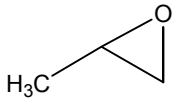
PROPYLENE OXIDE
CAS No. 75-56-9
First Listed in the *Sixth Annual Report on Carcinogens*



CARCINOGENICITY

Propylene oxide is *reasonably anticipated to be a human carcinogen* based on sufficient evidence of carcinogenicity in experimental animals (NTP 1984, IARC 1985, 1987, 1994). When administered by inhalation, propylene oxide induced hemangiomas or hemangiosarcomas of the nasal cavity in mice of both sexes. When administered by inhalation, propylene oxide increased the incidences of papillary adenomas of the nasal turbinates in rats of both sexes (NTP 1984). When administered by inhalation to male weanling rats, the compound increased the incidences of adrenal pheochromocytomas and peritoneal mesotheliomas. When administered by gavage to female rats, propylene oxide produced a dose-dependent increase in the incidence of local tumors, primarily squamous cell carcinomas of the forestomach. When administered by subcutaneous injection to female mice, the compound increased the incidence of local tumors, mainly fibrosarcomas (IARC 1985, 1987, 1994).

No adequate data were available from human studies to evaluate the carcinogenicity of propylene oxide in humans (IARC 1985, 1987, 1994).

PROPERTIES

Propylene oxide is a volatile, clear, colorless, extremely flammable liquid with an ether-like odor. It is soluble in water and miscible with acetone, benzene, carbon tetrachloride, diethyl ether, and methanol. It is sensitive to moisture and polymerizes at high temperature. The vapors may form explosive mixtures with air. Propylene oxide is highly reactive with acids, bases, oxidizing agents, copper and copper alloys, anhydrous metal chlorides, and other chemicals. It is incompatible with chlorine, permanganates, and perchlorates, and can attack some forms of plastics, rubber, and coatings (IARC 1994, HSDB 2001, NTP 2001).

USE

Propylene oxide is used primarily as a chemical intermediate in the production of polyurethane polyols (60% to 65%), propylene glycols (20% to 25%), glycol ethers (3% to 5%), and specialty chemicals. Polyurethane polyols are used to make polyurethane foams; whereas, propylene glycols are primarily used to make unsaturated polyester resins for the textile and construction industries. Propylene glycols are also used in drugs, cosmetics, solvents and emollients in food, plasticizers, heat transfer and hydraulic fluids, and antifreezes. In addition, propylene oxide may be used in fumigation chambers for the sterilization of packaged foods and as a pesticide (IARC 1994, HSDB 2001).

PRODUCTION

Propylene oxide was first prepared in 1860, but commercial production did not begin until the early 1900s (IARC 1985, 1994). U.S. production increased approximately two percent per year between 1988 and 1997 and is expected to remain at two to three percent per year increases through 2004 (Chemexpo 1998, 2001). Annual production ranged from 1.7 billion lb to 3.2 billion lb between 1977 and 1993. In 1995, propylene oxide was the 35th highest volume chemical produced in the U.S. (HSDB 2001). Production was 3.2 billion lb, 3.62 billion lb, and 3.69 billion lb in 1998, 1999, and 2000, respectively. The projected demand for 2004 is 4.07 billion lb. The total production capacity for the five U.S. chemical manufacturing facilities in 2001 was 4.98 billion lb (Chemexpo 1998, 2001). Chem Sources (2001) reported that there were 14 current U.S. suppliers of propylene oxide.

U.S. imports have decreased from approximately 25 to 50 million lb per year in the 1970s and 1980s to approximately 590,000 lb in 2000 (HSDB 2001, ITA 2001). Compared to domestic production, imports have been negligible in recent years. However, annual U.S. exports have increased from approximately 99 to 166 million lb in the 1970s and early 1980s to approximately 650 million lb in 1999 and 2000 (Chemexpo 2001, HSDB 2001, ITA 2001).

EXPOSURE

The primary routes of potential human exposure to propylene oxide are inhalation at the workplace during its use in the production of polyurethane polyols and propylene glycol. Consumer exposure may occur through ingestion of propylene oxide residues in foods from its use as an indirect food additive or by contact with consumer products containing propylene oxide. Consumer products found to contain the highest concentrations of propylene oxide include automotive and paint products. Propylene oxide does not occur naturally (IARC 1994, HSDB 2001).

The National Occupational Hazard Survey, conducted by NIOSH from 1972 to 1974, estimated that 268,433 workers potentially were exposed to propylene oxide. This estimate was derived from observations of the actual use of the compound (11% of total observations), the use of trade name products known to contain the compound (21%), and the use of generic products suspected of containing the compound (67%) (NIOSH 1976). The National Occupational Exposure Survey (1981-1983) indicated that approximately 420,000 workers, including 317,000 women, potentially were exposed to propylene oxide. This estimate was derived from observations of the actual use of the compound (2% of total observations) and the use of materials known to contain the compound (98%) (IARC 1994, HSDB 2001).

EPA's Toxic Chemical Release Inventory (TRI) listed 127 industrial facilities that produced, processed, or otherwise used propylene oxide in 1999 (TRI99 2001). Reported environmental releases of propylene oxide from the original industries were 4.9 million lb, 1.7 million lb, 1.2 million lb, and 728,000 lb in 1988, 1990, 1994, and 1999, respectively. Environmental releases from all industries were approximately 767,000 lb in 1999.

REGULATIONS

EPA regulates propylene oxide under the Clean Air Act (CAA), Clean Water Act (CWA), Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA), Food, Drug, and Cosmetic Act (FD&CA), Resource Conservation and Recovery Act (RCRA), and Toxic Substances Control Act (TSCA). Under CAA, EPA has set standards of performance for propylene oxide leaks in industry and under CWA and CERCLA, has established a reportable quantity (RQ) of 100 lb for propylene oxide, subjected it to handling and reporting requirements, and designating it as a hazardous substance. Propylene oxide is registered under FIFRA as a pesticide to fumigate processed spices, cocoa, and processed nutmeats (except peanuts). Propylene oxide is subject to permitting regulations under RCRA. The Interagency Testing Committee (ITC) has recommended testing for propylene oxide under TSCA. Developmental testing by manufacturers and processors is presently required.

FDA regulates propylene oxide as an indirect food additive in products which may come into contact with food and as an adjuvant for pesticide chemicals.

The American Conference of Governmental Industrial Hygienists (ACGIH) recommends a threshold limit value (TLV) at 2 ppm (4.8 mg/m^3) for propylene oxide. NIOSH recommends that exposure by all routes to propylene oxide be carefully controlled to levels as low as possible. OSHA has established a permissible exposure limit (PEL) of 100 ppm (240 mg/m^3). OSHA also regulates propylene oxide under the Hazard Communication Standard and as a chemical hazard in laboratories. Regulations are summarized in Volume II, Table 155.

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