1,3-Propane Sultone

CAS No. 1120-71-4

Reasonably anticipated to be a human carcinogen

First listed in the *Fourth Annual Report on Carcinogens* (1985)

Carcinogenicity

1,3-Propane sultone is *reasonably anticipated to be a human carcinogen* based on sufficient evidence of carcinogenicity from studies in experimental animals.

Cancer Studies in Experimental Animals

1,3-Propane sultone caused tumors in two rodent species, at several different tissue sites, and by several different routes of exposure. Administration of 1,3-propane sultone to rats by stomach tube caused brain cancer (glioma of the cerebrum and cerebellum) in both sexes and mammary-gland cancer (adenocarcinoma) in females. The incidences of leukemia and cancer of the small intestine (adenocarcinoma) and ear duct (squamous-cell carcinoma) also were somewhat increased in rats of both sexes (IARC 1974, Weisburger *et al.* 1981). In rats of unspecified sex given weekly or single intravenous injections of 1,3-propane sultone, tumors were observed at various tissue sites, including the brain and nervous system. A single intravenous injection of 1,3-propane sultone to pregnant rats on the 15th day of gestation caused malignant neural tumors and tumors of the pancreas and ovary in the offspring. 1,3-Propane sultone administered by subcutaneous injection caused cancer at the injection site in female mice following repeated injections (adenoacanthoma and sarcoma) and in rats (of unspecified sex) following single or repeated injections (myosarcoma, fibrosarcoma, or sarcoma) (IARC 1974).

Since 1,3-propane sultone was listed in the *Fourth Annual Report on Carcinogens,* additional studies in rodents have been identified. Dermal exposure to 1,3-propane sultone caused tumors of the skin and lymphoreticular tissue in mice of both sexes, and subcutaneous injection of 1,3-propane sultone caused lung cancer (anaplastic adenocarcinoma) in male rats (IARC 1999).

Cancer Studies in Humans

No epidemiological studies were identified that evaluated the relationship between human cancer and exposure specifically to 1,3-propane sultone.

Properties

1,3-Propane sultone exists at room temperature as a colorless liquid or white crystalline solid (Akron 2009, HSDB 2009). In liquid form (at temperatures above 31°C), it has a foul odor. It is very soluble in water and readily soluble in ketones, esters, and aromatic hydrocarbons. It is stable under normal handling and storage conditions, but it may react slowly with water to form an acid compound, 3-hydroxy-1-propanesulfonic acid. When heated to decomposition, 1,3-propane sultone emits toxic fumes of sulfur oxides and carbon monoxide. Physical and chemical properties of 1,3-propane sultone are listed in the following table.

Property	Information
Molecular weight	122.1[a]
Specific gravity	1.393 at 40°C/4°C[a]
Melting point	31°C[a]
Boiling point	180°C at 0.039 atm[a]
Log K_{ow}	–0.28[b]
Water solubility	171 g/L at 25°C[b]
Vapor pressure	0.27 mm Hg at 25°C[b]
Vapor density relative to air	4.2[c]

Sources: [a]HSDB 2009, [b]ChemIDplus 2009, [c]Akron 2009.

Use

1,3-Propane sultone is used as a chemical intermediate to introduce the sulfopropyl group into molecules and to confer water solubility and an anionic character to the molecules (Dado *et al.* 2006, HSDB 2009). It is used as a chemical intermediate in the production of fungicides, insecticides, cation-exchange resins, dyes, vulcanization accelerators, detergents, lathering agents, bacteriostats, and a variety of other chemicals and as a corrosion inhibitor for mild (untempered) steel (IARC 1999, Dado *et al.* 2006).

Production

1,3-Propane sultone was first produced in the United States in 1963 (IARC 1974). In 1974, the only U.S. producer of 1,3-propane sultone manufactured less than 500 kg (1,100 lb) annually (IARC 1974). No information on the global production of 1,3-propane sultone was available in 1999 (IARC 1999). In 2009, 1,3-propane sultone was produced by one manufacturer each in Europe and China (SRI 2009) and was available from 28 suppliers, including 13 U.S. suppliers (Chem Sources 2009). Reports filed in 1986, 1990, and 2002 under the U.S. Environmental Protection Agency's Toxic Substances Control Act Inventory Update Rule indicated that U.S. production plus imports of 1,3-propane sultone totaled 10,000 to 500,000 lb (EPA 2004); no inventory update reports for 1,3-propane sultone were filed in 1994 or 1998.

Exposure

The routes of potential human exposure to 1,3-propane sultone are ingestion, inhalation, and dermal contact. 1,3-Propane sultone is not known to occur naturally. Consumers could potentially be exposed to its residues when using detergents, corrosion inhibitors, and other products manufactured from 1,3-propane sultone. When released to air, 1,3-propane sultone will react with photochemically produced hydroxyl radicals, with a half-life of 8 days, and when released to water or moist soil, it will rapidly hydrolyze (HSDB 2009). 1,3-Propane sultone may occur in the waste streams of industrial facilities making or using it, but is not expected to be present for long periods, because it is readily hydrolyzed (IARC 1974). According to EPA's Toxics Release Inventory, environmental releases of 1,3-propane sultone have not exceeded 750 lb in any year since 1988; in many years, no releases were reported. In 2009, one facility released 260 lb of 1,3-propane sultone, including 250 lb to air and 10 lb to a hazardous-waste landfill (TRI 2009). The potential for occupational exposure is highest for workers involved in the formulation of compounds made from 1,3-propane sultone or the production of its end products (IARC 1974).

Regulations

Environmental Protection Agency (EPA)

Clean Air Act

National Emission Standards for Hazardous Air Pollutants: Listed as a hazardous air pollutant.

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 code for which the listing is based wholly or partly on the presence of 1,3-propane sultone = U193.
Listed as a hazardous constituent of waste.

Guidelines

American Conference of Governmental Industrial Hygienists (ACGIH)

Threshold limit value – time-weighted average (TLV-TWA) = exposure by all routes should be as low as possible.

National Institute for Occupational Safety and Health (NIOSH, CDC, HHS)

Listed as a potential occupational carcinogen.

References

Akron. 2009. *The Chemical Database*. The Department of Chemistry at the University of Akron. http://ull.chemistry.uakron.edu/erd and search on CAS number. Last accessed: 6/4/09.

ChemIDplus. 2009. *ChemIDplus Advanced*. National Library of Medicine. http://chem.sis.nlm.nih.gov/chemidplus/chemidheavy.jsp and select Registry Number and search on CAS number. Last accessed: 6/4/09.

ChemSources. 2009. *Chem Sources - Chemical Search.* Chemical Sources International. http://www.chemsources.com/chemonline.html and search on propanesultone. Last accessed: 6/4/09.

Dado GP, Knaggs EA, Nepras MJ. 2006. Sulfonation and sulfation. In *Kirk-Othmer Encyclopedia of Chemical Technology,* vol. 23. Online edition. New York: John Wiley & Sons. 52 pp.

EPA. 2004. *Non-confidential IUR Production Volume Information.* U.S. Environmental Protection Agency. http://www.epa.gov/oppt/iur/tools/data/2002-vol.html and search on CAS number.

HSDB. 2009. *Hazardous Substances Data Bank.* National Library of Medicine. http://toxnet.nlm.nih.gov/cgi-bin/sis/htmlgen?HSDB and search on CAS number. Last accessed: 6/4/09.

IARC. 1974. 1,3-Propane sultone. In *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. pp. 253-258.

IARC. 1999. 1,3-Propane sultone. In *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. pp. 1095-1102.

SRI. 2009. *Directory of Chemical Producers*. Menlo Park, CA: SRI Consulting. Database edition. Last accessed: 6/4/09.

TRI. 2009. *TRI Explorer Chemical Report*. U.S. Environmental Protection Agency. Last updated: 3/19/09. http://www.epa.gov/triexplorer and select Propane Sultone.

Weisburger EK, Ulland BM, Nam J. 1981. Carcinogenicity tests of certain environmental and industrial chemicals. *J Nat Cancer Inst* 67(1): 75-88.