

Dichloromethane (Methylene Chloride) CAS No. 75-09-2

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



Carcinogenicity

Dichloromethane (methylene chloride) is *reasonably anticipated to be a human carcinogen* based on sufficient evidence of carcinogenicity in experimental animals (NTP 1986). When administered by inhalation, the compound is carcinogenic in mice and female rats. It caused increased incidences of alveolar/bronchiolar neoplasms and hepatocellular neoplasms in mice of both sexes. Dichloromethane inhalation also increased the incidences of fibroadenoma of the mammary gland in female rats. There is some evidence of the carcinogenicity of dichloromethane in male rats, as shown by an increased incidence of fibroadenoma of the mammary gland (NTP 1986, IARC 1987).

No adequate human studies of the relationship between exposure to dichloromethane and human cancer were found (IARC 1979, 1982, 1999).

Properties

Dichloromethane is a clear, colorless, nonflammable, volatile liquid with a sweet, pleasant, chloroform-like odor. It is slightly soluble in water, alcohols, phenols, aldehydes, ketones, and organic liquids. Dichloromethane is miscible with chlorinated solvents, diethyl ether, and ethanol. It will form an explosive mixture in an atmosphere with a high oxygen content, or in the presence of liquid oxygen, nitrite, potassium, or sodium. When heated to decomposition, it emits highly toxic fumes of phosgene (IARC 1979, 1999, HSDB 2000).

Use

Dichloromethane is used principally as a solvent in paint removers (23% of the dichloromethane produced); WHO (1996) and IARC (1999) noted that the primary use of dichloromethane is based on its solvent properties. It is also used as an aerosol propellant (20%); processing solvent in the manufacture of steroids, antibiotics, vitamins, and tablet coatings (20%); as a degreasing agent (8%); in electronics manufacturing (7%); and as a polyurethane foam blowing agent (5%) (CMR 1986). Dichloromethane is also used in metal cleaning, as a solvent in the production of polycarbonate resins and triacetate fibers, in film processing, in ink formulations, and as an extraction solvent for spice oleoresins, caffeine, and hops (NTP 1986, SRI Int. 1984). Dichloromethane was once registered for use in the United States as an insecticide for commodity fumigation of strawberries, citrus fruits, and a variety of grains (EPA 1969). It is no longer included in any registered pesticide products (HSDB 2000).

According to the EPA Consumer Use and Shelf Survey, dichloromethane is used in spray shoe polish, water repellent/protectors, spot removers, wood floor and panel cleaners, contact cement, super glues, spray adhesives, adhesive removers (general purpose, tile and wallpaper), silicone lubricants (excluding automotive), specialized electronic cleaners (for TV, VCR, razor, etc.), wood stains, varnishes and finishes, paint thinners, paint removers, aerosol spray paints, primers, aerosol rust removers, outdoor water repellents, glass frosting/artificial snow, spray lubricant for cars, transmission cleaners, battery terminal protector, brake quieter/cleaner, and gasket removers. The amount of dichloromethane present

in these products varies both within and among product categories. Not all brands in a particular product category contain dichloromethane. In those products containing dichloromethane, concentrations vary from a low of 0.1% in several categories to a high of 100% in a paint stripper.

Production

Moderate growth in the dichloromethane industry averaged approximately 3% annually from 1970 to 1983. With the increase in the manufacture of water-based aerosol spray systems that do not use dichloromethane, the demand for dichloromethane declined an estimated 1 to 2% per year through 1990 (CMR 1986). The U.S. annual production in 1994 was 403 million lb (ATSDR 2000). From 1991 to 1994, annual production was approximately 350 to 400 million lb. The EPA (OPPT) High Production Volume Chemicals list provided a production volume range of 365 to 651 million lb (EPA 1997). Chem Sources (2001) estimated 43 U.S. companies supplied dichloromethane. In 2000, approximately 33 million lb were imported and approximately 126 million lb were exported (ITA 2001).

Exposure

The primary routes of potential human exposure to dichloromethane are inhalation and ingestion. Dermal absorption has been observed, although it occurs more slowly than absorption after ingestion or inhalation (NTP 1986). The principal route of exposure for the general population to dichloromethane is inhalation of ambient air. Inhalation exposure may also occur through the use of consumer products containing dichloromethane such as paint removers, which results in relatively high levels being found in indoor air (IPCS 1996, WHO 1996, ATSDR 2000). In the surrounding air of rural and remote areas, concentrations between 0.07 to 0.29 $\mu\text{g}/\text{m}^3$ have been measured. In suburban areas, the average concentration is less than 2 $\mu\text{g}/\text{m}^3$, while in urban areas it is less than 15 $\mu\text{g}/\text{m}^3$. Near hazardous waste sites, levels up to 43 $\mu\text{g}/\text{m}^3$ have been recorded (IPCS 1996).

Occupational exposure to dichloromethane occurs during production, primarily during filling and packaging. Because of its use in paint strippers, exposure also occurs during formulation of paint removers, original equipment manufacture, and in commercial furniture refinishing (IPCS 1996). EPA estimated that over one million workers were exposed to dichloromethane (NCI 1987). The National Occupational Hazard Survey, conducted by NIOSH from 1972 to 1974, estimated that 2.5 million workers were potentially exposed to dichloromethane vapors (NIOSH 1976). Based on health hazard evaluations of various U.S. companies conducted in 1973 and 1974 by NIOSH, the concentrations of dichloromethane to which workers exposed in the following occupations were determined: servicing diesel engines, 11 ppm; spray painting booths, 1 to 74 ppm; chemical plant, 0 to 5,520 ppm with an 8-hr TWA of 875 ppm; ski manufacture, 0 to 36 ppm; cleaning foam heads, 3 to 29 ppm; cleaning nozzles in plastics manufacture, 5 to 37 ppm; plastic tank construction, several ppm. A 1973 study of occupational exposure to hair spray propellants determined that dichloromethane exposure of beauticians exceeded a daily mean concentration of 1 to 2 ppm (IARC 1979). The use of dichloromethane in hair sprays has been banned by the FDA (ATSDR 2000). Total on-site releases during 1999 in the United States were listed in EPA's TRI99 (2001); these releases amounted to approximately 36 million lb. This list included 691 facilities that produced, processed or otherwise used dichloromethane in 1999. Annual releases have shown a gradual, steady decline over the past twelve years (131 million lb released in 1988).

Dichloromethane occurs in surface water, ground water, finished drinking water, commercially bottled artesian well water, and surface water sites in heavily industrialized river basins. Higher levels of dichloromethane are typically found in groundwater, since

volatilization is restricted. It was the sixth most frequently detected organic contaminant in groundwater from hazardous waste disposal sites in 1987 with a detection frequency of 19% (ATSDR 2000).

Regulations

CPSC

Products containing dichloromethane must be labeled to indicate that inhalation of dichloromethane vapor has produced cancer in certain laboratory animals and specify precautions that should be taken during consumer use

DOT

Dichloromethane 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 = 4.6 µg/L; based on fish/shellfish consumption only = 590 µg/L

Comprehensive Environmental Response, Compensation, and Liability Act

Reportable Quantity (RQ) = 1,000 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 - U080, F001, F002, F024, F025, K009, K010, K156, K157, K158

Listed as a Hazardous Constituent of Waste

Safe Drinking Water Act

Maximum Contaminant Level (MCL) = 0.005 mg/L

FDA

Dichloromethane may be used as a solvent to prepare modified hop extract, spice oleoresins, and coffee with maximum residual concentrations that range from 5-150 ppm

Dichloromethane is banned from use in cosmetic products

Maximum permissible level in bottled water = 0.005 mg/L

OSHA

Permissible Exposure Limit (PEL) = 25 ppm

Short-Term Exposure Limit = 125 ppm

Guidelines

ACGIH

Threshold Limit Value - Time-Weighted Average Limit (TLV-TWA) = 50 ppm

CPSC

Requests manufacturers to eliminate the use of hazardous chemicals, including dichloromethane, in children's products

NIOSH

Immediately Dangerous to Life and Health (IDLH) = 2300 ppm

Listed as a potential occupational carcinogen

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