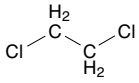
1,2-Dichloroethane

CAS No. 107-06-2

Reasonably anticipated to be a human carcinogen

First listed in the *Second Annual Report on Carcinogens* (1981)

Also known as ethylene dichloride



Carcinogenicity

1,2-Dichloroethane is *reasonably anticipated to be a human carcinogen* based on sufficient evidence of carcinogenicity from studies in experimental animals.

Cancer Studies in Experimental Animals

Oral exposure to 1,2-dichloroethane caused tumors in mice and rats at several different tissue sites. Administration of 1,2-dichloroethane by stomach tube caused malignant lymphoma and benign lung tumors (alveolar/bronchiolar adenoma) in mice of both sexes, blood-vessel cancer (hemangiosarcoma) in rats of both sexes, mammary-gland cancer (adenocarcinoma) in female mice and rats, uterine cancer (endometrial stromal tumors) in female mice, forestomach cancer (squamous-cell carcinoma) in male rats, and liver cancer (hepatocellular carcinoma) in male mice (NCI 1978).

Since 1,2-dichloroethane was listed in the *Second Annual Report on Carcinogens,* an additional study in rodents has been identified. In mice and rats, inhalation exposure to 1,2-dichloroethane caused mammary-gland tumors in both species and liver and lung tumors in mice (IARC 1999).

Cancer Studies in Humans

The data available from epidemiological studies are inadequate to evaluate the relationship between human cancer and exposure specifically to 1,2-dichloroethane. Since 1,2-dichloroethane was listed in the *Second Annual Report on Carcinogens,* additional epidemiological studies have been identified. The International Agency for Research on Cancer reviewed five cohort mortality studies and one nested case-control study of chemical workers with exposure to 1,2-dichloroethane and other chemicals (such as ethylene oxide or chlorohydrin) (IARC 1999). Excesses of lymphatic and hematopoietic cancer were observed in three cohort studies (Hogstedt *et al.* 1979, Benson and Teta 1993, Olsen *et al.* 1997), pancreatic cancer in one study (Benson and Teta 1993), and stomach cancer in one study (Hogstedt *et al.* 1979). No excesses of cancer were found in a fourth cohort study (Sweeney *et al.* 1986) or in a cohort study of brain cancer with a nested case-control study (Austin and Schnatter 1983a,b). Because all of the workers in these studies potentially were coexposed to numerous agents, it is not possible to evaluate excess risks associated specifically with exposure to 1,2-dichloroethane.

Properties

1,2-Dichloroethane is a chlorinated aliphatic hydrocarbon that exists at room temperature as a colorless oily liquid with a sweet, pleasant odor similar to that of chloroform (HSDB 2009). It is slightly soluble in water, soluble in acetone, benzene, and carbon tetrachloride, and miscible with alcohol, chloroform, and ether. 1,2-Dichloroethane is stable at normal temperatures and pressures (Akron 2009). Physical and chemical properties of 1,2-dichloroethane are listed in the following table.

Property	Information
Molecular weight	99.0[a]
Specific gravity	1.2351 at 20°C[a]
Melting point	–35.3°C[a]
Boiling point	83.5°C[a]
Log K_{ow}	1.48[a]
Water solubility	8.6 g/L at 25°C[a]
Vapor pressure	78.9 mm Hg at 25°C[a]
Vapor density relative to air	3.42[b]

Sources: [a]HSDB 2009, [b]Akron 2009.

Use

1,2-Dichloroethane is currently used primarily to produce vinyl chloride (IPCS 1995, IARC 1999). It was formerly used as a solvent for processing pharmaceutical products; as a solvent for fats, oils, waxes, gums, resins, and particularly for rubber; and in paint, varnish, and finish removers (HSDB 2009). It was also used as an insect fumigant for stored grains and in mushroom houses, a soil fumigant in peach and apple orchards, a cleaner for upholstery and carpets, a solvent in textile cleaning and metal degreasing, a lead scavenger in antiknock gasoline, a starting material for chlorinated solvents such as vinylidene chloride, a dispersant for plastics and elastomers such as synthetic rubber, an ore flotation compound, and an extractant in certain food processes (NIOSH 1978, IARC 1979, HSDB 2009). It has been replaced as a solvent and degreaser by less toxic compounds and is no longer registered for use as an insect fumigant in the United States (IARC 1999). Therapeutically, 1,2-dichloroethane formerly was used as a general anesthetic instead of chloroform, especially in ophthalmic surgery (HSDB 2009).

Production

U.S. commercial production of 1,2-dichloroethane was first reported in 1922 (IARC 1979). 1,2-Dichloroethane is a major industrial chemical and ranks among the highest-volume chemicals produced in the United States (EPA 2009a). In 2003, total U.S. annual production capacity for 1,2-dichloroethane was over 35 billion pounds (CMR 2003). In 2009, 1,2-dichloroethane was produced by 95 manufacturers worldwide, including 15 in the United States (SRI 2009), and was available from 67 suppliers, including 35 U.S. suppliers (Chem Sources 2009). U.S. imports of 1,2-dichloroethane peaked at 155 million kilograms (341 million pounds) in 1999, declining to 498,000 kg (1 million pounds) in 2007 and rebounding to 44 million kilograms (96 million pounds) in 2008 (USITC 2009). U.S. exports of 1,2-dichloroethane also peaked in 1999, at 1.2 billion kilograms (2.6 billion pounds), falling to a low of 398 million kilograms (875 million pounds) in 2006. Reports filed every four years under the U.S. Environmental Protection Agency's Toxic Substances Control Act Inventory Update Rule indicated that U.S. production plus imports of 1,2-dichloroethane totaled over a billion pounds from 1986 to 2006 (EPA 2004, 2009b).

Exposure

The routes of potential human exposure to 1,2-dichloroethane are inhalation, ingestion, and dermal contact (IARC 1979). For the general population, the greatest source of exposure is inhalation of contaminated ambient or indoor air, with a minor contribution from ingestion of contaminated drinking water. Releases to the environment may result from the manufacture, use, storage, distribution, and disposal of 1,2-dichloroethane (ATSDR 2001). 1,2-Dichloroethane is also an anaerobic biodegradation product of tetrachloroethane. According to EPA's Toxics Release Inventory, environmental releases of 1,2-dichloroethane peaked in 1990, at 6,525,967 lb, over 5.6 million pounds (85%) of which was released to air. In 2007, 56 facilities released a to-

tal of 450,400 lb of 1,2-dichloroethane, of which 334,000 lb (74%) was released to air, 96,568 lb (21%) to land, 17,000 lb (4%) to on-site and off-site underground injection wells, and 2,310 lb (0.5%) to water (TRI 2009). 1,2-Dichloroethane was identified in at least 570 of the 1,585 hazardous-waste sites proposed for inclusion on EPA's National Priorities List; however, the number of sites evaluated for 1,2-dichloroethane was not reported (ATSDR 2001).

1,2-Dichloroethane has been detected in ambient air (urban and rural) and indoor air of residences near hazardous-waste disposal sites and in surface water, groundwater, and drinking water (ATSDR 2001). In the 1980s, mean concentrations of 1,2-dichloroethane in U.S. ambient air ranged from 0.33 to 6.05 μg/m^3 (IPCS 1998). EPA reported that 1,2-dichloroethane was present in 53 of 204 surface-water samples taken near heavily industrialized areas across the United States (IARC 1979). Drinking-water samples from a number of urban and rural locations in the United States have been reported to be contaminated with 1,2-dichloroethane. Concentrations in sources of drinking-water supplies were reported to range from trace amounts to 4.8 μg/L in surface water and from trace amounts to 400 μg/L in groundwater. Ingestion of 1,2-dichloroethane in contaminated drinking water is expected to be an important source of exposure for 4% to 5% of the U.S. population. 1,2-Dichloroethane has also been detected in food items and in human breath, urine, and milk (ATSDR 2001).

Occupational exposure to 1,2-dichloroethane now occurs chiefly among workers involved in the production of vinyl chloride (IPCS 1998). The National Occupational Exposure Survey (conducted from 1981 to 1983) estimated that 83,246 workers in 1,526 plants, including 33,361 women, potentially were exposed to 1,2-dichloroethane (NIOSH 1990). The largest numbers of exposed workers were employed in the Chemical and Allied Products, Apparel and Other Textile Products, Business Services, and Petroleum and Coal Products industries as machine operators, assemblers, production inspectors, checkers, and examiners (ATSDR 2001).

Regulations

Coast Guard, Department of Homeland Security

Minimum requirements have been established for safe transport of 1,2-dichloroethane on ships and barges.

Department of Transportation (DOT)

1,2-Dichloroethane is considered a hazardous material, and special requirements have been set for marking, labeling, and transporting this material.

Environmental Protection Agency (EPA)

Clean Air Act

National Emissions Standards for Hazardous Air Pollutants: Listed as a hazardous air pollutant.
New Source Performance Standards: Manufacture of 1,2-dichloroethane is subject to certain provisions for the control of volatile organic compound emissions.
Urban Air Toxics Strategy: Identified as one of 33 hazardous air pollutants that present the greatest threat to public health in urban areas.

Clean Water Act

Effluent Guidelines: Listed as a toxic pollutant.
Designated a hazardous substance.
Water Quality Criteria: Based on fish or shellfish and water consumption = 0.38 μg/L; based on fish or shellfish consumption only = 37 μg/L.

Comprehensive Environmental Response, Compensation, and Liability Act

Reportable quantity (RQ) = 100 lb.

Emergency Planning and Community Right-To-Know Act

Toxics Release Inventory: Listed substance subject to reporting requirements.

Resource Conservation and Recovery Act

Characteristic Hazardous Waste: Toxic characteristic leaching procedure (TCLP) threshold = 0.5 mg/L.
Listed Hazardous Waste: Waste codes for which the listing is based wholly or partly on the presence of 1,2-dichloroethane = U077, F024, F025, K018, K019, K020, K029, K030, K096.
Listed as a hazardous constituent of waste.

Safe Drinking Water Act

Maximum contaminant level (MCL) = 0.005 mg/L.

Food and Drug Administration (FDA)

Maximum permissible level in bottled water = 0.005 ppm.
Ethylene dichloride in spice oleoresins when present as a residue from the extraction of spice is allowed in concentrations not to exceed 30 ppm.
Ethylene dichloride residues shall not exceed 150 ppm when used in the production of modified hop extract used in beer.
Ethylene dichloride residues shall not exceed 250 ppm when used as a solvent in the production of the food additive whole fish protein concentrate.
Polyethylenimine polymer may be used as a fixing material in the immobilization of glucoamylase enzyme for use in the manufacture of beer, with residual 1,2-dichloroethane levels not to exceed 1 ppm.
The maximum quantity of ethylene dichloride permitted to remain in or on the extracted by-products in the manufacture of animal feeds is 300 parts per million.

Occupational Safety and Health Administration (OSHA)

While this section accurately identifies OSHA's legally enforceable PELs for this substance in 2010, specific PELs may not reflect the more current studies and may not adequately protect workers.
Acceptable peak exposure = 200 ppm (maximum duration = 5 min in any 3 h).
Ceiling concentration = 100 ppm.
Permissible exposure limit (PEL) = 50 ppm.

Guidelines

American Conference of Governmental Industrial Hygienists (ACGIH)

Threshold limit value – time-weighted average (TLV-TWA) = 10 ppm.

National Institute for Occupational Safety and Health (NIOSH)

Immediately dangerous to life and health (IDLH) limit = 50 ppm.
Recommended exposure limit (time-weighted-average workday) = 1 ppm (4 mg/m^3).
Short-term exposure limit (STEL) = 2 ppm (8 mg/m^3).
Listed as a potential occupational carcinogen.

References

Akron. 2009. *The Chemical Database*. The Department of Chemistry at the University of Akron. http://ull.chemistry.uakron.edu/erd and search on CAS number. Last accessed: 12/18/09.

ATSDR. 2001. *Toxicological Profile for 1,2-Dichloroethane*. Agency for Toxic Substances and Disease Registry. http://www.atsdr.cdc.gov/toxprofiles/tp38.pdf. 297 pp.

Austin SG, Schnatter AR. 1983a. A cohort mortality study of petrochemical workers. *J Occup Med* 25(4): 304-312.

Austin SG, Schnatter AR. 1983b. A case control study of chemical exposures and brain tumors in petrochemical workers. *J Occup Med* 25(4): 313-320.

Benson LO, Teta MJ. 1993. Mortality due to pancreatic and lymphopoietic cancers in chlorohydrin production workers. *Br J Ind Med* 50(8): 710-716.

ChemSources. 2009. *Chem Sources - Chemical Search*. Chemical Sources International. http://www.chemsources.com/chemonline.html and search on ethylene dichloride. Last accessed: 12/18/09.

CMR. 2003. Chemical profile — ethylene dichloride. *Chem Mark Rep* 11/10/03. http://www.icis.com/Articles/2005/12/02/532639/chemical-profile-ethylene-dichloride.html.

EPA. 2004. *Non-confidential IUR Production Volume Information*. U.S. Environmental Protection Agency. http://www.epa.gov/oppt/iur/tools/data/2002-vol.html and search on CAS number.

EPA. 2009a. *1990 HPV Chemical List*. U.S. Environmental Protection Agency. http://www.epa.gov/HPV/pubs/update/hpv_1990.htm.

EPA. 2009b. *Non-confidential 2006 IUR Company/Chemical Records*. U.S. Environmental Protection Agency. http://cfpub.epa.gov/iursearch/2006_iur_companyinfo.cfm?chemid=2753&outchem=comp. Last accessed: 7/9/09.

Hogstedt C, Rohlen O, Berndtsson BS, Axelson O, Ehrenberg L. 1979. A cohort study of mortality and cancer incidence in ethylene oxide production workers. *Br J Ind Med* 36(4): 276-280.

HSDB. 2009. *Hazardous Substances Data Bank*. National Library of Medicine. http://toxnet.nlm.nih.gov/cgi-bin/sis/htmlgen?HSDB and search on CAS number. Last accessed: 12/18/09.

IARC. 1979. 1,2-Dichloroethane. In *Some Halogenated Hydrocarbons*. IARC Monographs on the Evaluation of Carcinogenic Risk of Chemicals to Humans, vol. 20. Lyon, France: International Agency for Research on Cancer. pp. 429-448.

IARC. 1999. 1,2-Dichloroethane. In *Re-evaluation of Some Organic Chemicals, Hydrazine, and Hydrogen Peroxide*. IARC Monographs on the Evaluation of Carcinogenic Risk of Chemicals to Humans, vol. 71. Lyon, France: International Agency for Research on Cancer. pp. 501-529.

IPCS. 1995. *Environmental Health Criteria No. 176. 1,2-Dichloroethane*. International Programme on Chemical Safety. http://www.inchem.org/documents/ehc/ehc/ehc176.htm. Last accessed: 3/31/05.

IPCS. 1998. *Concise International Chemical Assessment No. 1. 1,2-Dichloroethane*. International Programme on Chemical Safety. http://www.inchem.org/documents/cicads/cicads/cicad01.htm. Last accessed: 3/31/05.

NCI. 1978. *Bioassay of 1,2-Dichloroethane for Possible Carcinogenicity (CAS No. 107-06-2)*. Technical Report Series no. 55. Bethesda, MD: National Institutes of Health. 64 pp.

NIOSH. 1978. *Current Intelligence Bulletin 25. Ethylene Dichloride (1,2-Dichloroethane)*. National Institute for Occupational Safety and Health. http://www.cdc.gov/niosh/78149_25.html.

NIOSH. 1990. *National Occupational Exposure Survey (1981-83)*. National Institute for Occupational Safety and Health. Last updated: 7/1/90. http://www.cdc.gov/noes/noes1/24130sic.html. Last accessed: 7/9/07.

Olsen GW, Lacy SE, Bodner KM, Chau M, Arceneaux TG, Cartmill JB, Ramlow JM, Boswell JM. 1997. Mortality from pancreatic and lymphopoietic cancer among workers in ethylene and propylene chlorohydrin production. *Occup Environ Med* 54(8): 592-598.

SRI. 2009. *Directory of Chemical Producers*. Menlo Park, CA: SRI Consulting. Database edition. Last accessed: 5/09.

Sweeney MH, Beaumont JJ, Waxweiler RJ, Halperin WE. 1986. An investigation of mortality from cancer and other causes of death among workers employed at an east Texas chemical plant. *Arch Environ Health* 41(1): 23-28.

TRI. 2009. *TRI Explorer Chemical Report.* U.S. Environmental Protection Agency. http://www.epa.gov/triexplorer and select 1,2-Dichloroethane. Last accessed: 12/18/09.

USITC. 2009. *USITC Interactive Tariff and Trade DataWeb.* United States International Trade Commission. http://dataweb.usitc.gov/scripts/user_set.asp and search on HTS no. 290315. Last accessed: 12/18/09.