoning include labored breathing, shock, halted urine output, metabolic acidosis, muscle cramps, and convulsions. The compound's caustic action may cause the esophagus to close. Inhalation of zinc phosphide dust is followed in several hours by vomiting, diarrhea, bluing of the skin, rapid pulse, fever, and shock[83].

Short Term Exposure: Serious health hazard. Poisonous if ingested. Irritates the respiratory tract. Contact with the eyes can cause severe irritation, burns, photophobia, and possible permanent damage. Dermal contact causes irritation. This chemical is a central nervous system depressant. Inhalation of zinc phosphide dust is followed in several hours by vomiting, diarrhea, cyanosis (bluing of skin), rapid pulse, fever and shock. The breath smells of phosphine. The compound is very caustic and may cause closing of the esophagus. Inhalation of phosphine (formed when zinc phosphide is exposed to flame, water or acids) can cause pulmonary edema, a medical emergency that can be delayed for several hours. This can cause death. Zinc phosphide is very caustic when ingested and forms phosphine. Extensive liver damage and kidney damage can occur. Ingestion of 4–5 grams has produced death in human adults, but also doses of 25 to 50 grams have been survived. The lowest oral lethal dose reported for women is 80 mg/kg. Symptoms of oral ingestion include nausea, abdominal pain, vomiting, tightness in chest, excitement, agitation and chills; faintness, weakness, dyspnea, fall in blood pressure, change in pulse rate, diarrhea, intense thirst, convulsions, paralysis, and coma. Early labored breathing, shock, halted urinary output, metabolic acidosis, muscle cramps and convulsions are grave prognostic signs. LD_{50} (oral, rat) = 21 mg/kg[83]; LD_{50} (dermal, rat) = >900 mg/kg.

Long Term Exposure: The substance may cause effects on the liver, kidneys, heart, and nervous system. Repeated low exposure causes chronic poisoning, anemia, bronchitis, and gastrointestinal, visual, speech, and motor disturbances.

Points of Attack: Lungs, liver, kidneys, heart, blood and central nervous system.

Medical Surveillance: There are tests available to measure zinc in your blood, urine, hair, saliva, and feces. High levels of zinc in the feces can mean high recent zinc exposure. High levels of zinc in the blood can mean high zinc consumption and/or high exposure. Tests to measure zinc in hair may provide information on long-term zinc exposure; however, the relationship between levels in your hair and the amount of zinc you were exposed to is not clear. Liver and kidney function tests. EKG. Lung function tests. Consider chest x-ray following acute overexposure. Complete blood count.

First Aid: *Emergency life-support procedures:* Acute exposure to zinc phosphide may require decontamination and life support for the victims. Emergency personnel should wear protective clothing appropriate to the type and degree of contamination. Air-purifying or supplied-air respiratory equipment should also be worn, as necessary. Rescue vehicles should carry supplies such as plastic sheeting and disposable plastic bags to assist in preventing spread of contamination. *Inhalation exposure:* Move victim to fresh air. Emergency personnel should avoid self-exposure to zinc phosphide. Evaluate vital signs including pulse and respiratory rate and note any trauma. If no pulse is detected, provide CPR. If not breathing, provide artificial respiration. If breathing is labored, administer 100% humidified oxygen or other respiratory support. Rush to a health care facility. Obtain authorization and/or further instructions from the local hospital for performance of other invasive procedures. *Dermal/eye exposure:* Remove victims from exposure. Emergency personnel should avoid self-exposure to zinc phosphide. Evaluate vital signs including pulse and respiratory rate, and note any trauma. If no pulse is detected, provide CPR. If not breathing, provide artificial respiration. If breathing is labored, administer 100% humidified oxygen or other respiratory support. Remove contaminated clothing as soon as possible. If eye exposure has occurred, eyes must be flushed with lukewarm water for at least 15 minutes.

Wash exposed skin areas thoroughly with soap and water. Rush to a health care facility. *Ingestion exposure:* Evaluate vital signs including pulse and respiratory rate, and note any trauma. If no pulse is detected, provide CPR. If not breathing, provide artificial respiration. If breathing is labored, administer 100% humidified oxygen or respiratory support. Rush to a health care facility. DO NOT induce vomiting or attempt to neutralize[83]. If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least 15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately. If this chemical contacts the skin, remove contaminated clothing and wash immediately with soap and water. Seek medical attention immediately. If this chemical has been inhaled get medical attention for phosphine (IDLH level = 50 ppm), remove from exposure, begin rescue breathing (using universal precautions) if breathing has stopped, and CPR if heart action has stopped. Transfer promptly to a medical facility. If the zinc salt is ingested, get medical attention for phosphine poisoning. Give one tablespoonful of mustard in a glass of warm water; repeat until vomit fluid is clear; avoid use of all oils. Do not make an unconscious person vomit. Medical observation is recommended for at least 24 to 48 hours following breathing overexposure, as pulmonary edema may be delayed. Death from phosphine may occur following convulsions, which may occur suddenly after apparent recovery of patient.

Note to physician or authorized medical personnel: In cases of zinc salt ingestion, empty stomach with emetics or gastric lavage with 1:5000 solution of potassium permanganate. As first aid for pulmonary edema, a physician or authorized paramedic may consider administering a corticosteroid spray.

Advanced treatment for phosphine exposure: In cases of respiratory compromise secure airway and respiration via endotracheal intubation. If not possible, perform cricothyroidotomy if equipped and trained to do so. Treat patients who have bronchospasm with aerosolized bronchodilators. The use of bronchial sensitizing agents in situations of multiple chemical exposures may pose additional risks. Consider the health of the myocardium before choosing which type of bronchodilator should be administered. Cardiac sensitizing agents may be appropriate; however, the use of cardiac sensitizing agents after exposure to certain chemicals may pose enhanced risk of cardiac arrhythmias (especially in the elderly). Consider racemic epinephrine aerosol for children who develop stridor. Dose 0.25–0.75 mL of 2.25% racemic epinephrine solution in 2.5 cc water, repeat every 20 minutes as needed, cautioning for myocardial variability. Patients who are comatose, hypotensive, or having seizures or cardiac arrhythmias should be treated according to advanced life support protocols. If evidence of shock or hypotension is observed begin fluid administration. For adults, bolus 1000 mL/hour intravenous saline or lactated Ringer's solution if blood pressure is under 80 mmHg; if systolic pressure is over 90 mmHg, an infusion rate of 150 to 200 mL/hour is sufficient. For children with compromised perfusion administer a 20 mL/kg bolus of normal saline over 10 to 20 minutes, then infuse at 2 to 3 mL/kg/hour.

Personal Protective Methods: Wear protective gloves and clothing to prevent any reasonable probability of dermal and/or eye contact. Safety equipment suppliers/manufacturers can provide recommendations on the most protective glove/clothing material for your operation. All protective clothing (suits, gloves, footwear, headgear) should be clean, available each day, and put on before work. Contact lenses should not be worn when working with this chemical. Wear dust-proof chemical goggles and face shield unless full facepiece respiratory protection is worn.

Respirator Selection: Where potential exists for exposures to zinc dusts, use a NIOSH/MSHA- or European Standard EN149-approved respirator equipped with particulate (dust/fume/mist) filters. Particulate filters must be checked every day before work for physical damage, such as rips or tears, and replaced as needed. Where potential for high exposure exists, use a NIOSH/MSHA- or European Standard EN149-approved supplied-air respirator with a full facepiece operated in the positive-pressure mode, or with a full facepiece, hood, or helmet in the continuous-flow mode; or use a NIOSH/MSHA- or European Standard EN149-approved self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive-pressure mode.

Storage: (1) Color Code-Yellow Stripe (*strong reducing agent*): Reactivity Hazard; Store separately in a area isolated from flammables, combustibles, or other yellow-coded materials. Color Code-Red Stripe: Flammability Hazard: Store separately from all other flammable materials. Prior to working with this chemical you should be trained on its proper handling and storage. Before entering confined space where this chemical may be present, check to make sure that an explosive concentration does not exist. Store in tightly closed containers in a cool, well-ventilated area away from chlorine compounds, oxidizing agents, and combustible materials. Sources of ignition, such as smoking and open flames, are prohibited where this chemical is handled, used, or stored, Use only non-sparking tools and equipment, especially when opening and closing containers. Wherever this chemical is used, handled, manufactured, or stored, use explosion-proof electrical equipment and fittings. Piping should be electrically bonded and grounded. Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: Zinc phosphide requires a shipping label of "Dangerous when wet material, poisonous materials." It falls in Hazard Class 4.3, Subsidiary Risks: 6.1. Label 4.3, 6.1.

Spill Handling:

Small spills (from a small package or a small leak from a large package)

when spilled in water:

First: Isolate in all directions (feet/meters) 200/60
Then: Protect persons downwind (miles/kilometers)
Day 0.2/0.3
Night 0.6/1.4

Large spills (from a large package or from many small packages)

First: Isolate in all directions (feet/meters) 1500/
Then: Protect persons downwind (miles/kilometers)
Day 1.3/2.1
Night 4.6/7.4

Clean up and disposal must be supervised by a specialist. For spills, clean up and emergency situations, wear a positive-pressure, pressure-demand, full facepiece self-contained breathing apparatus (SCBA) or pressure-demand supplied-air respirator with escape SCBA and a fully encapsulating, chemical-resistant suit. DuPont™ Tychem® has been suggested in the literature. Eliminate all ignition sources. Avoid touching or walking through spilled material. Stop leak if you can do it without risk. Avoid getting water on spilled substance or inside containers. Use water spray to reduce vapors or divert vapor cloud drift. Avoid allowing water runoff to contact spilled material. Cover small spills with noncombustible and DRY materials such as lime, earth, sand or soda ash followed with plastic sheet to minimize spreading or contact with rain. Dike for later disposal; do not apply water unless directed to do so[ERG].

Fire Extinguishing: Flammable solid. Water or moisture reacts with this chemical, releasing phosphine, a spontaneously flammable and poisonous gas. Reaction with water may generate high heat that will increase the concentration of fumes in the air. Hazardous decomposition includes metal fumes, zinc oxide, and sulfur oxide and other poisonous fumes are released in heat of fire. Zinc fume may be released in fire situations and may cause "metal fume fever"[17]. fire may restart after it has been extinguished. Vapors may accumulate in confined areas (basement, tanks, hopper/tank cars etc.). Contact with metals may evolve flammable hydrogen gas. Containers may explode when heated or if contaminated with water. Runoff from fire control or dilution water may be corrosive and/or toxic and cause pollution. As an immediate precautionary measure, isolate spill or leak area in all directions for at least 50 meters/150 feet for liquids and at least 25 meters/75 feet for solids. *Fire involving tanks, tank trucks or vehicle loads:* isolate for 800 meters/0.5 mile in all directions; also, consider initial evacuation for 800 meters/0.5 mile in all directions. Wear protective suits, gloves, boots, and self-contained breathing apparatus when fighting fires involving zinc phosphide. Approach fire from upwind, stay out of low areas, to avoid hazardous vapors and toxic decomposition products[17]. *DO NOT* use carbon dioxide or halogenated extinguishing agents (as phosphine gas will be released). *Small fire:* CO_2, dry chemical, dry sand/clay/ground limestone, alcohol-resistant foam. *Large fire:* water spray, fog or alcohol-resistant foam. *Note:* some foams will react with the material and release corrosive/toxic gases. Move containers from fire area if you can do it without risk. Use water spray or fog; do not use straight streams. Dike fire-control water for later disposal; do not scatter the material. *Fire involving tanks or car/trailer loads:* fight fire from maximum distance or use unmanned hose holders or monitor nozzles. Do not get water inside containers. Cool containers with flooding quantities of water until well after fire is out. Withdraw immediately in the case of rising sound from venting safety devices or discoloration of tank. *Always* stay away from tanks engulfed in fire.

Disposal Method Suggested: Zinc phosphide is a poor candidate for incineration[83]. Generators of waste (equal to or greater than 100 kg/mo) containing this contaminant, EPA hazardous waste number P122, U249, must conform with USEPA regulations in storage, transportation, treatment and disposal of waste ***[40 CFR 240-280, 300-306, 702-799 (7/1/2006)]***. Must be supervised and handled by a specialist.

References:

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- USEPA, "Reregistration Eligibility Decision (RED) Fact Sheet, Zinc Phosphide," Office of Pesticides and Toxic Substances, Washington DC (July 1998). http://www.epa.gov/REDs/0026red.pdf
- New Jersey Department of Health and Senior Services, "Hazardous Substance Fact Sheet, Zinc Phosphide," Trenton, NJ (May 2000). http://www.state.nj.us/health/eoh/rtkweb/2041.pdf
- Sax, N. I., Ed., "Dangerous Properties of Industrial Materials Report," 5, No. 5, 103-106 (1985)
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- Pohanish, R. P., "Rapid Guide to Hazardous Chemicals in the Environment," Van Nostrand Reinhold, New York, NY (1997)
- Agency for Toxic Substances and Disease Registry, U.S. Department of Health and Human Services, Public Health Service, "Managing Hazardous Materials Incidents," Atlanta, GA (June 2003)
- Gervais, J. A; Luukinen, B.; Buhl, K.; Stone, D., *Zinc Phosphide/Phosphine Technical Fact Sheet*; National Pesticide Information Center, Oregon State University Extension Services, Corvallis OR (2010)

Ziram Z:0158

Use Type: Fungicide, Microbiocide, Animal repellant
CAS Number: 137-30-4

Formula: $C_6H_{12}N_2S_4Zn$

Synonyms: Amyl zimate; Antrene bis(dimethyl carbamodithioato-*s,s'*)zinc; Carbamic acid, dimethyldithio-, zinc salt; Carbazinc; Carbamodithioic acid, dimethyl-, zinc salt; Dimethylcarbamodithioic acid, zinc complex; Dimethylcarbamodithioic acid, zinc salt; Dimethylcarbamate, zinc salt; Dimethylcarbamo dithiocarbamic acid, zinc salt; ENT 988; Methyl zimate; Methyl ziram; NCI-C50442; Zinc bis(dimethyldithio carbamate); Zinc bis(dimethyldithiocarbamoyl)disulphide; Zinc dimethyldithiocarbamate; Zinc, bis(dimethylcarbamodithioato-*s,s'*)-, (T-4)-; Zinkcarbamate; Zinc *N,N*-dimethyldithiocarbamate; ZnDMDC

Trade Names: AAPROTECT®; AAVOLEX®; AAZIRA®; ACCELERATOR®-L; ACCELERATOR® MZ® Powder; ACETO ZDED®; ACETO ZDMD®; ALCOBAM ZM®; ANCANZATE ME®; CARBAZINC®; CIRAM®; CORONA COROZATE®; COROZATE®; CUMAN®; CUMAN L®; CYMATE®; DRUPINA® 90; EPTAC-1®; FUCLASIN®; FUCLASIN® ULTRA; FUKLASIN®; FUNGOSTOP®; HERMAT ZDM®; HEXAZIR®; KARBAM WHITE®; KYPZIN®; METHASAN®; METHAZATE®; MEXENE®; MEZENE®; MILBAM®; MILBAN®; MOLURAME®; MYCRONIL®; OCTOCURE ZDM-50®; ORCHARD® BRAND ZIRAM; PERKACIT ZDMC®; POMARSOL® Z FORTE; PRODARAM®; PROKIL® Ziram; RHODIACID®; SOXINAL®-PZ; SOXINOL®-PZ; TRICARBAMIX Z®; TSIMAT®; TSIRAM® (Russian); ULTRA ZINC DMC®; VANCIDE® MZ-96; VANCIDE® 51Z Dispersion (with Zinc 2-mercaptobenzothiazolate); VANCIDE® 51Z Dispersion (with Ziram); ZERLATE®; ZINCMATE®; ZIMATE®; ZIMATE®; METHYL®; ZIRAMVIS®; ZIRASAN®; ZIRBERK®; ZIREX 90®; ZIRIDE®; ZIRTHANE®; ZITOX®

Chemical class: Dithiocarbamate

EPA/OPP PC Code: 034805

California DPR Chemical Code: 629

HSDB Number: 1788

UN/NA & ERG Number: UN2771(solid)/151

RTECS® Number: ZH0525000

EC Number: 205-288-3 [*Annex I Index No.:* 006-012-00-2]

Uses: Ziram is an agricultural fungicide registered to control fungal diseases on a wide range of crops including stone fruits, pome fruits, nut crops, vegetables and commercially grown ornamentals, and as a soil and seed treatment. In addition, it is formulated as a bird and rabbit repellent for outdoor foliar applications to ornamentals. Registered for use in EU countries[115]. Registered for use in the U.S.

U.S. Maximum Allowable Residue Levels for the fungicide Ziram, calculated as zinc ethylenebisdithiocarbamate [40 CFR 180.116]: in or on raw agricultural commodities: apples 7 ppm; apricots 7 ppm; beans 7 ppm; beets (with or without tops) or beet greens alone 7 ppm; blackberries 7 ppm; blueberries (huckleberries) 7 ppm; boysenberries 7 ppm; broccoli 7 ppm; brussels sprouts 7 ppm; cabbage 7 ppm; carrots 7 ppm; cauliflower 7 ppm; celery 7 ppm; cherries 7 ppm; collards 7 ppm; cranberries 7 ppm; cucumbers 7 ppm; dewberries 7 ppm; eggplants 7 ppm; gooseberries 7 ppm; grapes 7 ppm; kale 7 ppm; kohlrabi 7 ppm; lettuce 7 ppm; loganberries 7 ppm; melons 7 ppm; nectarines 7 ppm; onions 7 ppm; peaches 7 ppm; peanuts 7 ppm; pears 7 ppm; peas 7 ppm; peppers 7 ppm; pumpkins 7 ppm; quinces 7 ppm; radishes (with or without tops) or radish tops 7 ppm; raspberries 7 ppm; rutabagas (with or without tops) or rutabaga tops 7 ppm; spinach 7 ppm; squash 7 ppm; strawberries 7 ppm; summer squash 7 ppm; tomatoes 7 ppm; turnips (with or without tops) or turnip greens 7 ppm; and youngberries, in or on almonds 0.1 ppm and pecans 0.1 ppm.

Human toxicity (long-term)[101]: Very low–140.00 ppb, Health Advisory.

Fish toxicity (threshold)[101]: Extra high–0.6214300 ppb, MATC (Maximum Acceptable Toxicant Concentration)

Regulatory Authority and Advisory Information:

Carcinogenicity[83]: EPA, Suggestive evidence of carcinogenicity, but not sufficient to assess human carcinogenic potential; Likely to be Carcinogenic to Humans. IARC: Group 3, unclassifiable as to human carcinogenicity

Acute Oral Category: 2, WARNING.

Health Advisory: Mutagen, Developmental & Reproductive Toxin (TRI), Very toxic by Inhalation (EU)

US/ADI (Acceptable Daily Intake) = 0.0125 mg/kg/day[16]

Clean Water Act: Section 307 Toxic Pollutants, as zinc and compounds

Safe Drinking Water Act: SMCL, 5 mg/L; Priority List (55 FR 1470), as zinc

AB 2588-Air Toxics "Hot Spots" Chemicals (CAL) as zinc compounds

EPA Hazardous Waste Number (RCRA No.): P205 (Ziram)

Superfund/EPCRA 40CFR302.4 RQ: CERCLA, 1 lb (0.454 kg) as Zinc, bis(dimethylcarbamodithioato-*S,S'*)-

CERCLA Reportable Quantity (RQ): 10 lb (4.54 kg)

The "Director's List" (CAL/OSHA) as zinc compounds

EPCRA Section 313: (Category N982, Zinc compounds)

Form R *de minimis* concentration reporting level: 1.0% as zinc compounds

Regulated Marine Pollutant

European/International Regulations: Hazard Symbol: T+, Xn; Xi; N; risk phrases: R22; R26; R37; R41; R43; R48/22; R50/53; safety phrases: S1/2; S22; S26; S28; S36/37/39; S45; S60; S61 (see Appendix 1)

WGK (German Aquatic Hazard Class): 3-Severe hazard to waters.

Description: Ziram is white (when pure), combustible powder. Odorless. Commercial product is available as wettable powders, liquids, and pastes. Molecular weight = 305.81; Specific gravity (H_2O:1) = 1.66 @ 25°C; Boiling point = (decomposes); Freezing/Melting point = 246–250°C (crystals); 146°C (dust)[IARC]; Vapor pressure = 1×10^{-7} mmHg @ 20°C; Flash point = 93.3°C. Practically insoluble in water; solubility = <1 mg/L @ 21.1°C. Physical and toxicological properties may be affected by carrier solvents in commercial formulations.

Incompatibilities: Combustible material. Dust may form explosive mixture in air. Water, acid, oxidizing materials.

Heat, or contact with moisture or acids causes rapid decomposition and the generation of toxic and flammable hydrogen sulfide and carbon disulfide. Flammable gases are generated by reaction with aldehydes, nitrides, and hydrides. Incompatible with oxidizers including peroxides, acids, acid halides, mercury[88]. Decomposition products in fire includes carbon monoxide, carbon dioxide, and nitrogen compounds of sulfur and nitrogen. Corrosive to iron, copper brass and zinc metals, especially in the presence of moisture. Heat alkalies (lime), moisture can cause decomposition. Decomposes on prolonged storage. Degradation produces ethylene thiourea. May corrode iron, copper and other metals.

Permissible Concentration in Water: Federal Drinking Water Guidelines: 4 ppb[14]. State Drinking Water Guidelines: Maine 25 μg/L. Canadian Drinking Water Standards: AO$\leq$5.0 mg[Zn]/L.

Determination in Water: EPA EMSLC Method 630. The Determination of Dithiocarbamate Pesticides in Municipal and Industrial Wastewater by UV-VIS Spectrophotometry. Log K_{ow} = <2.0. Highly toxic to marine organisms, but unlikely to bioaccumulate. A regulated marine pollutant.

Routes of Entry: Inhalation of dust or aerosol, ingestion; absorption through intact skin.

Harmful Effects and Symptoms

Short Term Exposure: Concentrated solutions are slightly corrosive to eyes, skin, and mucous membranes. Dust inhalation can cause irritation of the respiratory system with sneezing. Eye contact can be corrosive, and cause irritation, watering, pain, and inflammation of the eyelids. Dermal contact can cause irritation and minor ulceration. Ingestion can cause gastritis, nausea, vomiting, fever, muscle twitching, seizure, rapid respiration, slow heart beat. In vivo, it may cause hemolysis, dystrophy of the muscle, liver and kidney damage, emphysema, local necrosis of the intestine, neural and visual disturbances, irritation of the skin and mucous membranes and dermatitis. It can also cause headache, tightness of the chest and irritation of the respiratory tract[88]. May cause edema and hemorrhage of the brain. Severe exposure may result in death. Unlike carbamates the dithiocarbamates are not cholinesterase inhibitors, but some of them may react with recently ingested alcohol or alcohol-containing products including wine, medications, and cold remedies such as cough-syrups. LD_{50} (oral, rat) = 100–300 mg/kg[83]; LD_{50} (dermal, rat) = >6 g/kg.

Long Term Exposure: May be neurotoxic; may affect the central nervous system. May tend to inhibit alcohol metabolism and may interfere with thyroid function, tending to cause goiter. May cause tumors and is mutagenic according to literature. May cause reproductive and fetal effects. A skin sensitizer/irritant.

Points of Attack: Respiratory system, central nervous system, cardiovascular system, brain, skin, eyes. Thyroid. Reproductive cells.

Medical Surveillance: This chemical is a suspected or known human carcinogen. Exposed persons should contact a physician for advice regarding the possible long term health effects and advice for medical monitoring. There are tests available to measure zinc in your blood, urine, hair, saliva, and feces. High levels of zinc in the feces can mean high recent zinc exposure. High levels of zinc in the blood can mean high zinc consumption and/or high exposure. Tests to measure zinc in hair may provide information on long-term zinc exposure; however, the relationship between levels in your hair and the amount of zinc you were exposed to is not clear. Medical observation is recommended for 24 to 48 hours following breathing overexposure, as pulmonary edema may be delayed. administering a corticosteroid spray. Cigarette smoking may exacerbate pulmonary injury and should be discouraged for at least 72 hours following exposure. Before employment and at regular times after that, the following are recommended: If symptoms develop or overexposure occurs, repeat the above tests as soon as possible and get an exam of the nervous system. Also consider complete blood count and chest x-ray following acute overexposure. Evaluation by a qualified allergist, including exposure history and testing, may help diagnose allergy.

First Aid: If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least 15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately. If this chemical contacts the skin, remove contaminated clothing and wash immediately with soap and water. Seek medical attention immediately. If this chemical has been inhaled, remove from exposure, begin rescue breathing (using universal precautions) if breathing has stopped, and CPR if heart action has stopped. Transfer promptly to a medical facility. When this chemical has been swallowed, get medical attention. If victim is conscious and able to swallow, have victim drink 4 to 8 ounces of water. Do not induce vomiting. *Note to physician or authorized medical personnel*: Medical observation is recommended for 24 to 48 hours following breathing overexposure, as pulmonary edema may be delayed. As first aid for pulmonary edema, a doctor or authorized paramedic might consider administering a corticosteroid spray. Cigarette smoking may exacerbate pulmonary injury and should be discouraged for at least 72 hours following exposure. Evaluation by a qualified allergist, including exposure history and testing, may help diagnose allergy.

Personal Protective Methods: Reacts with the following absorbent materials: Cellulose-Based; Mineral- and Clay-Based; Dirt/Earth[88]. Wear protective gloves and clothing to prevent any reasonable probability of dermal and/or eye contact. Safety equipment suppliers/manufacturers can provide recommendations on the most protective glove/clothing material for your operation. All protective clothing (suits, gloves, footwear, headgear) should be clean, available each day, and put on before work. Contact lenses should not be worn when working with this chemical. Wear splash-proof chemical goggles and face shield unless full facepiece respiratory protection is worn. Employees should wash immediately with soap when skin is wet or contaminated. Provide emergency showers and eyewash.

Respirator Selection: Where the neat (undiluted) test chemical is weighed and diluted, wear a NIOSH-approved half-face respirator equipped with a combination filter cartridge, i.e. organic vapor/acid gas/HEPA (specific for organic vapors, HCl, acid gas, SO_2 and a high-efficiency particulate filter)[88]

Storage: Color Code-Blue: Health Hazard/Poison: Store in a tightly closed container in a dry, well-ventilated and secure poison location. Prior to working with this chemical you should be trained on its proper handling and storage. Where possible, automatically transfer material from other storage containers to process containers. Store pesticides in original containers, complete with labels listing ingredients, use directions, and first aid. Keep them away from areas where flooding is possible or where they might leak into wells, drains, ground water, basements, or surface water.

Shipping: Thiocarbamate and dithiocarbamate pesticides, solid, toxic, require a label of "poisonous materials." They usually fall in Hazard Class 6.1.

Spill Handling: As an immediate precautionary measure, isolate spill or leak area in all directions for at least 25 meters/75 feet. Increase, if necessary, in the downwind direction. Wear a NIOSH-approved half-face respirator equipped with a combination filter cartridge [i.e. organic vapor/acid gas/HEPA (specific for organic vapors, HCl, acid gas, SO_2 and a high-efficiency particulate filter)][NTP]. DuPont™ Tychem® suit fabrics are recommended in the literature. First, dampen the solid spill material with 5% ammonium hydroxide, then transfer the dampened material to a suitable container. Use absorbent paper dampened with 5% ammonium hydroxide to pick up any remaining material. Seal all contaminated clothing and absorbent paper in a vapor-tight plastic bag for eventual disposal. Wash all contaminated surfaces with 5% ammonium hydroxide followed by washing with a soap and water solution. Do not reenter the contaminated area until an expert or other responsible person has verified that the area has been properly cleaned.

Fire Extinguishing: When heated to decomposition ziram emits toxic fumes of carbon monoxide, carbon dioxide, sulfur oxides and nitrogen oxides. Fires involving ziram can be controlled with dry chemical, carbon dioxide or Halon extinguishers; water spray may also be used[88]. *Fires involving a tank, rail car or tank truck:* isolate and consider evacuation for 800 meters/0.5 mile in all directions[ERG].

Disposal Method Suggested: Do not discharge into drains or sewers. Dispose of waste material as hazardous waste using a licensed disposal contractor to an approved landfill. Consult with environmental regulatory agencies for guidance on acceptable disposal practices. Generators of waste containing this contaminant (≥100 kg/mo) must conform with EPA regulations governing storage, transportation, treatment, and waste disposal. A potential candidate for liquid injection incineration at a temperature range of 650 to 1,600°C and a residence time 0.1 to 2 seconds. Also, a potential candidate for rotary kiln incineration at a temperature range of 820 to 1,600°C and residence times of seconds for liquids and gases, and hours for solids[83].

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Appendix 1: European/International Hazard Codes, risk phrases, and safety phrases

HAZARD CODES

Explosive (E)
Oxidizing (O)
Highly flammable (F)
Extremely Flammable (F+)
Toxic (T)
Very toxic (T+)
Harmful (Xn)
Irritant (Xi)
Corrosive (C)
Dangerous to the Environment (N)

(LIST OF R-PHRASES) RISK PRECAUTIONS

R1 - Explosive when dry.
R2 - Risk of explosion by shock, friction, fire or other sources of ignition.
R3 - Extreme risk of explosion by shock, friction, fire or other sources of ignition.
R4 - Forms very sensitive explosive metallic compounds.
R5 - Heating may cause an explosion.
R6 - Explosive with or without contact with air.
R7 - May cause fire.
R8 - Contact with combustible material may cause fire.
R9 - Explosive when mixed with combustible material.
R10 - Flammable.
R11 - Highly flammable.
R12 - Extremely flammable.
R14 - Reacts violently with water.
R15 - Contact with water liberates extremely flammable gases.
R16 - Explosive when mixed with oxidizing substances.
R17 - Spontaneously flammable in air.
R18 - In use, may form flammable/explosive vapour-air mixture.
R19 - May form explosive peroxides.
R20 - Harmful by inhalation.
R21 - Harmful in contact with skin.
R22 - Harmful if swallowed.
R23 - Toxic by inhalation.
R24 - Toxic in contact with skin.
R25 - Toxic if swallowed.
R26 - Very toxic by inhalation.
R27 - Very toxic in contact with skin.
R28 - Very toxic if swallowed.
R29 - Contact with water liberates toxic gas.
R30 - Can become highly flammable in use.
R31 - Contact with acids liberates toxic gas.
R32 - Contact with acids liberates very toxic gas.
R33 - Danger of cumulative effects.
R34 - Causes burns.
R35 - Causes severe burns.
R36 - Irritating to eyes.
R37 - Irritating to respiratory system.
R38 - Irritating to skin.
R39 - Danger of very serious irreversible effects.
R40 - Limited evidence of a carcinogenic effect.
R41 - Risk of serious damage to eyes.
R42 - May cause sensitization by inhalation.
R43 - May cause sensitisation by skin contact.
R44 - Risk of explosion if heated under confinement.
R45 - May cause cancer.
R46 - May cause heritable genetic damage.
R48 - Danger of serious damage to health by prolonged exposure.
R49 - May cause cancer by inhalation.
R50 - Very toxic to aquatic organisms.
R51 - Toxic to aquatic organisms.
R52 - Harmful to aquatic organisms.
R53 - May cause long-term adverse effects in the aquatic environment.
R54 - Toxic to flora.
R55 - Toxic to fauna.
R56 - Toxic to soil organisms.
R57 - Toxic to bees.
R58 - May cause long-term adverse effects in the environment.
R59 - Dangerous for the ozone layer.
R60 - May impair fertility.
R61 - May cause harm to the unborn child.
R62 - Possible risk of impaired fertility.
R63 - Possible risk of harm to the unborn child.
R64 - May cause harm to breastfed babies.
R65 - Harmful: may cause lung damage if swallowed.
R66 - Repeated exposure may cause skin dryness or cracking.
R67 - Vapours may cause drowsiness and dizziness.
R68 - Possible risk of irreversible effects.
R 14/15 - Reacts violently with water, liberating extremely flammable gases.
R 15/29 - Contact with water liberates toxic, extremely flammable gas.
R 20/21 - Harmful by inhalation and in contact with skin.
R 20/22 - Harmful by inhalation and if swallowed.
R 21/22 - Harmful in contact with skin and if swallowed.

R 20/21/22 - Harmful by inhalation, in contact with skin and if swallowed.
R 23/24 - Toxic by inhalation and in contact with skin.
R 24/25 - Toxic in contact with skin and if swallowed.
R 23/25 - Toxic by inhalation and if swallowed.
R 23/24/25 - Toxic by inhalation, in contact with skin and if swallowed.
R 26/27 - Very toxic by inhalation and in contact with skin.
R 26/28 - Very toxic by inhalation and if swallowed.
R 26/27/28 - Very toxic by inhalation, in contact with skin and if swallowed.
R 27/28 - Very toxic in contact with skin and if swallowed.
R 36/37 - Irritating to eyes and respiratory system.
R 36/38 - Irritating to eyes and skin.
R 37/38 - Irritating to respiratory system and skin.
R 36/387/38 - Irritating to eyes, respiratory system and skin.
R 39/23 - Toxic: danger of very serious irreversible effects through inhalation.
R 39/24 - Toxic: danger of very serious irreversible effects in contact with skin.
R 39/25 - Toxic: danger of very serious irreversible effects if swallowed.
R 39/32/24 - Toxic: danger of very serious irreversible effects through inhalation and in contact with skin.
R 39/23/25 - Toxic: danger of very serious irreversible effects through inhalation and if swallowed.
R 39/24/25 - Toxic: danger of very serious irreversible effects in contact with skin and if swallowed.
R 39/23/24/25 - Toxic: danger of very serious irreversible effects through inhalation, in contact with skin and if swallowed.
R 39/26 - Very toxic: danger of very serious irreversible effects through inhalation.
R 39/26/27 - Very toxic: danger of very serious irreversible effects through inhalation and in contact with skin.
R 39/27 - Very toxic: danger of very serious irreversible effects in contact with skin.
R 39/28 - Very toxic: danger of very serious irreversible effects if swallowed.
R 39/26/28 - Very toxic: danger of very serious irreversible effects through inhalation and if swallowed.
R 39/27/28 - Very toxic: danger of very serious irreversible effects in contact with skin and if swallowed.
R 39/26/27/28 - Very toxic: danger of very serious irreversible effects through inhalation, in contact with skin and if swallowed.
R 68/20 - Harmful: possible risk of irreversible effects through inhalation.
R 68/21 - Harmful: possible risk of irreversible effects in contact with skin.
R 68/22 - Harmful: possible risk of irreversible effects if swallowed.
R 68/20/21 - Harmful: possible risk of irreversible effects through inhalation and in contact with skin.
R 68/20/22 - Harmful: possible risk of irreversible effects through inhalation and if swallowed.
R 68/21/22 - Harmful: possible risk of irreversible effects in contact with skin and if swallowed.
R 68/20/21/22 - Harmful: possible risk of irreversible effects through inhalation, in contact with skin and if swallowed.
R 42/43 - May cause sensitization by inhalation and skin contact.
R 48/20 - Harmful: danger of serious damage to health by prolonged exposure through inhalation.
R 48/21 - Harmful: danger of serious damage to health by prolonged exposure in contact with skin.
R 48/22 - Harmful: danger of serious damage to health by prolonged exposure if swallowed.
R 48/20/21 - Harmful: danger of serious damage to health by prolonged exposure through inhalation and in contact with skin.
R 48/20/22 - Harmful: danger of serious damage to health by prolonged exposure through inhalation and if swallowed.
R 48/21/22 - Harmful: danger of serious damage to health by prolonged exposure in contact with skin and if swallowed.
R 48/20/21/22 - Harmful: danger of serious damage to health by prolonged exposure through inhalation, in contact with skin and if swallowed.
R 48/23 - Toxic: danger of serious damage to health by prolonged exposure through inhalation.
R 48/24 - Toxic: danger of serious damage to health by prolonged exposure in contact with skin.
R 48/25 - Toxic: danger of serious damage to health by prolonged exposure if swallowed.
R 48/23/24 - Toxic: danger of serious damage to health by prolonged exposure through inhalation and in contact with skin.
R 48/23/25 - Toxic: danger of serious damage to health by prolonged exposure through inhalation and if swallowed.
R 48/24/25 - Toxic: danger of serious damage to health by prolonged exposure in contact with skin and if swallowed.
R 48/23/24/25 - Toxic: danger of serious damage to health by prolonged exposure through inhalation, in contact with skin and if swallowed.
R 50/53 - Very toxic to aquatic organisms, may cause long-term adverse effects in the aquatic environment.
R 51/53 - Toxic to aquatic organisms, may cause long-term adverse effects in the aquatic environment.
R 52/53 - Harmful to aquatic organisms, may cause long-term adverse effects in the aquatic environment.

(LIST OF S-PHRASES) SAFETY PRECAUTIONS

S 1 - Keep locked up
S 2 - Keep out of the reach of children
S 3 - Keep in a cool place
S 4 - Keep away from living quarters
S 5 - Keep contents under … (appropriate liquid to be specified by the manufacturer)
S 6 - Keep under … (inert gas to be specified by the manufacturer)

S 7 - Keep container tightly closed
S 8 - Keep container dry
S 9 - Keep container in a well-ventilated place
S 12 - Do not keep the container sealed
S 13 - Keep away from food, drink and animal feedingstuffs
S 14 - Keep away from … (incompatible materials to be indicated by the manufacturer)
S 15 - Keep away from heat
S 16 - Keep away from sources of ignition–No smoking
S 17 - Keep away from combustible material
S 18 - Handle and open container with care
S 20 - When using do not eat or drink
S 21 - When using do not smoke
S 22 - Do not breathe dust
S 23 - Do not breathe gas/fumes/vapour/spray (appropriate wording to be specified by the manufacturer)
S 24 - Avoid contact with skin
S 25 - Avoid contact with eyes
S 26 - In case of contact with eyes, rinse immediately with plenty of water and seek medical advice
S 27 - Take off immediately all contaminated clothing
S 28 - After contact with skin, wash immediately with plenty of (to be specified by the manufacturer)
S 29 - Do not empty into drains
S 30 - Never add water to this product
S 33 - Take precautionary measures against static discharges
S 35 - This material and its container must be disposed of in a safe way
S 36 - Wear suitable protective clothing
S 37 - Wear suitable gloves
S 38 - In case of insufficient ventilation wear suitable respiratory equipment
S 39 - Wear eye/face protection
S 40 - To clean the floor and all objects contaminated by this material use … (to be specified by the manufacturer)
S 41 - In case of fire and/or explosion do not breathe fumes
S 42 - During fumigation/spraying wear suitable respiratory equipment (appropriate wording to be specified by the manufacturer)
S 43 - In case of fire use … (indicate in the space the precise type of fire-fighting equipment. If water increases the risk add: Never use water)
S 45 - In case of accident or if you feel unwell seek medical advice immediately (show the label where possible)
S 46 - If swallowed, seek medical advice immediately and show this container or label
S 47 - Keep at temperature not exceeding …°C (to be specified by the manufacturer)
S 48 - Keep wetted with … (appropriate material to be specified by the manufacturer)
S 49 - Keep only in the original container
S 50 - Do not mix with … (to be specified by the manufacturer)
S 51 - Use only in well-ventilated areas
S 52 - Not recommended for interior use on large surface areas
S 53 - Avoid exposure–Obtain special instructions before use
S 56 - Dispose of this material and its container to hazardous or special waste collection point
S 57 - Use appropriate containment to avoid environmental contamination
S 59 - Refer to manufacturer/supplier for information on recovery/recycling
S 60 - This material and its container must be disposed of as hazardous waste
S 61 - Avoid release to the environment. Refer to special instructions/safety data sheet
S 62 - If swallowed, do not induce vomiting: seek medical advice immediately and show this container or label
S 63 - In case of accident by inhalation: remove casualty to fresh air and keep at rest
S 64 - If swallowed, rinse mouth with water (only if the person is conscious)
S 1/2 - Keep locked up and out of the reach of children
S 3/7 - Keep container tightly closed in a cool place
S 3/9/14 - Keep in a cool, well-ventilated place away from … (incompatible materials to be indicated by the manufacturer)
S 3/9/49 - Keep only in the original container in a cool, well-ventilated place
S 3/9/14/49 - Keep only in the original container in a cool, well-ventilated place away from … (incompatible materials to be indicated by the manufacturer)
S 3/14 - Keep in a cool place away from … (incompatible materials to be indicated by the manufacturer)
S 7/8 - Keep container tightly closed and dry
S 7/9 - Keep container tightly closed and in a well-ventilated place
S 7/47 - Keep container tightly closed and at a temperature not exceeding … °C (to be specified by the manufacturer)
S 20/21 - When using do not eat, drink or smoke
S 24/25 - Avoid contact with skin and eyes
S 27/28 - After contact with skin, take off immediately all contaminated clothing, and wash immediately with plenty of … (to be specified by the manufacturer)
S 29/35 - Do not empty into drains; dispose of this material and its container in a safe way
S 29/56 - Do not empty into drains, dispose of this material and its container at hazardous or special waste collection point
S 36/37 - Wear suitable protective clothing and gloves
S 36/39 - Wear suitable protective clothing and eye/face protection
S 37/39 - Wear suitable gloves and eye/face protection
S 36/37/39 - Wear suitable protective clothing, gloves and eye/face protection
S 47/49 - Keep only in the original container at a temperature not exceeding … °C (to be specified by the manufacturer)

Appendix 2: Synonym and Trade Name-Cross Index

Appendix 3: CAS Number-Cross Index