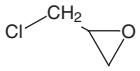
Epichlorohydrin
CAS No. 106-89-8

Reasonably anticipated to be a human carcinogen
First Listed in the *Fourth Annual Report on Carcinogens* (1985)



Carcinogenicity

Epichlorohydrin is *reasonably anticipated to be a human carcinogen* based on sufficient evidence of carcinogenicity in experimental animals (IARC 1976, 1982, 1987, 1999). When administered by gavage, epichlorohydrin induced carcinomas and papillomas of the forestomach in male rats. When administered by inhalation, the compound induced carcinomas and papillomas of the nasal cavity in male rats. Subcutaneous injection of epichlorohydrin produced local sarcomas in female mice. Epichlorohydrin also was active as an initiator in a two-stage skin carcinogenesis study of female mice, but it did not induce tumors when applied alone to the skin.

There is inadequate evidence for the carcinogenicity of epichlorohydrin in humans (IARC 1976, 1982, 1987, 1999). One study of factory workers exposed to epichlorohydrin shows a significant excess of respiratory cancer; however, some of the workers may have also been exposed to diisopropyl sulfate.

Properties

Epichlorohydrin is a colorless liquid with an irritating, chloroform-like odor. It is slightly soluble in water, miscible with alcohol, ether, chloroform, trichloroethylene, and carbon tetrachloride and insoluble in petroleum hydrocarbons (HSDB 2000). Epichlorohydrin hydrolyzes slowly at room temperature and more rapidly in the presence of heat or traces of acid. When heated to decomposition, epichlorohydrin emits toxic fumes of hydrochloric acid and other chlorinated compounds. The commercial product is 98% pure with a maximum of 0.2% water.

Use

Epichlorohydrin has been used in the production of various synthetic materials, including epoxy resins (68% of the epichlorohydrin produced), synthetic glycerin (19%), elastomers (3%), and others (10%) (NCI 1985). It has also been used to cure propylene-base rubbers, as a solvent for cellulose esters and ethers and in resins with high wet-strength for the paper industry (IARC 1999). Epichlorohydrin is also used in the production of Zeospan, a specialty polyether rubber used for automobile parts (Chem. Week 1986). There is widespread use of epichlorohydrin as a stabilizer.

Production

Chem Sources (2001) identified 20 U.S. suppliers of epichlorohydrin. The 1997 *Directory of Chemical Producers* listed two domestic producers of the chemical, with a total output of 725 million lb (SRI 1997). The USITC has listed two companies producing undisclosed amounts of epichlorohydrin since 1980 (USITC 1981-1991, 1993-1995). The Chemical Economics Handbook, however, provided production and import and export data through 1989 (SRI 1991). In 1989, 495 million lb of epichlorohydrin were produced in the United States with 18 million lb imported and 60 million lb exported (SRI 1991).

Exposure

The primary routes of potential human exposure to epichlorohydrin are ingestion, inhalation, and dermal contact. Levels of epichlorohydrin in food, food additives, or food packaging are so low that the potential daily intake through ingestion is minimal. According to the FDA, epichlorohydrin is no longer used in the starch industry. Occupational exposure is possible during its production and during the synthesis of its end products. Evidence suggests that epichlorohydrin is readily absorbed when ingested or inhaled and that it is a systemic poison when absorbed through the skin (NCI 1985, NIOSH 1978). The National Occupational Exposure Survey (1981-1983) indicated that 3,306 workers, including 558 women, potentially were exposed to epichlorohydrin (NIOSH 1984). This estimate was derived from observations of the actual use of the compound (80% of total observations) and the use of trade name products known to contain the compound (20%). The National Occupational Hazard Survey, conducted by NIOSH from 1972 to 1974, estimated that 41,380 people in 58 different occupational categories were potentially exposed to epichlorohydrin in the workplace. This estimate was based only on actual observations of the use of the compound and trade name products containing or suspected of containing the compound (NIOSH 1976). Comprehensive industrial surveys conducted for NIOSH included five facilities: two manufacturing epichlorohydrin and three producing epoxy resins and glycerin. The survey results suggested that chemical operators at these plants had the greatest potential for exposure to epichlorohydrin. Time-weighted averages (TWAs) ranged from nondetectable to 2.1 ppm in the two manufacturing plants and from nondetectable to 0.83 ppm in the resin production plants. A limited number of samples also indicated a relatively high potential for epichlorohydrin exposure for shipping workers in epichlorohydrin production plants (0.06 to 0.28 ppm TWA) (NIOSH 1978, NCI 1985).

EPA's Toxic Chemical Release Inventory (TRI) estimated that 353,964 lb of epichlorohydrin were released to the environment from 48 facilities that produced, processed, or used the chemical in the United States in 1996. Of that total, 93.5% was released to air, 5.9% to water, and 0.6% to land. A facility located in Freeport, Texas, reporting under industrial classifications for manufacture of alkalis and chlorine (SIC Code 2812), industrial gases (2813), industrial inorganic chemicals (2819), plastics materials and resins (2821), industrial organic chemicals (2869), and adhesives and sealants (2891), accounted for 41.4% of the total air emissions and 91.6% of the total water release (TRI96 1998). The total amount of epichlorohydrin released on-site in 1999 (TRI99 2001) was 148,532 lb. Total on-site release data from 1988 showed a continued decrease from the 1988 level of 783,298 lb.

Regulations

DOT

Epichlorohydrin is considered a hazardous material and a marine pollutant 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
- Prevention of Accidental Release: Threshold Quantity (TQ) = 20,000 lb

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
- Reportable Quantity (RQ) = 100 lb
- Threshold Planning Quantity (TPQ) = 1,000 lb

Resource Conservation and Recovery Act
- Listed Hazardous Waste: Waste codes in which listing is based wholly or partly on substance - U041, K017
- Listed as a Hazardous Constituent of Waste

Safe Drinking Water Act
- Treatment Technique: product of dose and monomer level does not exceed 0.01% dosed at 20 mg/L (or equivalent) in drinking water systems

FDA

Food starch may be etherified or esterified by treatment with epichlorohydrin with maximum epichlorohydrin levels ranging from 0.1-0.3% (depending on process)

OSHA

Permissible Exposure Limit (PEL) = 5 ppm (19 mg/m^3)

Guidelines

ACGIH

Threshold Limit Value - Time-Weighted Average Limit (TLV-TWA) = 0.5 ppm

NIOSH

Immediately Dangerous to Life and Health (IDLH) = 75 ppm

REFERENCES

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

ChemWeek. 1986. Chem Week 138(8): 21.

HSDB. 2000. Hazardous Substances Data Base. National Library of Medicine. http://toxnet.nlm.nih.gov/cgi-bin/sis/htmlgen?HSDB.

IARC. 1976. Cadmium, Nickel Some Epoxides, Miscellaneous Industrial Chemicals and General Considerations on Volatile Anaesthetics. IARC Monographs on the Evaluation of Carcinogenic Risk of Chemicals to Humans, vol. 11. Lyon, France: International Agency for Research on Cancer. 306 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.

IARC. 1999. Re-evaluation of Some Organic Chemicals, Hydrazine, and Hydrogen Peroxide. IARC Monographs on the Evaluation of Carcinogenic Risk of Chemicals to Humans, vol. 71. Lyon, France: International Agency for Research on Cancer. 1589 pp.

NCI. 1985. Monograph on Human Exposure to Chemicals in the Workplace: Epichlorohydrin. Technical Report No. 84631. Bethesda, MD: Department of Health and Human Services.

NIOSH. 1976. National Occupational Hazard Survey (1972-74). Cincinnati, OH: Department of Health, Education and Welfare.

NIOSH. 1978. Epichlorohydrin Manufacture and It's Use - Industrial Hygiene Survey. DHEW (NIOSH) Publication No. 78-151. 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.

SRI. 1991. Chemical Economics Handbook. Menlo Park, CA: SRI International.

SRI. 1997. Directory of Chemical Producers, United States, 1997. Stanford Research Institute, Menlo Park, CA: SRI International.

TRI96. 1998. Toxic Chemical Release Inventory 1996. Data contained in the Toxic Chemical Release Inventory (TRI). National Library of Medicine.

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/.

USITC. 1981. Synthetic Organic Chemicals, United States Production and Sales, 1980. USITC Publication No 1183. Washington, D.C.: U.S. Government Printing Office.

USITC. 1982. Synthetic Organic Chemicals, United States Production and Sales, 1981. USITC Publication No 1292. Washington, D.C.: U.S. Government Printing Office.

USITC. 1983. Synthetic Organic Chemicals, United States Production and Sales, 1982. USITC Publication No 1422. Washington, D.C.: U.S. Government Printing Office.

USITC. 1984. Synthetic Organic Chemicals, United States Production and Sales, 1983. USITC Publication No 1588. Washington, D.C.: U.S. Government Printing Office.

USITC. 1985. Synthetic Organic Chemicals, United States Production and Sales, 1984. USITC Publication No 1745. Washington, D.C.: U.S. Government Printing Office.

USITC. 1986. Synthetic Organic Chemicals, United States Production and Sales, 1985. USITC Publication No 1892. 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.

USITC. 1988. Synthetic Organic Chemicals, United States Production and Sales, 1987. USITC Publication No 2118. Washington, D.C.: U.S. Government Printing Office.

USITC. 1989. Synthetic Organic Chemicals, United States Production and Sales, 1988. USITC Publication No 2219. Washington, D.C.: U.S. Government Printing Office.

USITC. 1990. Synthetic Organic Chemicals, United States Production and Sales, 1989. USITC Publication No 2338. Washington, D.C.: U.S. Government Printing Office.

USITC. 1991. Synthetic Organic Chemicals, United States Production and Sales, 1990. USITC Publication No 2470. Washington, D.C.: U.S. Government Printing Office.

USITC. 1993. Synthetic Organic Chemicals, United States Production and Sales, 1991. USITC Publication No 2607. Washington, D.C.: U.S. Government Printing Office.

USITC. 1994. Synthetic Organic Chemicals, United States Production and Sales, 1992. USITC Publication No 2720. Washington, D.C.: U.S. Government Printing Office.

USITC. 1995. Synthetic Organic Chemicals, United States Production and Sales, 1994. USITC Publication No 2933. Washington, D.C.: U.S. Government Printing Office.