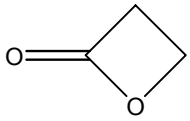
β-PROPIOLACTONE
CAS No. 57-57-8
First Listed in the *Second Annual Report on Carcinogens*



CARCINOGENICITY

β-Propiolactone is *reasonably anticipated to be a human carcinogen* based on sufficient evidence of carcinogenicity in experimental animals (IARC 1974, 1999). When administered by gavage, β-propiolactone induced squamous cell carcinomas of the forestomach in female rats. When applied topically, β-propiolactone induced papillomas that underwent a malignant change to squamous cell carcinomas in mice, and papillomas, melanomas, keratoacanthomas, and squamous cell carcinomas of the skin in male hamsters. When administered by subcutaneous injection, β-propiolactone induced injection-site sarcomas in mice and rats of both sexes, and fibrosarcomas, adenocarcinomas, and squamous cell carcinomas in female mice. A single intraperitoneal injection of β-propiolactone induced lymphomas in mice of both sexes and hepatomas in male mice. Keratoacanthomas and one melanoma developed in guinea pigs that received skin applications of β-propiolactone; however, the significance of these results is questionable because no controls were included in this study.

No data were available to evaluate the carcinogenicity of β-propiolactone in humans (IARC 1974, 1999).

PROPERTIES

β-Propiolactone is a colorless liquid with a slightly sweet odor. It is soluble in water and miscible with ethanol, acetone, diethyl ether, and chloroform (IARC 1999). β-Propiolactone polymerizes during storage and is slowly hydrolyzed in water with a half-life of approximately three hours at 25°C; however, it is stable when stored in glass and refrigerated. It is a highly reactive chemical because of the strained four-membered lactone ring and is incompatible with strong oxidizing agents and strong bases. This chemical poses a moderate fire hazard when exposed to heat or flame, and when heated to decomposition, it emits acrid smoke and fumes of carbon monoxide and carbon dioxide (HSDB 2001, NTP 2001). β-Propiolactone is available in a grade containing 97% minimum active ingredient (IARC 1974).

USE

β-Propiolactone was once a commercially important industrial chemical. At one time, more than 85% of β-propiolactone produced in the United States was used captively to manufacture acrylic acid and esters; however, it has been replaced by other more efficient and less expensive methods (Kirk-Othmer 1978). β-Propiolactone has been used to sterilize blood plasma, vaccines, tissue grafts, surgical instruments, and enzymes; as a vapor-phase disinfectant in enclosed spaces; and in organic synthesis. Its sporicidal action is used against vegetative bacteria, pathogenic fungi, and viruses (IARC 1974, 1999).

PRODUCTION

β-Propiolactone was first produced commercially in the United States in 1958 and one U.S. company produced β-propiolactone from 1958 until at least 1973 (IARC 1974). U.S. production in 1972 was approximately 48.5 million lb, but was less than 1,000 lb in 1975 (HSDB 2001). No other production data were available (IARC 1974, 1999).

Chem Sources (2001) identified five U.S. suppliers for β-propiolactone. No specific data for U.S. imports or exports of β-propiolactone were located.

EXPOSURE

Because it is no longer used as a sterilant in medical procedures or in food, the potential for the general population to be exposed to β-propiolactone is limited. Occupational exposure may occur by inhalation and dermal contact at industrial facilities where it is used as a chemical intermediate (HSDB 2001). Potential exposure to waste effluents from production and manufacturing plants is minimal because of β-propiolactone's short half-life in water (IARC 1974). The National Institute for Occupational Safety and Health (NIOSH) estimated that 575 workers were potentially exposed to β-propiolactone in the U.S. in the National Occupational Hazard Survey conducted from 1972 to 1974 (HSDB 2001). No current exposure estimates were located.

REGULATIONS

EPA regulates β-propiolactone under the Superfund Amendments and Reauthorization Act (SARA), subjecting it to reporting requirements and mandating that emergency response plans be prepared if the threshold planning quantity of 500 lb is reached. EPA has proposed handling and reporting and record-keeping requirements for β-propiolactone under the Resource Conservation and Recovery Act (RCRA). EPA also controls releases of the compound under SARA and under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), with a reportable quantity (RQ) of 10 lb for the compound.

ACGIH recommends a threshold limit value (TLV) of 0.5 ppm (1.5 mg/m^3) for β-propiolactone. OSHA regulates β-propiolactone on the basis of its carcinogenicity in animals under the Occupational Safety and Health Act (OSH Act). The regulation requires protective clothing, use of respirators, training in hygiene, medical surveillance, engineering controls to limit contamination, sign requirements for posting in regulated areas, and labeling requirements for containers. OSHA also regulates β-propiolactone as a chemical hazard in laboratories and under the Hazard Communication Standard. Regulations are summarized in Volume II, Table 154.

REFERENCES

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

HSDB. Hazardous Substances Data Bank. Online database produced by the National Library of Medicine. Beta-Propiolactone. Last updated August 9, 2001. Last review date, August 7, 1991.

IARC. International Agency for Research on Cancer. IARC Monographs on the Evaluation of the Carcinogenic Risk of Chemicals to Man. Some Aromatic Amines, Hydrazine and Related Substances, *N*-Nitroso Compounds and Miscellaneous Alkylating Agents. Vol. 4. 286 pp. Lyon, France: IARC, 1974.

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Kirk-Othmer Encyclopedia of Chemical Technology, Third Edition. Vol. 1. New York, NY: John Wiley and Sons, 1978.

NTP. National Toxicology Program. NTP Chemical Repository. β-Propiolactone. Last updated August 13, 2001. (http://ntp-server.niehs.nih.gov and search 57-57-8).