1,3–Dichloropropene

542-75-6

Hazard Summary

1,3–Dichloropropene is used as a component in formulations for soil fumigants. Acute (short-term) inhalation exposure of humans following a spill caused mucous membrane irritation, chest pain, and breathing difficulties. Effects on the lung have been observed in rats acutely exposed to 1,3– dichloropropene by inhalation. Chronic (long-term) dermal exposure may result in skin sensitization in humans. Damage to the nasal mucosa and urinary bladder are the primary health effects of rodents chronically exposed to 1,3–dichloropropene by inhalation. Information on the carcinogenic effects of 1,3– dichloropropene in humans is limited; two cases of histiocytic lymphomas and one case of leukemia have been reported in humans accidentally exposed by inhalation to concentrated vapors during cleanup of a tank truck spill. An increased incidence of bronchioalveolar adenomas has been reported in male mice exposed by inhalation but not in rats or female mice. EPA has classified 1,3–dichloropropene as a Group B2, probable human carcinogen.

Please Note: The main sources of information for this fact sheet are EPA's Integrated Risk Information System (IRIS) (5), which contains information on inhalation chronic toxicity of 1,3-dichloropropene and the RfC, oral chronic toxicity and the RfD, and the carcinogenic effects of 1,3-dichloropropene, and the Agency for Toxic Substances and Disease Registry's (ATSDR's) Toxicological Profile for 1,3-Dichloropropene. (1)

Uses

• 1,3-Dichloropropene is the predominant component of several formulations used in agriculture as soil fumigants for parasitic nematodes. (1,4)

Sources and Potential Exposure

- Workers may be occupationally exposed to 1,3-dichloropropene, dermally or by inhalation, during its manufacture, formulation, or application as a soil fumigant. (1,2)
- The general public may be exposed via inhalation near source areas or from the consumption of contaminated drinking water from wells near some hazardous waste sites. (1,2)

Assessing Personal Exposure

• 1,3-Dichloropropene or its breakdown products can be detected in blood and urine to determine whether or not exposure has occurred. However, metabolites measured in blood and urine are not specific to 1,3-dichloropropene. (1)

Health Hazard Information

Acute Effects:

- Acute inhalation exposure of humans after a tank truck spill resulted in mucous membrane irritation, cough, chest pain, and breathing difficulties. (1)
- Effects on the lung, including emphysema and edema, have been observed in rats acutely exposed to 1,3-

dichloropropene by inhalation. (1)

- Lung congestion and hemorrhage, ulcerations of the glandular stomach, hemorrhage of the small intestine, dark and patchy liver, and hemorrhage of the liver have been observed in rats acutely exposed to 1,3dichloropropene in their diet or via gavage (experimentally placing the chemical in the stomach). Neurotoxic effects, including hunched posture, lethargy, ptosis, ataxia, and decreased respiratory rate, have also been observed in orally exposed rats. (1)
- Acute animal tests in rats, mice, and rabbits have demonstrated 1,3-dichloropropene to have moderate acute toxicity from inhalation, moderate to high acute toxicity from oral exposure, and high acute toxicity from dermal exposure. (3)

Chronic Effects (Noncancer):

- Chronic dermal exposure may result in skin sensitization in humans. (1)
- Damage to the nasal mucosa and urinary bladder are the primary health effects of rodents chronically exposed to 1,3-dichloropropene by inhalation. Hyperplastic lesions of the upper respiratory tract and degeneration of the olfactory epithelium in the nasal turbinates have been observed in chronically exposed rats and mice. Chronic inhalation exposure of mice has resulted in changes in the urinary bladder. (1,4,5)
- In mice chronically exposed by inhalation, hyperplasia and hyperkeratosis of the forestomach and effects to the urinary bladder, liver, and kidneys have been observed. In one study, reversible cloudy swelling of the renal tubular epithelium was reported in rats chronically exposed by inhalation. (1,4,5)
- Hyperplasia of the forestomach and decreased body weight resulted in rats exposed to 1,3dichloropropene in the diet, and hyperplasia of the urinary bladder resulted in mice chronically exposed via gavage. (1,4)
- The Reference Concentration (RfC) for 1,3-dichloropropene is 0.02 milligrams per cubic meter (mg/m³) based on hypertrophy/hyperplasia of the nasal respiratory epithelium in mice. The RfC is an estimate (with uncertainty spanning perhaps an order of magnitude) of a continuous inhalation exposure to the human population (including sensitive subgroups) that is likely to be without appreciable risk of deleterious noncancer effects during a lifetime. It is not a direct estimator of risk but rather a reference point to gauge the potential effects. At exposures increasingly greater than the RfC, the potential for adverse health effects increases. Lifetime exposure above the RfC does not imply that an adverse health effect would necessarily occur. (5)
- EPA has high confidence in the RfC based on: high confidence in the study on which the RfC was based because it is a well-designed study using two species of animals (both sexes) and including detailed histopathological examinations of numerous tissues with extensive analysis of the respiratory system and corroborative studies performed in both rats and mice have also shown this to be a sensitive endpoint; and high confidence in the database because several studies reported similar effects on the respiratory system at comparable exposure levels, and acute effects observed in humans were similar to the animal effects. (5)
- The Reference Dose (RfD) for 1,3-dichloropropene is 0.03 milligrams per kilogram per day (mg/kg/d) based on chronic irritation of the forestomach in rats. (5)
- EPA has high confidence in the RfD based on: high confidence in the study on which the RfD was based because it was well designed, well conducted, and consistent with other findings, and high confidence in the database because of reproductive and developmental studies, toxicokinetics, inhalation toxicity, and genotoxicity. (5)

Reproductive/Developmental Effects:

- A study of male workers engaged in the manufacture of 1,3-dichloropropene indicated no significant effect on fertility at exposure levels occurring in the work environment. (4)
- No evidence of developmental toxicity was observed in rats or rabbits exposed to 1,3-dichloropropene by inhalation, but significant maternal toxicity was seen in both species. (4)
- In one study of rats exposed by inhalation, fewer fetuses per litter were reported at the highest exposure concentration but maternal toxicity was also observed. (1)
- In other studies, no adverse reproductive effects were observed in rats and mice exposed by inhalation.

Cancer Risk:

- Information on the carcinogenic effects of 1,3-dichloropropene in humans is limited. Two cases of histiocytic lymphomas and one case of leukemia have been reported in emergency response personnel exposed to concentrated 1,3-dichloropropene vapors during cleanup of a tank truck spill. (1,4,5)
- An increased incidence of bronchioalveolar adenomas has been reported in male mice exposed by inhalation but not in rats or female mice. (1,4)
- Forestomach and liver tumors in rats and forestomach, urinary bladder, and lung tumors in mice have been observed in rodents exposed to 1,3-dichloropropene via gavage. Liver tumors were noted in rats exposed to 1,3-dichloropropene in the diet. (1,4,5)
- EPA has classified 1,3-dichloropropene as a Group B2, probable human carcinogen. (5)
- EPA uses mathematical models, based on animal studies, to estimate the probability of a person developing cancer from breathing air containing a specified concentration of a chemical. EPA has calculated an inhalation unit risk estimate of 4×10^{-1} (µg/m⁻¹). (5)
- EPA has calculated an oral cancer slope factor of 0.1 $(mg/kg/d)^{-1}$. (5)

Physical Properties

- The chemical formula for 1,3-dichloropropene is C₃ H₄ Cl₂, and its molecular weight is 110.98 g/mol. (1)
 1,3-Dichloropropene occurs as a colorless liquid that dissolves in water. (1)
- 1,3-Dichloropropene has a sweet chloroform-like odor, with an odor threshold of 1 part per million (ppm). (1)
- The vapor pressure for 1,3-dichloropropene is 34 to 43 mm Hg at 25 °C, and its log octanol/water partition
- coefficient (log K) is 1.60. (1)
 The half-life of 1,3-dichloropropene in ambient air may range from 7 to 50 hours. (1)

Conversion Factors:

To convert concentrations in air (at 25°C) from ppm to mg/m³: mg/m³ = (ppm) × (molecular weight of the compound)/(24.45). For 1,3-dichloropropene: 1 ppm = 4.54 mg/m^3 .

Health Data from Inhalation Exposure

1,3-Dichloropropene



ACGIH TLV -- American Conference of Governmental and Industrial Hygienists' threshold limit value expressed as a time-weighted average; the concentration of a substance to which most workers can be exposed without adverse effects.

 LC_{50} (Lethal Concentration _)--A calculated concentration of a chemical in air to which exposure for a specific length of time is expected to cause death in 50% of a defined experimental animal population. LOAEL--Lowest-observed-adverse-effect level.

NIOSH REL -- National Institute of Occupational Safety and Health's recommended exposure limit; NIOSHrecommended exposure limit for an 8- or 10-h time-weighted-average exposure and/or ceiling. NOAEL--No-observed-adverse-effect level.

OSHA PEL--Occupational Safety and Health Administration's permissible exposure limit expressed as a timeweighted average; the concentration of a substance to which most workers can be exposed without adverse effect averaged over a normal 8-h workday or a 40-h workweek.

The health and regulatory values cited in this factsheet were obtained in May 2000.

^bHealth numbers are toxicological numbers from animal testing or risk assessment values developed by EPA. Regulatory numbers are values that have been incorporated in Government regulations, while advisory numbers are nonregulatory values provided by the Government or other groups as advice. NIOSH and ACGIH numbers are advisory.

The LOAEL and NOAEL are from the critical study used as the basis for the EPA RfC.

References

- 1. Agency for Toxic Substances and Disease Registry (ATSDR). Toxicological Profile for 1,3-Dichloropropene. U.S. Public Health Service, U.S. Department of Health and Human Services, Atlanta, GA. 1992.
- 2. U.S. Department of Health and Human Services. Hazardous Substances Data Bank (HSDB, online database). National Toxicology Information Program, National Library of Medicine, Bethesda, MD. 1993.
- 3. U.S. Department of Health and Human Services. Registry of Toxic Effects of Chemical Substances (RTECS, online database). National Toxicology Information Program, National Library of Medicine, Bethesda, MD. 1993.
- 4. U.S. Environmental Protection Agency. Health and Environmental Effects Profile for 1,3-Dichloropropene. ECAO-CIN-G074. Environmental Criteria and Assessment Office, Office of Health and Environmental Assessment, Office of Research and Development, Cincinnati, OH. 1989.
- 5. U.S. Environmental Protection Agency. Integrated Risk Information System (IRIS) on 1,3-Dichloropropene. National Center for Environmental Assessment, Office of Research and Development, Washington, DC. 2000.
- 6. U.S. Environmental Protection Agency. Health Effects Assessment Summary Tables. FY-1997 Update. National Center for Environmental Assessment, Office of Research and Development, Office of Emergency and Remedial Response, Washington, DC. 1997.
- 7. American Conference of Governmental Industrial Hygienists (ACGIH). 1999 TLVs and BEIs. Threshold Limit Values for Chemical Substances and Physical Agents, Biological Exposure Indices. Cincinnati, OH. 1999.
- 8. National Institute for Occupational Safety and Health (NIOSH). Pocket Guide to Chemical Hazards. U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention. Cincinnati, OH. 1997.