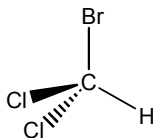


BROMODICHLOROMETHANE

CAS No. 75-27-4

First Listed in the *Sixth Annual Report on Carcinogens*



CARCINOGENICITY

Bromodichloromethane is *reasonably anticipated to be a human carcinogen* based on sufficient evidence of carcinogenicity in experimental animals (NTP 1987, IARC 1991, 1999). When administered by gavage, bromodichloromethane increased the incidences of tubular cell adenomas and adenocarcinomas in the kidney, and adenocarcinomas and adenomatous polyps in the large intestine in rats of both sexes. When administered by gavage, bromodichloromethane increased the incidences of tubular cell adenomas and adenocarcinomas in the kidney of male mice, and increased the incidences of hepatocellular adenomas and carcinomas in female mice (NTP 1987, ATSDR 1989).

No data were available to evaluate the carcinogenic effects in humans following long-term oral exposure to bromodichloromethane *per se* (IARC 1999). Several epidemiological studies indicate there may be an association between ingestion of chlorinated drinking water (which typically contains bromodichloromethane) and increased risk of cancer in humans, but these studies cannot provide information on whether any observed effects are due to bromodichloromethane or to one or more of the hundreds of other by-products that are also present in chlorinated water (ATSDR 1989).

PROPERTIES

Bromodichloromethane is a colorless liquid that boils at 90.1°C. It is soluble in water (4,500 mg/L), alcohol, ether, acetone, benzene, and chloroform. Bromodichloromethane is not readily flammable (IARC 1991).

USE

Bromodichloromethane is used in the synthesis of organic chemicals and as a reagent in laboratory research (EPA 1980, Sittig 1985). It has also been used to separate minerals and salts, as a flame retardant, and in fire extinguishers (HSDB 2000).

PRODUCTION

Bromodichloromethane is not used or produced commercially in the United States. Small quantities are produced, but quantitative volumes are not available (ATSDR 1989). Chem Sources (2001) lists 19 current suppliers of the chemical. Import or export figures were also not found, but little, if any, is expected (ATSDR 1989).

EXPOSURE

The major source of exposure to bromodichloromethane is in drinking water (IARC 1991, 1999). The primary potential occupational exposure will be to those workers using the compound as a reagent for research or to synthesize organic chemicals. Most other uses of the chemical have been discontinued (Gosselin *et al.* 1984). The National Occupational Exposure Survey (1981-1983) estimated that 3,266 workers, including 503 female workers, potentially are exposed to bromodichloromethane (NIOSH 1984).

Bromodichloromethane is not produced or used on a large commercial scale; it is unlikely that significant releases to the environment will result from industrial processes (Perwak *et al.* 1980). If contamination occurs from a spill on land, volatilization will occur, which is the predominant environmental removal process, or the compound will leach into ground waters, where significant biodegradation can occur under anaerobic conditions (HSDB 2000). EPA's Toxic Chemical Release Inventory (TRI) lists seven industrial facilities that produced, supplied, or otherwise used bromodichloromethane in 1987 (TRI 1988). Five of the seven facilities reported releases to the environment, all of them to the air. The estimated total of bromodichloromethane released was 15,000 lb. In 1999, 3,485 lb were released to the environment (TRI99 2001). Bromodichloromethane has a relatively long half-life in air, estimated to be 2 to 3 months. Reactions with hydroxyl radicals or singlet oxygen are probably the only identifiable transformation processes in the atmosphere (ATSDR 1989). Long-range global transport is possible. Bromodichloromethane has been detected in rainwater, indicating that washout from the atmosphere is possible; however, it is likely that the compound will revolatilize (HSDB 2000). The major anthropogenic source of bromodichloromethane is its formation as a result of the chlorination treatment of drinking, waste, or cooling waters (Perwak *et al.* 1980). Trihalomethanes (THMs) are generally present in the finished water treated with chlorine (Kirk-Othmer 1984). The amount of bromodichloromethane produced during the chlorination is dependent on temperature, pH, bromide ion concentration of the water, THM precursors, and actual treatment processes. The organic THM precursors are naturally occurring humic, tannic, and fulvic acids (Kirk-Othmer 1981, 1984).

The general population is exposed to the compound through consumption of contaminated drinking water, beverages, and food products, and inhalation of contaminated ambient air. THMs were detected in 78 of 80 city water supplies (Kirk-Othmer 1981). The concentrations of the halogenated hydrocarbons were higher in the finished water than in the raw waters. The highest detected concentration of bromodichloromethane in New Orleans drinking water for raw water is 11 µg/L and 116 µg/L for finished water (NRC 1980). It is estimated that bromodichloromethane levels increase by 30% to 100% in water distribution pipes; formation of bromodichloromethane is likely to continue as long as chlorine and organic THM precursors remain in the water (ATSDR 1989). Bromodichloromethane was detected in 445 of 945 finished water supplies from groundwater sources; the median level was approximately 1.8 ppb (HSDB 2000). Bromodichloromethane was detected in 35 of 40 Michigan water supplies at a median concentration of 2.7 ppb (Furlong and D'Itri 1986). The EPA surveyed the water supplies of 113 U.S. cities in 1976 to 1977; median levels of bromodichloromethane were 5.9 to 18 ppb (EPA 1980). Concentrations of bromodichloromethane in 14 of 63 industrial wastewater discharges ranged from <10 to 100 ppb (Perry *et al.* 1979).

Exposure can also occur from dermal contact with and ingestion of chlorinated swimming pool water; the portion of the population that frequents indoor swimming pools and saunas is at potentially higher risk from inhalation exposure (ATSDR 1989). Levels of 13 to 34 µg/L were detected in chlorinated freshwater pools (Beech *et al.* 1980). Lindstrom *et al.* (1997) examined dermal and inhalation exposures of two college students (one male and one female) during a

typical two-hour swimming workout. The results suggested the dermal pathway as the major means of exposure versus the inhalation route and showed a measurable body burden of bromodichloromethane connected with training.

Although consumers are potentially exposed to bromodichloromethane from contaminated food, resulting from use of chlorinated water to produce these foods, it is not common and is at low levels (HSDB 2000). In a survey conducted for FDA, bromodichloromethane was detected in 4 of 39 food products, including one composite dairy food (1.2 ppb), butter (7 ppb), and two beverages (0.3 to 0.6 ppb) (Entz *et al.* 1982). Cola drinks were found to contain 2.3 to 3.8 ppb. Bromodichloromethane was detected in noncaramel-colored soft drinks (0.1 to 0.2 ppb) and in cola drinks (0.9 to 5.9 ppb) (Abdel-Rahman 1982).

REGULATIONS

EPA regulates bromodichloromethane under the Clean Water Act (CWA), Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), Resource Conservation and Recovery Act (RCRA), Safe Drinking Water Act (SDWA), and Superfund Amendments and Reauthorization Act (SARA). EPA has established water quality criteria for bromodichloromethane, effluent guidelines, rules for regulating hazardous spills, general threshold amounts, and requirements for handling and disposal of bromodichloromethane, rules for regulating hazardous spills, general threshold amounts, and requirements for handling and disposal for bromodichloromethane under CWA, CERCLA, and RCRA. EPA established a maximum contaminant level (MCL) of 0.080 mg/L for total THMs under the SDWA.

OSHA regulates bromodichloromethane under the Hazard Communication Standard and as a chemical hazard in laboratories. Regulations are summarized in Volume II, Table 23.

REFERENCES

Abdel-Rahman, M.S. The Presence of Trihalomethanes in Soft Drinks. *J. Appl. Toxicol.* Vol. 2, 1982, pp. 165-166.

ATSDR. Agency for Toxic Substances and Disease Registry. Toxicological Profile for Bromodichloromethane. (Final Report). Atlanta, GA: ATSDR, Public Health Service, U.S. Department of Health and Human Services. 1989. 88 pp. NTIS Accession No. PB90-167461.

Beech, J.A., R. Diaz, C. Ordaz, and B. Palomeque. Nitrates, Chlorates and Trihalomethanes in Swimming Pool Water. *Am. J. Public Health.* Vol. 70, 1980, pp. 79-82.

Chem Sources. Chemical Sources International, Inc. <http://www.chemsources.com>, 2001

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

Entz, R.C., K.W. Thomas, and E.W. Diachenko. Residues of Volatile Halocarbons in Foods Using Headspace Gas Chromatography. *J. Agric. Chem.* Vol. 30, 1982, pp. 846-849.

Furlong, E.A.-N., and F.M. D'Itri. Trihalomethane Levels in Chlorinated Michigan Drinking Water. *Ecol. Modeling* Vol. 32, 1986, pp. 215-225.

Gosselin, R.E., R.P. Smith, H.C. Hodge, and J.E. Braddock. *Clinical Toxicology of Commercial Products*. Fifth Edition. Baltimore, MD: Williams and Wilkins, 1984.

HSDB. Hazardous Substances Data Bank. Online database produced by the National Library of Medicine. Bromodichloromethane. Profile last updated June 12, 2000. Last review date, January 29, 2000.

IARC. International Agency for Research on Cancer. IARC Monographs on the Evaluation of Carcinogenic Risks to Humans. Bromodichloromethane. Vol. 52, pp. Lyon, France: IARC, 1991.

IARC. International Agency for Research on Cancer. IARC Monographs on the Evaluation of Carcinogenic Risks to Humans. Re-evaluation of Some Organic Chemicals, Hydrazine and Hydrogen Peroxide. Vol. 71, Part 3. 1,589 pp. Lyon, France: IARC, 1999.

Kirk-Othmer Encyclopedia of Chemical Technology, Third Edition. Vol. 16. New York, NY: John Wiley and Sons, 1981.

Kirk-Othmer Encyclopedia of Chemical Technology, Third Edition. Vol. 24. New York, NY: John Wiley and Sons, 1984.

Lindstrom, A.B., J.D. Pliel, and D.C. Berkoff. Alveolar Breath Sampling and Analysis to Assess Trihalomethane Exposures During Competitive Swimming Training. *Environ. Health Perspect.* Vol. 105, No. 6, 1997, pp. 636-641.

NIOSH. National Institute for Occupational Safety and Health. National Occupational Exposure Survey (1981-83). Cincinnati, OH: Department of Health and Human Services, 1984.

NRC. National Research Council. *Drinking Water and Health*, Vol. 3. Washington: National Academy Press, 1980. 415 pp.

NTP. National Toxicology Program. Technical Report Series No. 321. Toxicology and Carcinogenesis Studies of Bromodichloromethane (CAS No. 75-27-4) in F344/N Rats and B6C3F₁ Mice (Gavage Studies). NTIS Publication No. PB88-168687. National Toxicology Program, Research Triangle Park, NC, and Bethesda, MD, 1987.

Perry, D.L., C.C. Chuang, G.A. Jungclaus, et al. Identification of Organic Compounds in Industrial Discharges. U.S. Environmental Protection Agency, Office of Research and Development, Athens, GA. EPA-600/4-79-106. 1979.

Perwak J., M. Goyer, J. Harris, G. Schimke, and K. Scow. Exposure and Risk Assessment for Trihalomethanes (Chloroform, Bromoform, Bromodichloromethane, Dibromochloromethane) (Final Report). Report No. EPA/440/4-81/018. NTIS Publication No. PB85-211977. Washington, DC: U.S. Environmental Protection Agency, Office of Water Regulations and Standards, 1980.

Sittig, M. *Handbook of Toxic and Hazardous Chemicals and Carcinogens*, Second Edition. 950 pp. Park Ridge, NJ: Noyes Publications, 1985.

Bromodichloromethane (Continued)

TRI88. Toxic Chemical Release Inventory 1989. Data contained in the Toxic Chemical Release Inventory (TRI). Available from National Library of Medicine's TOXNET system, 1990.

TRI99. Toxic Chemical Release Inventory 1999. Data contained in the Toxic Chemical Release Inventory (TRI). Available from National Library of Medicine's TOXNET system, 2001.