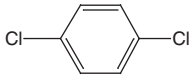
1,4-Dichlorobenzene
CAS No. 106-46-7

Reasonably anticipated to be a human carcinogen
First Listed in the *Fifth Annual Report on Carcinogens* (1989)



Carcinogenicity

1,4-Dichlorobenzene (*p*-dichlorobenzene) is *reasonably anticipated to be a human carcinogen* based on sufficient evidence of carcinogenicity in experimental animals (IARC 1982, 1987, 1999, NTP 1987). When administered by gavage, the compound increased the incidences of hepatocellular carcinomas and adenomas in mice of both sexes. When administered by gavage, 1,4-dichlorobenzene increased the incidences of renal tubular cell adenocarcinomas in male rats, but there was no evidence of carcinogenicity in female rats.

No adequate data were available to evaluate the carcinogenicity of 1,4-dichlorobenzene in humans (IARC 1982, 1987, 1999). One study reported the occurrence of leukemia in five humans who had been exposed to dichlorobenzenes.

Properties

1,4-Dichlorobenzene occurs as colorless or white crystals (monoclinic prisms or leaflets) with a distinctive aromatic odor, similar to mothballs. It is practically insoluble in water and soluble in ether, chloroform, carbon disulfide, benzene, alcohol, and acetone. 1,4-Dichlorobenzene is noncorrosive, volatile, and combustible. 1,4-Dichlorobenzene is flammable when exposed to heat, flame, or oxidizers. When it is heated to decomposition, toxic gases and vapors (such as hydrochloric acid and carbon monoxide) are released (HSDB 2000).

Use

For the past 20 years 1,4-dichlorobenzene has been used primarily as a space deodorant in products such as room deodorizers, urinal and toilet bowl blocks, and as an insecticide fumigant for moth control (accounting for approximately 35 to 55% of the 1,4-dichlorobenzene produced) (ATSDR 1998). It is also used as an intermediate in the production of polyphenylene sulfide, a plastic used in the electrical and electronics industries (27%), and in the production of 1,2,4-trichlorobenzene (9%) (NTP 1987, CMR 1987). The remainder of the 1,4-dichlorobenzene produced is used as a germicide/disinfectant; a soil fumigant; an insecticide for fruit borers and ants; a pesticide; an animal repellent; a chemical intermediate in the production of a variety of yellow, red, and orange pigments; in the manufacture of air deodorizers, dyes, pharmaceuticals, and resin-bonded abrasives; and as an agent to control mold and mildew growth on tobacco seeds, leather, and some fabrics (Kirk-Othmer 1979, SRI 1982, Chem. Prod. 1983, CMR 1987, ATSDR 1998).

Production

1,4-Dichlorobenzene was first produced commercially in the United States in 1915 (IARC 1982). Chem Sources (2001) listed 30 U.S. suppliers of 1,4-dichlorobenzene. The 1997 Directory of Chemical Producers identified three producers of the compound, yielding a total of 144 million lb (SRI 1997).

Import volumes in 1993 and 1994 (7.2 and 6.7 million lb, respectively) increased almost three fold when compared to the period from 1990 to 1992 (ATSDR 1998). U.S. import and export volumes for the year 2000 were 7.4 and 27.1 million lb, respectively (ITA 2001). Exports were expected to increase by approximately 1 to 2% annually through 1989 because of the production of polyphenylene sulfide overseas. Growth of the market for deodorizers is expected to be slow, and the demand for 1,4-dichlorobenzene as an insecticidal fumigant for moth control has declined over the past few years (CMR 1987).

Exposure

The primary route of potential human exposure to 1,4-dichlorobenzene is inhalation, with an average daily intake from ambient air estimated to be approximately 35 µg (NTP 1987, ATSDR 1998). There is also potential for dermal contact and ingestion of the chemical from residue in polyphenylene sulfide coatings of articles intended for repeated contact with food. 1,4-Dichlorobenzene has also been detected in meats and eggs following exposure of the animals and in fish from contaminated waters (IARC 1982). The concentrations in food and water are generally low and are not as significant as exposure from air (ATSDR 1998). When released into water, the compound rapidly volatilizes. 1,4-Dichlorobenzene has been detected in ground water, but its concentrations are low and range from 0.6 to 0.74 µg/L (IARC 1999).

The major potential sources of consumer exposure are its uses as a deodorizer and a moth control agent. Occupational exposure to 1,4-dichlorobenzene occurs during its manufacture, its conversion to polyphenylene sulfide, and its other industrial uses. Concentrations in urban areas and in the vicinity of hazardous waste sites generally average less than 25.2 µg/m^3, but indoor air concentrations of 1,4-dichlorobenzene may be one to three orders of magnitude higher where it is used as a space deodorizer or moth repellent (ATSDR 1998). Concentrations of 42 to 4,350 mg/m^3 have been measured in the air of various factories (Kirk-Othmer 1979, NTP 1987). In 1983, an EPA study estimated that 92% of the 1,4-dichlorobenzene consumed in the United States is released into the atmosphere. EPA's Toxic Chemical Release Inventory (TRI) listed 23 industrial facilities that produced, processed, or otherwise used 1,4-dichlorobenzene in 1988 (TRI88 1990). The facilities reported releases of 1,4-dichlorobenzene to the environment which were estimated to total 1.8 million lb. According to the TRI99, the estimated releases to the environment were 188,805 lb. Of the total environmental release, discharges to air accounted for 94.4% (178,254 lb), releases to water represented 1.0% (1,881 lb), to soil, 0.7% (1,370 lb), and via underground injection, 3.9% (7,300 lb) (TRI99 2001).

The Total Exposure Assessment Methodology (TEAM) study measured combined 1,3- and 1,4-dichlorobenzene levels in personal overnight samples collected from more than 570 individuals in four states. Levels measured were assumed to be representative of 1,4-dichlorobenzene because 1,3-dichlorobenzene has limited commercial production. Levels detected ranged from 0.03 to 1,550 µg/m^3 and mean levels ranged from 7.23 to 56.0 µg/m^3. Less than 5% of all samples were above 200 µg/m^3 and less than 1% were near the maximum (1,550 µg/m^3). Exposure sources were not pinpointed (Pellizzari *et al.* 1987, Sparacino *et al.* 1987). In two other studies, levels of 1,3- and 1,4-dichlorobenzene measured in two homes for the elderly and eight homes in Tennessee, respectively, were in the same range as that measured in the TEAM study. Median levels in this study were 0.56 and 2.9 µg/m^3 (Sheldon *et al.* 1985, Guerin 1985).

In 1980, EPA reported that approximately 1 million workers in the United States were exposed to 1,4-dichlorobenzene during its production and processing (EPA 1980). However, industry sources state that less than 1,000 workers were potentially exposed annually (CPA 1986). The National Occupational Exposure Survey (1981-1983) indicated that 27,242 workers, including 7,239 women, potentially were exposed to 1,4-dichlorobenzene in the workplace (NIOSH 1984). The National Occupational Hazard Survey, conducted by NIOSH from 1972 to 1974, estimated that 697,803 workers were potentially exposed to 1,4-dichlorobenzene in the workplace (NIOSH 1976). This estimate was based on observations of the actual use of the compound (1% of total observations), the use of trade name products suspected of

containing the compound (3%), and the use of generic products suspected of containing the compound (95%).

Regulations

DOT

1,4-Dichlorobenzene is considered a hazardous material and a marine pollutant and special requirements have been set for marking, labeling, and transporting this material

EPA

Clean Air Act

NESHAP: Listed as a Hazardous Air Pollutant (HAP)

NSPS: Manufacture of substance is subject to certain provisions for the control of Volatile Organic Compound (VOC) emissions

Clean Water Act

Effluent Guidelines: Listed as a Toxic Pollutant

Water Quality Criteria: Based on fish/shellfish and water consumption = 400 µg/L; based on fish/shellfish consumption only = 2,600 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 Toxic Hazardous Waste: TCLP Threshold = 7.5 mg/L

Listed Hazardous Waste: Waste codes in which listing is based wholly or partly on substance - U072, K149, K150

Listed as a Hazardous Constituent of Waste

Safe Drinking Water Act

Maximum Contaminant Level (MCL) = 0.075 mg/L

FDA

Maximum permissible level in bottled water = 0.075 mg/L

Polyphenylene sulfide resins, produced by the reaction of 1,4-dichlorobenzene and sodium sulfide, may be used in coatings that come in contact with food provided the maximum residual 1,4-dichlorobenzene levels do not exceed 0.8 ppm and other requirements are met

OSHA

Permissible Exposure Limit (PEL) = 75 ppm (450 mg/m^3)

Guidelines

ACGIH

Threshold Limit Value - Time-Weighted Average Limit (TLV-TWA) = 10 ppm

NIOSH

Immediately Dangerous to Life and Health (IDLH) = 150 ppm

Listed as a potential occupational carcinogen

REFERENCES

ATSDR. 1998. Toxicological Profile for 1,4-Dichlorobenzene. Update. (Final Report). NTIS Accession No. PB99-121972. Atlanta, GA: Agency for Toxic Substances and Disease Registry. 295 pp.

ChemProd. 1983. Chemical Product Synopsis: 1,4-Dichlorobenzene. Cortland, NY: Mansville Chemical Products Corporation.

ChemSources. 2001. Chemical Sources International, Inc. http://www.chemsources.com.

CMR. 1987. Chemical Profile: 1,4-Dichlorobenzene. Chem Mark Report 232(3): 46.

EPA. 1980. Assessment of Testing Needs: Chlorinated Benzenes, Support Document for Proposed Health Effects Test Rule. TSCA Chemical Assessment Series, Section 4. EPA-560/11-80-014. Washington, D.C.: U.S. Environmental Protection Agency, Office of Pesticide Programs and Toxic Substances.

Guerin, M. R. 1985. Indoor Air Analysis for Volatile Organic Pollutants. Final Report. Intra-labratory correspondence from M.R. Guerin, Analytical Chemistry Division, to R.B. Gammage, Health and Safety Research Division. Oak Ridge, TN, Oak Ridge National Laboratory.

HSDB. 2000. Hazardous Substances Data Base. National Library of Medicine. http://toxnet.nlm.nih.gov/cgi-bin/sis/htmlgen?HSDB.

IARC. 1982. Some Industrial Chemicals and Dyestuffs. IARC Monographs on the Evaluation of Carcinogenic Risk of Chemicals to Humans, vol. 29. Lyon, France: International Agency for Research on Cancer. 416 pp.

IARC. 1987. Overall Evaluations of Carcinogenicity. IARC Monographs on the Evaluation of Carcinogenic Risk of Chemicals to Humans, Supplement 7. Lyon, France: International Agency for Research on Cancer. 440 pp.

IARC. 1999. Some Chemicals That Cause Tumors of the Kidney or Urinary Bladder in Rodents and Some Other Substances. IARC Monographs on the Evaluation of Carcinogenic Risk of Chemicals to Humans, vol. 73. Lyon, France: International Agency for Research on Cancer. 338 pp.

ITA. 2001. Subheading 290361: para-Dichlorobenzene. International Trade Administration. U.S. Department of Commerce. http://www.ita.doc.gov/td/industry/otea/Trade-Detail/.

Kirk-Othmer. 1979. Kirk-Othmer Encyclopedia of Chemical Technology, 3rd ed., vol. 5. New York, NY: Jon Wiley and Sons.

NIOSH. 1976. National Occupational Hazard Survey (1972-74). Cincinnati, OH: Department of Health, Education and Welfare.

NIOSH. 1984. National Occupational Exposure Survey (1981-83). Cincinnati, OH: U. S. Department of Health and Human Services. http://www.cdc.gov/noes/noes3/empl0003.html.

NTP. 1987. Toxicology and Carcinogenesis Studies of 1,4-Dichlorobenzene (CAS No. 106-46-7) in F344/N Rats and B6C31F Mice (Gavage Studies). Technical Report Series No 319. NIH Publication No. 87-2575. Research Triangle Park, NC: National Toxicology Program. 198 pp.

Pellizzari, E. D., K. Perritt, T. D. Hartwell, L. C. Michael, R. Whitmore, R. W. Handy, D. Smith and H. Zelon. 1987. Total Exposure Assessment Methodology (TEAM) Study: Selected Communities in Northern and Southern California. Volume III, Final Report. EPA Publication No. 600/6-87/002c. Washington, D.C.: U.S. Environmental Protection Agency, Office of Research and Development.

Sheldon, L. S., R. W. Handy, T. D. Hartwell, R. W. Whitmore, H. S. Zelon and E. D. Pellizzari. 1985. Total Exposure Assessment Methodology Special Study - Indoor Air Study. Draft Final Report. Washington, D.C.: U.S. Environmental Protection Agency, Office of Research and Development.

Sparacino, C. M., L. S. Sheldon, R. Whitmore, C. Leininger, H. Zelon, R. W. Handy and D. Smith. 1987. Total Exposure Assessment Methodology (TEAM) Study: Elizabeth and Bayonne, New Jersey, Devils Lake, North Dakota, and Greensboro, North Carolina. Volume II. Final Report. EPA Publication No. 600/6-87/002b. Washington, D.C.: U.S. Environmental Protection Agency, Office of Research and Development.

SRI. 1982. Chemical Economics Handbook. Menlo Park, CA: SRI International.

SRI. 1997. Directory of Chemical Producers, United States, 1997. Stanford Research Institute, Menlo Park, CA: SRI International.

TRI88. 1990. Toxic Chemical Release Inventory 1988. Data contained in the Toxic Chemical Release Inventory (TRI). National Library of Medicine. http://www.epa.gov/triexplorer/.

TRI99. 2001. Toxic Chemical Release Inventory 1999. Data contained in the Toxic Chemical Release Inventory (TRI). National Library of Medicine. http://www.epa.gov/triexplorer/.