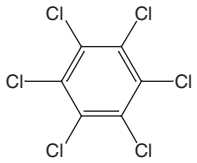
Hexachlorobenzene
CAS No. 118-74-1

Reasonably anticipated to be a human carcinogen
First Listed in the *Third Annual Report on Carcinogens* (1983)



Carcinogenicity

Hexachlorobenzene is *reasonably anticipated to be a human carcinogen* based on sufficient evidence of carcinogenicity in experimental animals (IARC 1982, 1987). When administered in the diet, hexachlorobenzene induced liver tumors in female rats and mice of both sexes, and hepatomas, liver hemangioendotheliomas, and thyroid adenomas in hamsters of both sexes (IARC 1979, Smith and Cabral 1980).

There is inadequate evidence for the carcinogenicity of hexachlorobenzene in humans. Hepatocellular carcinoma has been associated with porphyria resulting from consumption of grain treated with hexachlorobenzene (IARC 1987). An IARC Working Group reported that although there were no case reports or epidemiological studies available to evaluate the carcinogenicity of hexachlorobenzene in humans, it should be regarded as if it presented a carcinogenic risk to humans (IARC 1979).

Properties

Hexachlorobenzene occurs as white needles. It is insoluble in water, but is soluble in benzene, carbon disulfide, chloroform, and ether. Under most environmental conditions, it has a very low degradation rate. It is combustible, but it does not ignite readily. When heated to decomposition, hexachlorobenzene emits highly toxic fumes of hydrochloric acid, other chlorinated compounds, carbon monoxide, and carbon dioxide. Hexachlorobenzene is a stable and nonreactive compound, but it can react violently with dimethylformamide at temperatures >65°C. The technical grade product contains 98% hexachlorobenzene, 1.8% pentachlorobenzene, and 0.2% tetrachlorobenzene (IARC 1979, HSDB 2001).

Use

No current commercial uses of hexachlorobenzene as an end-product in the United States could be found. It was used as a seed-treatment fungicide for onions, sorghum, wheat, and other grains (IARC 1979); however, all registered pesticide uses were voluntarily cancelled in 1984 (ATSDR 2000). It was also used as a chemical intermediate in dye manufacture and synthesis of other organic chemicals, in the production of pyrotechnic compositions for the military, as a raw material for synthetic rubber, a plasticizer for polyvinyl chloride, and as a wood preservative (ATSDR 2000, HSDB 2001).

Production

Commercial production of hexachlorobenzene in the United States was first reported in 1933. Hexachlorobenzene has not been produced commercially in the United States since the late 1970s; however, it is produced as a by-product or impurity during the synthesis of several chlorinated solvents and pesticides, such as tetrachloroethylene, trichloroethylene, carbon tetrachloride, vinyl chloride, atrazine, propazine, simazine, pentachlorophenol, chlorothalonil, and pentachloronitrobenzene. In 1972, an estimated 2.5 million to 4.9 million lb of hexachlorobenzene was produced in the United States as a by-product of other chlorinated chemicals. Production as an end product in 1975 was only 3,200 lb compared to 7,770 to 25,350 lb produced as a by-product in 1984. In addition, hexachlorobenzene may be formed during combustion of municipal waste or in waste streams from chlor-alkali and wood-preserving plants (IARC 1979, ATSDR 2000).

Hexachlorobenzene imports in 1977 and 1982 totaled approximately 5,400 and 38,000 lb, respectively (ATSDR 2000, HSDB 2001). Although neither hexachlorobenzene nor DDT is used in the United States, imports and exports values for hexachlorobenzene and DDT (combined) in 2000 were reported at approximately 58,000 lb and 33,000 lb, respectively (ITA 2001).

The 1979 TSCA Inventory identified two companies producing 5.5 million lb of hexachlorobenzene and one company importing 5,500 lb in 1977 (TSCA 1979). Currently, 10 U.S. chemical companies reportedly produce hexachlorobenzene for on-site use and processing, as a by-product, or as an impurity (ATSDR 2000). In addition, Chemical Sources International (Chem Sources 2001) listed 10 current U.S. suppliers of hexachlorobenzene.

Exposure

The current potential for exposure to hexachlorobenzene for the general population is limited because commercial production of hexachlorobenzene has ceased in the United States. Nevertheless, it continues to be produced as a by-product from the manufacture of other chlorinated chemicals and persists in the environment from past releases. The production and use of hexachlorobenzene as a fungicide prior to 1984, and its occurrence as a by-product in the manufacture of other chemicals indicate that some human exposure may occur in both occupational and nonoccupational settings. Human exposure may occur through ingestion, inhalation, and skin contact. Populations with potentially high exposures include chemical workers, individuals living near a waste site or industrial facility that may release hexachlorobenzene to the air or drinking water supplies, and individuals who ingest contaminated fish and wildlife (ATSDR 2000, HSDB 2001).

The National Occupational Hazard Survey, conducted by NIOSH (1976) from 1972 to 1974, estimated that 4,400 workers were possibly exposed to hexachlorobenzene in the workplace. The National Occupational Exposure Survey, conducted from 1981 to 1983, indicated that 1,038 workers employed at 10 facilities were potentially exposed to hexachlorobenzene (ATSDR 2000). Occupations with the highest potential for human exposure included fungicide application, organic chemical synthesis, synthetic rubber production, seed disinfection, pesticide production, and wood preservation.

Fourteen of 20 companies listed in EPA's Toxics Release Inventory (TRI) reported environmental releases of 28,125 lb in 1999 (TRI99 2001). Most of these releases were to land with on-site and off-site releases being comparable. More than 94% of the reported releases were from two facilities. According to the TRI99 (2001), annual environmental releases of hexachlorobenzene ranged from approximately 12,600 lb to more than one million lb between 1988 and 1999. Past airborne emissions of hexachlorobenzene in the United States were estimated to be between 46,300 and 63,900 lb per year. These emissions resulted primarily from pesticide use and the manufacture of chlorinated solvents (CEN 1988). Between 750 and 25,000 lb per year are released as a by-product from chlorinated solvent production plants and approximately 125 to 1,000 lbs per year are released from municipal refuse incineration (ATSDR 2000).

Hexachlorobenzene is among the most persistent environmental pollutants because of its relative stability and resistance to degradation. Hexachlorobenzene released to the environment is taken up by plants and animals and can build up through the food chain (ATSDR 2000).

Human adipose tissue samples collected across the United States between 1973 and 1983 show that the general population is exposed to hexachlorobenzene. However, dietary surveys conducted by the FDA

show that the frequency of detection of hexachlorobenzene in foods has declined from approximately 9% in the early 1980s to <2% in 1994. Consequently, the average daily intake of hexachlorobenzene from foods declined by a factor of five during this period (ATSDR 2000).

Regulations

DOT

Hexachlorobenzene is considered a hazardous material 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

Urban Air Toxics Strategy: Identified as one of 33 HAPs that present the greatest threat to public health in urban areas

Clean Water Act

Effluent Guidelines: Listed as a Toxic Pollutant

Water Quality Criteria: Based on fish/shellfish and water consumption = 0.00028 µg/L;

based on fish/shellfish consumption only = 0.00029 µg/L

Comprehensive Environmental Response, Compensation, and Liability Act

Reportable Quantity (RQ) = 10 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 = 0.13 mg/L

Listed Hazardous Waste: Waste codes in which listing is based wholly or partly on substance - U127, F024, F025, K016, K018, K030, K042, K085, K149, K150, K151

Listed as a Hazardous Constituent of Waste

Safe Drinking Water Act

Maximum Contaminant Level (MCL) = 0.001 mg/L

FDA

Maximum permissible level in bottled water = 0.001 mg/L

Guidelines

ACGIH

Threshold Limit Value - Time-Weighted Average Limit (TLV-TWA) = 0.002 mg/m^3

REFERENCES

ATSDR. 2000. Toxicological Profile for Hexachlorobenzene. Update. (Draft for Public Comment). Atlanta, GA: Agency for Toxic Substances and Disease Registry. 349 pp.

CEN. 1988. Production Profiles. Chem Eng News 66(6): 37.

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

HSDB. 2001. 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. 1982. Chemicals, Industrial Processes and Industries Associated with Cancer in Humans. IARC Monographs on the Evaluation of Carcinogenic Risk of Chemicals to Humans, Supplement 4. Lyon, France: International Agency for Research on Cancer. 292 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.

ITA. 2001. Subheading 290362: Hexachlorobenzene and DDT (1,1,1-Trichloro-2,2-bis(*p*-chlorophenyl)ethane. 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.

Smith, A. G. and J. R. Cabral. 1980. Liver-cell tumours in rats fed hexachlorobenzene. Cancer Lett 11(2): 169-72.

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/.

TSCA. 1979. Toxic Substances Control Act, Chemical Substances Inventory.