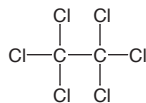


Hexachloroethane

CAS No. 67-72-1

Reasonably anticipated to be a human carcinogen
First Listed in the *Seventh Annual Report on Carcinogens* (1994)



Carcinogenicity

Hexachloroethane is *reasonably anticipated to be a human carcinogen* based on sufficient evidence of carcinogenicity in experimental animals (NTP 1989, IARC 1999). When administered in corn oil by gavage, hexachloroethane induced increased incidences of renal neoplasms and marginally increased incidences of adrenal pheochromocytoma in male rats. There was no corresponding evidence of carcinogenic activity in female rats. A significant increase in incidence of hepatocellular carcinomas was observed in similarly treated mice of both sexes (IARC 1979, 1999).

Little data is available to evaluate the carcinogenicity of hexachloroethane in humans. No association between exposure to hexachloroethane and cancer incidence was observed in one cohort study of workers at aluminum foundries and smelters in Sweden (IARC 1999).

Properties

Hexachloroethane is a colorless, nonflammable, crystalline solid with a camphor-like odor. It is insoluble in water, but is soluble in ethanol, diethyl ether, benzene, chloroform, and oils. Although hexachloroethane is nonflammable, at temperatures greater than 185°C it may emit toxic and irritating fumes containing tetrachloroethylene and carbon tetrachloride. It is reactive with alkalis, zinc, cadmium, aluminum, hot iron, and mercury. These reactions produce spontaneously explosive chloroacetylenes (HSDB 2000).

Use

The applications of hexachloroethane have been quite extensive; however, industrial uses are diminishing. It has been used as an anthelmintic to treat fascioliasis (liver flukes) in sheep and cattle; however, FDA approval for this use was withdrawn in 1971. Hexachloroethane has been used in metal and alloy production, mainly in refining aluminum alloys. It is also used for removing impurities from molten metals, recovering metals from ores or smelting products, and improving the quality of various metals and alloys. Hexachloroethane has been used as a degassing agent for magnesium, and it inhibits the explosiveness of methane and the combustion of ammonium perchlorate. Hexachloroethane mixed with stoichiometric amounts of zinc, zinc oxide, or titanium dioxide is commonly used in military smoke munitions (e.g., candles and grenades used to generate "smoke" or "fog", and pyrotechnics). Hexachloroethane has been used as an additive in combustible liquids (ignition suppressant) and fire extinguishing fluids. Hexachloroethane has had a variety of applications as a polymer additive. It has flame-proofing qualities, increases sensitivity to radiation cross linking, and it is used as a vulcanizing agent. Added to polymer fibers, hexachloroethane acts as a swelling agent and increases affinity for dyes. It is a main ingredient in production of some types of synthetic diamonds. Other uses of hexachloroethane in the United States have included: a plasticizer for cellulose esters, an accelerator in rubber, a retardant in fermentation processes, a moth repellent, a component of submarine paints, and a constituent of various fungicidal and insecticidal formulations. With

the possible exception of use for smoke generation, only limited quantities of hexachloroethane are used in these applications (IARC 1979, 1999, ATSDR 1997, HSDB 2000).

Prior to 1979, approximately 50% of the hexachloroethane distributed was used by the military to produce smoke and pyrotechnic devices, 30% to 40% was used to manufacture degassing pellets to remove air bubbles from molten ore at aluminum foundries, and 10% to 20% was used as an anthelmintic to control sheep flukes. Large amounts of hexachloroethane continue to be used by the military. It was estimated that an average of 192,802 lb of hexachloroethane was used annually at the major facility manufacturing the smoke and pyrotechnic devices between 1966 and 1977 (ATSDR 1997).

Production

Commercial production of hexachloroethane began in the United States in 1921 and continued until 1967 (IARC 1979, ATSDR 1997). It is also produced and used in-house or recycled in feedstock to produce tetrachloroethylene or carbon tetrachloride. It is produced as a by-product of industrial chlorination of C₂ hydrocarbons. Twenty-two current U.S. suppliers were identified (Chem Sources 2001). Estimated production in 1977 was between 2 and 20 million lb (ATSDR 1997). More recent production data were not located.

U.S. imports of hexachloroethane increased from the 1970s to the 1980s. Imports were reported at 1.6 million lb in 1976, more than 2 million lb in 1977, approximately 2.5 million lb in 1985 and approximately 4.5 million lb in 1986 (ATSDR 1997). Imports have apparently declined in recent years. Total U.S. imports for hexachloroethane and tetrachloroethane combined were approximately 1.5 million lb in 1989 and 612,000 lb in 2000 (USDOC 1990, ITA 2001). U.S. exports of hexachloroethane and tetrachloroethane combined were 714,000 lb in 2000 (ITA 2001).

Exposure

The primary routes of potential human exposure to hexachloroethane are through inhalation or ingestion of contaminated drinking water or fish. Hexachloroethane exposure to the general public is expected to be relatively low. Workers at industrial facilities where hexachloroethane is used or produced, either intentionally or as a by-product, may be exposed through inhalation or dermal absorption. Military or civilian personnel working with smoke or pyrotechnic devices that contain hexachloroethane could be exposed. One study reported hexachloroethane concentrations in the smoke ranging from 0.64 to 1.26 mg/m³ (ATSDR 1997). Annual environmental releases reported to the EPA's Toxics Release Inventory (TRI) ranged from approximately 5,400 to 360,000 lb for the years 1988 to 1999. In 1999, 19 facilities reported releasing 71,485 lb. One facility reported more than half of the total U.S. releases and three facilities accounted for approximately 93% of the total (TRI99 2001). In 1999, 43,500 lb were released to air, 9,274 lb were released to land, 320 lb were injected underground, one lb was released to surface water, and 18,390 lb were released off site (ATSDR 1997).

Hexachloroethane is relatively persistent in the environment and has been detected in the atmosphere and in drinking water at low levels; however, it is rarely found in surface waters, biota, ambient soil, sediments, or commercial food products. It was detected in only 2% of 1,253 effluent samples, one of 882 ambient surface-water samples, and none of 116 fish samples collected in the early 1980s. Although some bioconcentration in fish has been reported, biomagnification through the food chain is unlikely because hexachloroethane rarely occurs in surface water and it is rapidly metabolized by fish (ATSDR 1997).

In 1976, an initial list of 671 potential airborne pollutants was developed. From this list, only 77, including hexachloroethane, have

actually been measured in ambient air (NTP 1989). Class and Ballschmitter (1987) analyzed several atmospheric halocarbons in air samples from sampling sites distant from inhabited areas in the region of the North and South Atlantic and the Indian Oceans. They estimated that the emissions of hexachloroethane into the Northern Hemisphere were less than 1 kiloton per year and that the tropospheric lifetime of hexachloroethane was very long.

A NIOSH survey listed the real estate, paper and allied products, lumber and wood products, and amusement and recreation services industries as those that may have used hexachloroethane. In an occupational hazard survey conducted from 1972 to 1974, it was estimated that approximately 1,500 workers were potentially exposed to hexachloroethane (NIOSH 1976). The National Occupational Exposure Survey conducted by NIOSH from 1981 to 1983 indicated that 8,515 workers, including 575 women, were potentially exposed to hexachloroethane. This estimate was derived from observations of the actual use of the compound (62% of total observations) and the use of trade name products known to contain the compound (38%) (NIOSH 1984).

Regulations

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 = 1.4 µg/L; based on fish/shellfish consumption only = 3.3 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 = 3.0 mg/L

Listed Hazardous Waste: Waste codes in which listing is based wholly or partly on substance - U131, F024, F025, K016, K030

Listed as a Hazardous Constituent of Waste

OSHA

Permissible Exposure Limit (PEL) = 1 ppm (10 mg/m³)

Guidelines

ACGIH

Threshold Limit Value - Time-Weighted Average Limit (TLV-TWA) = 1 ppm

NIOSH

Recommended Exposure Limit (REL) = 1 ppm (10 mg/m³)

Immediately Dangerous to Life and Health (IDLH) = 300 ppm

Listed as a potential occupational carcinogen

REFERENCES

- ATSDR. 1997. Toxicological Profile for Hexachloroethane. (Final Report). NTIS Accession No. PB98-101041. Atlanta, GA: Agency for Toxic Substances and Disease Registry. 185 pp.
- ChemSources. 2001. Chemical Sources International, Inc. <http://www.chemsources.com>.
- Class, T. and K. Ballschmitter. 1987. Global baseline pollution studies, X. Atmospheric halocarbons: Global budget estimations for tetrachloroethane, 1,2-dichloroethane, 1,1,2,2-tetrachloroethane, hexachloroethane and hexachlorobutadiene. Estimation of the hydroxyl radical concentrations in the troposphere of the northern and southern hemisphere. *Fresenius Z Anal Chem* 237: 198-204.
- HSDB. 2000. Hazardous Substances Data Base. National Library of Medicine. <http://toxnet.nlm.nih.gov/cgi-bin/sis/htmlgen?HSDB>.
- IARC. 1979. 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. 609 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 290319: Hexachloroethane and Tetrachloroethane. International Trade Administration. U.S. Department of Commerce. <http://www.ita.doc.gov/td/industry/otea/Trade-Detail/>.
- 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. 1989. Toxicology and Carcinogenesis Studies of Hexachloroethane (CAS No. 67-72-1) in F344/N Rats (Gavage Studies). Technical Report Series No 361. NIH Publication No. 89-2816. Research Triangle Park, NC: National Toxicology Program. 120 pp.
- 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/>.
USDOC Imports. 1990. U.S. Imports for Consumption, Harmonized TSUSA Commodity by Country of Origin. Washington, D.C.: U.S. Government Printing Office.