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: (CH₂O)₄POOCH = CC₄ or C₄H₇Cl₂O₄P
- 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 (mg/m³) 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, generalized 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 determinations.

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.

U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
Public Health Service Center for Disease Control
National Institute for Occupational Safety and Health

U.S. DEPARTMENT OF LABOR
Occupational Safety and Health Administration

September 1978
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 inges-
tion. 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 secre-
tion; 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,
ausuea, vomiting, abdominal cramps, and diarrhea
appear within 15 minutes to 2 hours. After skin absorp-
tion, 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 exer-
tion, involuntary twitches, fasciculations, and eventu-
ally paralysis; the most serious consequence is paralysis
of the respiratory muscles. Effects on the central ner-
vous 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 ex-
posure. Daily exposure to concentrations which are insuf-
ficient to produce symptoms following a single ex-
sposure 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/m³, the erythro-
cyte cholinesterase activity was reduced by approxi-
mately 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 dichlor-
vos): 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 quan-
titative information is available relating warning prop-
terties to air concentrations of dichlorvos, it is treated
as a material with poor warning properties. The concen-
tration in saturated air at 20 C could result in a
significant exposure relative to the permissible expo-
sure.

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, Wash-
ington, D.C. 20402 (GPO No. 017-033-00349-1).

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

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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 re worn 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**

- Formulation and mixing for insecticidal application
- 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
- Manufacture of dichlorvos

**Controls**

- Local exhaust ventilation; general dilution ventilation; personal protective equipment
- 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.

**REFERENCES**

# Respiratory Protection for Dichlorvos

<table>
<thead>
<tr>
<th>Condition</th>
<th>Minimum Respiratory Protection*</th>
<th>Required Above 1 mg/m³</th>
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<tbody>
<tr>
<td>Particulate or Vapor Concentration</td>
<td>Any supplied-air respirator.</td>
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<tr>
<td></td>
<td>Any self-contained breathing apparatus.</td>
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<tr>
<td>10 mg/m³ or less</td>
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<tr>
<td>50 mg/m³ or less</td>
<td>Any supplied-air respirator with a full facepiece, helmet, or hood.</td>
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<tr>
<td></td>
<td>Any self-contained breathing apparatus with a full facepiece.</td>
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<tr>
<td>200 mg/m³ or less</td>
<td>A Type C supplied-air respirator operated in pressure-demand or other positive pressure or continuous-flow mode.</td>
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<tr>
<td>Greater than 200 mg/m³** or entry and escape from unknown concentrations</td>
<td>Self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive pressure mode.</td>
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<tr>
<td>Fire Fighting</td>
<td>Self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive pressure mode.</td>
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<td>Escape</td>
<td>Any gas mask providing protection against organic vapors and particulates including pesticide respirators which meet the requirements of this class.</td>
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<td></td>
<td>Any escape self-contained breathing apparatus.</td>
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*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/m³, an auxiliary self-contained breathing apparatus operated in positive pressure mode should also be worn.