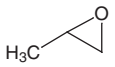
Propylene Oxide
CAS No. 75-56-9

Reasonably anticipated to be a human carcinogen
First Listed in the *Sixth Annual Report on Carcinogens* (1991)



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. Its molecular weight is 58.1, its melting point is -112.13°C, and its boiling point is 34.23°C. Propylene oxide has a specific gravity of 0.8304 at 20°C/20°C and an octanol-water partition coefficient of 0.03. It is soluble in water and miscible with acetone, benzene, carbon tetrachloride, diethyl ether, and ethanol. Propylene oxide is very reactive, particularly with chlorine, ammonia, strong oxidants, and acids. It may polymerize explosively when heated or involved in a fire (IARC 1994, HSDB 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 United States (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

DOT

Propylene oxide 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
- Prevention of Accidental Release: Threshold Quantity (TQ) = 10,000 lb

Comprehensive Environmental Response, Compensation, and Liability Act
- Reportable Quantity (RQ) = 100 lb

Emergency Planning and Community Right-To-Know Act
- Reportable Quantity (RQ) = 100 lb
- Threshold Planning Quantity (TPQ) = 10,000 lb
- Toxics Release Inventory: Listed substance subject to reporting requirements

Federal Insecticide, Fungicide, and Rodenticide Act
- The tolerance for residues of propylene oxide on cocoa bean, gum, nutmeat (except peanuts), and spices = 300 ppm

OSHA

Permissible Exposure Limit (PEL) = 100 ppm (240 mg/m^3)

Guidelines

ACGIH

Threshold Limit Value - Time-Weighted Average Limit (TLV-TWA) = 2 ppm

NIOSH

Immediately Dangerous to Life and Health (IDLH) = 400 ppm

Listed as a potential occupational carcinogen

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