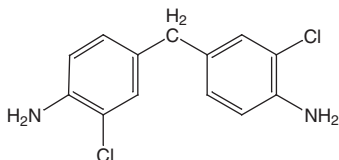


## 4,4'-Methylenebis(2-Chloroaniline)

### CAS No. 101-14-4

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



### Carcinogenicity

4,4'-Methylenebis(2-chloroaniline) is *reasonably anticipated to be a human carcinogen* based on sufficient evidence of carcinogenicity in experimental animals (IARC 1974, 1987, 1993). When administered in the diet, 4,4'-methylenebis(2-chloroaniline) increased the incidences of hemangiosarcomas in mice of both sexes and hepatomas in female mice. When administered in the diet, 4,4'-methylenebis(2-chloroaniline) induced lung adenomas and adenocarcinomas and several mesotheliomas in rats of both sexes. Further, when administered in the diet, 4,4'-methylenebis(2-chloroaniline) induced pulmonary adenomas, mammary adenocarcinomas, Zymbal gland carcinomas, and hepatocellular carcinomas in male rats. When administered by gavage, 4,4'-methylenebis(2-chloroaniline) induced transitional cell carcinomas of the urinary bladder in dogs. When administered by subcutaneous injection, 4,4'-methylenebis(2-chloroaniline) induced liver cell carcinomas and lung carcinomas in rats of both sexes.

There is inadequate evidence for the carcinogenicity of 4,4'-methylenebis(2-chloroaniline) in humans (IARC 1993). In a review, a higher than expected incidence of urinary bladder cancer was reported among workers in a U.K. facility that manufactured 4,4'-methylenebis(2-chloroaniline). An earlier study of workers manufacturing this compound in the United States, who were followed up for fewer than 16 years, failed to reveal any urinary bladder tumors (IARC 1987).

### Properties

4,4'-Methylenebis(2-chloroaniline) occurs as tan-colored pellets or flakes with a faint, amine-like odor. It is soluble in alcohol, ether, most organic solvents, and lipids, and insoluble in water. When heated, it emits toxic fumes of hydrochloric acid and other chlorinated compounds as well as nitrogen oxides (HSDB 2001).

### Use

4,4'-Methylenebis(2-chloroaniline) has been used primarily as a curing agent for polyurethane prepolymers in the manufacture of castable urethane rubber products such as shock absorption pads and conveyor belting. (IARC 1993). In the laboratory, 4,4'-methylenebis(2-chloroaniline) has been used as a model compound for studying carcinogens (IARC 1974).

### Production

No current production data were available for 4,4'-methylenebis(2-chloroaniline). IARC (1993) reported that all U.S. supplies were imported from Japan. Chem Sources identified six domestic distributors of 4,4'-methylenebis(2-chloroaniline) in 2001 (Chem Sources 2001). More than 1.9 million lb of 4,4'-methylenebis(2-chloroaniline) were imported into the United States in 1989 (USDOC Imports 1990). Reports received by EPA in early 1983 indicated that U.S. manufacturers no longer produced 4,4'-methylenebis(2-chloroaniline) and that any 4,4'-methylenebis(2-chloroaniline) used is imported. The 1982 Directory of Chemical Producers indicated that one U.S. company produced 4,4'-

methylenebis(2-chloroaniline), but no production data were available (SRI 1982). The Consumer Product Safety Commission (CPSC) also reported one manufacturer in 1981. 4,4'-Methylenebis(2-chloroaniline) was not reported to the (USITC) from 1980 to 1986 (USITC 1987); in 1979, however, two producers reported 4,4'-methylenebis(2-chloroaniline) production, with an implied total production of more than 10,000 lb (USITC 1980). The 1979 TSCA Inventory identified four companies producing 11 million lb of 4,4'-methylenebis(2-chloroaniline) and one company importing 55,000 lb in 1977. In 1977, the EPA identified five producers and importers of 4,4'-methylenebis(2-chloroaniline), with a domestic production of 369,000 lb; no imports were reported. Production of 4,4'-methylenebis(2-chloroaniline) first was reported in the United States in 1956 (IARC 1974).

### Exposure

The primary routes of potential human exposure to 4,4'-methylenebis(2-chloroaniline) are inhalation, dermal contact, and ingestion (IARC 1993). Persons with the greatest possible risk of exposure to 4,4'-methylenebis(2-chloroaniline) were those persons involved in the manufacture of polyurethane and plastic products during the curing process. When used as a curing agent, 4,4'-methylenebis(2-chloroaniline) is melted before mixing into elastomer formulation and possibly could volatilize and be emitted into waste gases and wastewater from facilities where it is being used. In 1971, investigators detected 4,4'-methylenebis(2-chloroaniline) in all samples of soil that were obtained within a three-quarter mile radius of a chemical plant in Michigan. Some samples taken from soil on public roads in the area contained more than 500 ppm 4,4'-methylenebis(2-chloroaniline). Sludge from the wastewater treatment plant in the area contained as much as 86 ppm 4,4'-methylenebis(2-chloroaniline), and samples of sludge obtained from the industrial lagoon contained 2,000 ppm. Urine from workers at the plant contained concentrations as high as 49 ppm of 4,4'-methylenebis(2-chloroaniline) per liter of urine (IARC 1974). The National Occupational Hazard Survey, conducted by NIOSH from 1972 to 1974, estimated that 33,000 workers were possibly exposed to 4,4'-methylenebis(2-chloroaniline) in the workplace (NIOSH 1976). CPSC reported that residual levels of 4,4'-methylenebis(2-chloroaniline) may be present in final products, such as polyurethane foam and other plastic components. However, data describing actual levels of impurities and the potential for consumer exposure are lacking. EPA's Toxic Chemical Release Inventory (TRI) listed twenty industrial facilities that produced, processed, or otherwise used 4,4'-methylenebis(2-chloroaniline) in 1999 (TRI99 2001). The facilities reported releases of 4,4'-methylenebis(2-chloroaniline) to the environment that were estimated to total 12,650 lb. Additional exposure information may be found in the ATSDR Toxicological Profile for 4,4'-methylenebis(2-chloroaniline) (ATSDR 1994).

### Regulations

#### EPA

##### Clean Air Act

NESHAP: Listed as a Hazardous Air Pollutant (HAP)

##### 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

Listed Hazardous Waste: Waste codes in which listing is based wholly or partly on substance - U158

Listed as a Hazardous Constituent of Waste

### Guidelines

#### ACGIH

Threshold Limit Value - Time-Weighted Average Limit (TLV-TWA) = 0.01 ppm

#### NIOSH

Recommended Exposure Limit (REL) = 0.003 mg/m<sup>3</sup>

Listed as a potential occupational carcinogen

REFERENCES

- ATSDR. 1994. Toxicological Profile for 4,4-Methylenebis(2-chloroaniline) (MBOCA). (Final Report). NTIS Accession No. PB95-100186. Atlanta, GA: Agency for Toxic Substances and Disease Registry. 88 pp.
- 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. 1974. Some Aromatic Amines, Hydrazine and Related Substances, *N*-Nitroso Compounds and Miscellaneous Alkylating Agents. IARC Monographs on the Evaluation of Carcinogenic Risk of Chemicals to Humans, vol. 4. Lyon, France: International Agency for Research on Cancer. 286 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. 1993. Occupational Exposures of Hairdressers and Barbers and Personal Use of Hair Colourants; Some Hair Dyes, Cosmetic Colourants, Industrial Dyestuffs and Aromatic Amines. IARC Monographs on the Evaluation of Carcinogenic Risk of Chemicals to Humans, vol. 57. Lyon, France: International Agency for Research on Cancer. 428 pp.
- NIOSH. 1976. National Occupational Hazard Survey (1972-74). Cincinnati, OH: Department of Health, Education and Welfare.
- SRI. 1982. Chemical Economics Handbook. Menlo Park, CA: SRI International.
- 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.
- USITC. 1980. Synthetic Organic Chemicals, United States Production and Sales, 1979. USITC Publication No 1099. Washington, D.C.: U.S. Government Printing Office.
- USITC. 1987. Synthetic Organic Chemicals, United States Production and Sales, 1986. USITC Publication No 2009. Washington, D.C.: U.S. Government Printing Office.
-