

# Occupational Health Guideline for Dichlorvos

## INTRODUCTION

This guideline is intended as a source of information for employees, employers, physicians, industrial hygienists, and other occupational health professionals who may have a need for such information. It does not attempt to present all data; rather, it presents pertinent information and data in summary form.

## SUBSTANCE IDENTIFICATION

- Formula:  $(\text{CH}_3\text{O})_2\text{POOCH}=\text{CCl}_2$  or  $\text{C}_4\text{H}_7\text{Cl}_2\text{O}_4\text{P}$
- Synonyms: DDVP; 2,2-dichlorovinyl dimethyl phosphate
- Appearance and odor: Colorless to amber liquid with a mild chemical odor.

## PERMISSIBLE EXPOSURE LIMIT (PEL)

The current OSHA standard for dichlorvos is 1 milligram of dichlorvos per cubic meter of air ( $\text{mg}/\text{m}^3$ ) averaged over an eight-hour work shift.

## HEALTH HAZARD INFORMATION

- **Routes of exposure**  
Dichlorvos can affect the body if it is inhaled, if it comes in contact with the eyes or skin, or if it is swallowed. It may enter the body through the skin.
- **Effects of overexposure**
  1. **Short-term Exposure:** After inhalation of dichlorvos, breathing and eye effects are the first to appear. These include tightness of the chest, wheezing, a bluish discoloration of the skin, small pupils, aching in and behind the eyes, blurring of vision, tearing, runny nose, headache, and watering of the mouth. After swallowing dichlorvos, loss of appetite, nausea, vomiting, abdominal cramps and diarrhea may appear within two hours. After skin absorption, sweating and twitching in the area of absorption may occur usually within 15 minutes to four hours. With severe intoxication by all routes, in addition to all the above symptoms, weakness, general-

ized twitching, and paralysis may occur and breathing may stop. In addition, dizziness, confusion, staggering, slurred speech, generalized sweating, irregular or slow heart beat, convulsions, and coma may occur.

2. **Long-term Exposure:** Repeated exposure to dichlorvos may make a person more susceptible to the effects of this and related chemicals. Repeated exposure to concentrations which are too small to produce symptoms after a single exposure may result in the onset of symptoms.

3. **Reporting Signs and Symptoms:** A physician should be contacted if anyone develops any signs or symptoms and suspects that they are caused by exposure to dichlorvos.

- **Recommended medical surveillance**

The following medical procedures should be made available to each employee who is exposed to dichlorvos at potentially hazardous levels:

1. **Initial Medical Examination:**

—A complete history and physical examination: The purpose is to detect pre-existing conditions that might place the exposed employee at increased risk, and to establish a baseline for future health monitoring. Persons with a history of reduced pulmonary function, convulsive disorders, or recent exposure to anticholinesterase agents would be expected to be at increased risk from exposure. Examination of the respiratory system, nervous system, cardiovascular system, and attention to the cholinesterase levels in the blood should be stressed. The skin should be examined for evidence of chronic disorders.

—Cholinesterase determination: Dichlorvos (DDVP) causes depressed levels of activity of cholinesterase in the serum and erythrocytes. The cholinesterase activity in the serum and erythrocytes should be determined by using medically acceptable biochemical tests prior to any new period of exposure.

2. **Periodic Medical Examination:** The aforementioned medical examinations should be repeated on an annual basis, with the exception of the cholinesterase determi-

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These recommendations reflect good industrial hygiene and medical surveillance practices and their implementation will assist in achieving an effective occupational health program. However, they may not be sufficient to achieve compliance with all requirements of OSHA regulations.

nation which should be performed quarterly or at any time overexposure is suspected or signs and symptoms of toxicity occur.

#### • Summary of toxicology

Dichlorvos (DDVP) is an anticholinesterase agent; absorption may occur from inhalation of the vapor or mist, from skin absorption of the liquid, or from ingestion. Signs and symptoms of overexposure are caused by the inactivation of the enzyme cholinesterase, which results in the accumulation of acetylcholine at synapses in the nervous system, skeletal and smooth muscle, and secretory glands. The sequence of the development of systemic effects varies with the route of entry. The onset of signs and symptoms may occur promptly or may be delayed for up to 12 hours. After inhalation, respiratory and ocular effects are the first to appear, often within a few minutes after exposure. Respiratory effects include tightness in the chest and wheezing due to bronchoconstriction and excessive bronchial secretion; laryngeal spasms and excessive salivation may add to the respiratory distress; cyanosis may also occur. Ocular effects include miosis, aching in and behind the eyes (attributed to ciliary spasm), blurring of distant vision, tearing, rhinorrhea, and frontal headache. After ingestion, gastrointestinal effects, such as anorexia, nausea, vomiting, abdominal cramps, and diarrhea appear within 15 minutes to 2 hours. After skin absorption, localized sweating and muscular fasciculations in the immediate area occur usually within 15 minutes to 4 hours; skin absorption is somewhat greater at higher ambient temperatures and is increased by the presence of dermatitis. With severe intoxication by all routes, an excess of acetylcholine at the neuromuscular junctions of skeletal muscle causes weakness aggravated by exertion, involuntary twitchings, fasciculations, and eventually paralysis; the most serious consequence is paralysis of the respiratory muscles. Effects on the central nervous system include giddiness, confusion, ataxia, slurred speech, Cheyne-Stokes respiration, convulsions, coma, and loss of reflexes. The blood pressure may fall to low levels, and cardiac irregularities including complete heart block may occur; these effects may sometimes be reversed by establishing adequate pulmonary ventilation. Complete symptomatic recovery usually occurs within 1 week; increased susceptibility to the effects of anticholinesterase agents persists for weeks after exposure. Daily exposure to concentrations which are insufficient to produce symptoms following a single exposure may result in the onset of symptoms. Continued daily exposure may be followed by increasingly severe effects. In a study of 13 workers exposed for 12 months to an average concentration of 0.7 mg/m<sup>3</sup>, the erythrocyte cholinesterase activity was reduced by approximately 35%, and the serum cholinesterase activity was reduced by 60%; the results of other tests and of thorough medical examinations conducted at regular intervals were entirely normal.

## CHEMICAL AND PHYSICAL PROPERTIES

#### • Physical data

1. Molecular weight: 221
2. Boiling point (1 mm Hg): 77 C (170 F)
3. Specific gravity (water = 1): 1.44
4. Vapor density (air = 1 at boiling point of dichlorvos): Not applicable
5. Melting point: Data not available
6. Vapor pressure at 32 C (90 F): 0.032 mm Hg
7. Solubility in water, g/100 g water at 20 C (68 F): 1 (approx).
8. Evaporation rate (butyl acetate = 1): Not applicable

#### • Reactivity

1. Conditions contributing to instability: None
2. Incompatibilities: None
3. Hazardous decomposition products: Toxic gases and vapors (such as hydrogen chloride gas, phosphoric acid mist, and carbon monoxide) may be released in a fire involving dichlorvos.
4. Special precautions: Dichlorvos will attack some forms of plastics, rubber, and coatings.

#### • Flammability

1. Not combustible

#### • Warning properties

1. Odor Threshold: No quantitative information is available concerning the odor threshold of dichlorvos.
2. Eye Irritation Level: Dichlorvos is not known to be an eye irritant.
3. Evaluation of Warning Properties: Since no quantitative information is available relating warning properties to air concentrations of dichlorvos, it is treated as a material with poor warning properties. The concentration in saturated air at 20 C could result in a significant exposure relative to the permissible exposure.

## MONITORING AND MEASUREMENT PROCEDURES

#### • General

Measurements to determine employee exposure are best taken so that the average eight-hour exposure is based on a single eight-hour sample or on two four-hour samples. Several short-time interval samples (up to 30 minutes) may also be used to determine the average exposure level. Air samples should be taken in the employee's breathing zone (air that would most nearly represent that inhaled by the employee).

#### • Method

An analytical method for dichlorvos is in the *NIOSH Manual of Analytical Methods*, 2nd Ed., Vol. 5, 1979, available from the Government Printing Office, Washington, D.C. 20402 (GPO No. 017-033-00349-1).

## RESPIRATORS

- Good industrial hygiene practices recommend that engineering controls be used to reduce environmental

concentrations to the permissible exposure level. However, there are some exceptions where respirators may be used to control exposure. Respirators may be used when engineering and work practice controls are not technically feasible, when such controls are in the process of being installed, or when they fail and need to be supplemented. Respirators may also be used for operations which require entry into tanks or closed vessels, and in emergency situations. If the use of respirators is necessary, the only respirators permitted are those that have been approved by the Mine Safety and Health Administration (formerly Mining Enforcement and Safety Administration) or by the National Institute for Occupational Safety and Health.

- In addition to respirator selection, a complete respiratory protection program should be instituted which includes regular training, maintenance, inspection, cleaning, and evaluation.

## PERSONAL PROTECTIVE EQUIPMENT

- Employees should be provided with and required to use impervious clothing, gloves, face shields (eight-inch minimum), and other appropriate protective clothing necessary to prevent repeated or prolonged skin contact with dichlorvos.

- Clothing contaminated with dichlorvos should be placed in closed containers for storage until it can be discarded or until provision is made for the removal of dichlorvos from the clothing. If the clothing is to be laundered or otherwise cleaned to remove the dichlorvos, the person performing the operation should be informed of dichlorvos's hazardous properties.

- Non-impervious clothing which becomes contaminated with dichlorvos should be removed immediately and not reworn until the dichlorvos is removed from the clothing.

- Employees should be provided with and required to use splash-proof safety goggles where liquid dichlorvos may contact the eyes.

## SANITATION

- Skin that becomes contaminated with dichlorvos should be immediately washed or showered with soap or mild detergent and water to remove any dichlorvos.

- Employees who handle dichlorvos should wash their hands thoroughly with soap or mild detergent and water before eating, smoking, or using toilet facilities.

## COMMON OPERATIONS AND CONTROLS

The following list includes some common operations in which exposure to dichlorvos may occur and control methods which may be effective in each case:

Operation	Controls
Formulation and mixing for insecticidal application	Local exhaust ventilation; general dilution ventilation; personal protective equipment
Application on vegetables, animals, agricultural premises, and for outdoor fogging; insecticidal use of tablets, rubbing devices, resin strips, animal collars, dust on animals, animal buildings, restaurants, hospitals, and aircraft	Personal protective equipment
Manufacture of dichlorvos	Personal protective equipment

## EMERGENCY FIRST AID PROCEDURES

In the event of an emergency, institute first aid procedures and send for first aid or medical assistance.

### • Eye Exposure

If dichlorvos or dichlorvos mists get into the eyes, wash eyes immediately with large amounts of water, lifting the lower and upper lids occasionally. Get medical attention immediately. Contact lenses should not be worn when working with this chemical.

### • Skin Exposure

If dichlorvos or dichlorvos mists get on the skin, immediately wash the contaminated skin using soap or mild detergent and water. If dichlorvos or dichlorvos mists soak through the clothing, remove the clothing immediately and wash the skin using soap or mild detergent and water. Get medical attention immediately.

### • Breathing

If a person breathes in large amounts of dichlorvos, move the exposed person to fresh air at once. If breathing has stopped, perform artificial respiration. Keep the affected person warm and at rest. Get medical attention as soon as possible.

### • Swallowing

When dichlorvos has been swallowed and the person is conscious, give the person large quantities of water immediately. After the water has been swallowed, try to get the person to vomit by having him touch the back of his throat with his finger. Do not make an unconscious person vomit. Get medical attention immediately.

### • Rescue

Move the affected person from the hazardous exposure. If the exposed person has been overcome, notify someone else and put into effect the established emergency rescue procedures. Do not become a casualty. Under-

stand the facility's emergency rescue procedures and know the locations of rescue equipment before the need arises.

## SPILL, LEAK, AND DISPOSAL PROCEDURES

- Persons not wearing protective equipment and clothing should be restricted from areas of spills or leaks until cleanup has been completed.

- If dichlorvos is spilled or leaked, the following steps should be taken:

1. Ventilate area of spill or leak.
2. Collect for reclamation or absorb in vermiculite, dry sand, earth, or a similar material.

- Waste disposal method:

Dichlorvos may be disposed of by absorbing it in vermiculite, dry sand, earth or a similar material and disposing in a secured sanitary landfill.

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## RESPIRATORY PROTECTION FOR DICHLORVOS

Condition	Minimum Respiratory Protection* Required Above 1 mg/m <sup>3</sup>
Particulate or Vapor Concentration	
10 mg/m <sup>3</sup> or less	Any supplied-air respirator. Any self-contained breathing apparatus.
50 mg/m <sup>3</sup> or less	Any supplied-air respirator with a full facepiece, helmet, or hood. Any self-contained breathing apparatus with a full facepiece.
200 mg/m <sup>3</sup> or less	A Type C supplied-air respirator operated in pressure-demand or other positive pressure or continuous-flow mode.
Greater than 200 mg/m <sup>3</sup> ** or entry and escape from unknown concentrations	Self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive pressure mode.  A combination respirator which includes a Type C supplied-air respirator with a full facepiece operated in pressure-demand or other positive pressure or continuous-flow mode and an auxiliary self-contained breathing apparatus operated in pressure-demand or other positive pressure mode.
Fire Fighting	Self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive pressure mode.
Escape	Any gas mask providing protection against organic vapors and particulates including pesticide respirators which meet the requirements of this class. Any escape self-contained breathing apparatus.

\*Only NIOSH-approved or MSHA-approved equipment should be used.

\*\*Use of supplied-air suits may be necessary to prevent skin contact while providing respiratory protection from airborne concentrations of dichlorvos; however, this equipment should be selected, used, and maintained under the immediate supervision of trained personnel. Where supplied-air suits are used above a concentration of 200 mg/m<sup>3</sup>, an auxiliary self-contained breathing apparatus operated in positive pressure mode should also be worn.

