Product Safety Assessment

Propylene Oxide


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Names
- CAS No. 75-56-9
- Propylene oxide
- Propene oxide
- Alkyl epoxide
- 1,2-propylene oxide
- Propene epoxide
- 1,2-epoxypropane
- Epoxypropane
- Methyl ethylene oxide
- Methyloxirane
- 2-methyloxirane

Product Overview
- Propylene oxide is a colorless, low-boiling, highly volatile liquid with a sweet, ether-like smell. It is highly flammable and reactive.\(^1\) For further details, see Product Description.
- Propylene oxide is a chemical intermediate used to make a wide range of industrial and consumer products. It is among the top 50 chemicals produced (by volume) in the world. About 60% of the propylene oxide produced annually by Dow is used to manufacture polyether polyols, a major component of polyurethane foam. Propylene oxide is also an intermediate in the manufacture of cosmetics, pharmaceuticals, household detergents, textiles, and many other products.\(^2,3\) For further details, see Product Uses.
- Exposure can occur either in a facility that manufactures propylene oxide or in the various industrial or manufacturing facilities that use propylene oxide.\(^4\) Dow does not sell propylene oxide for consumer use, so direct consumer contact with this product is unlikely. For further details, see Exposure Potential.
- Eye contact with liquid may cause severe irritation with corneal injury, which may result in permanent impairment of vision, even blindness. Prolonged skin contact is not likely to cause significant irritation unless the product is confined under clothing or gloves. Prolonged excessive inhalation may cause serious adverse effects, even death. Because exposed animals developed tumors in long-term testing, most agencies now regard propylene oxide as a possible or probable human carcinogen.\(^5,6,7\) For further details, see Health Information.
- Propylene oxide is readily biodegradable and photodegrades rapidly in the atmosphere. It is not likely to bioconcentrate and ranges from nontoxic to slightly toxic to aquatic organisms.\(^8\) For further details, see Environmental Information.
- Propylene oxide liquid and vapor are highly flammable. Vapors may travel long distances, accumulate in low-lying areas, and cause a flash fire or explosion. Avoid exposure to sources of ignition.\(^9\) For further details, see Physical Hazard Information.

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The Dow Chemical Company
**Product Safety Assessment:** Propylene Oxide

**Manufacture of Product**
- **Capacity** – In 2012, The Dow Chemical Company and its global affiliates produced nearly 2.3 million metric tonnes (5.0 billion pounds) of propylene oxide, representing about 24% of the world production capacity. Dow and its global affiliates produce propylene oxide at facilities around the world, including but not limited to facilities in Freeport, Texas, and Plaquemine, Louisiana, U.S.A.; Stade, Germany; Antwerp, Belgium; Map Ta Phut, Thailand; Ningbo, China; and Aratu, Brazil.
- **Process** – The two manufacturing processes used by Dow to produce propylene oxide commercially are the chlorohydrin process and the hydroperoxide process. In the chlorohydrin process, propylene is reacted with hypochlorous acid to form propylene chlorohydrin, which is subsequently reacted with sodium or calcium hydroxide to form propylene oxide and sodium or calcium chloride. In the hydroperoxide process, propylene reacts with hydrogen peroxide producing propylene oxide and water, with no significant co-products.

The two reaction sequences are shown below.

![Reaction Sequences](image)

**Product Description**
Propylene oxide is a colorless, low-boiling and highly volatile liquid with a sweet ether-like smell. It is highly flammable and reactive. Propylene oxide reacts readily with alcohols, amines, and acids. Propylene oxide also reacts with water to form propylene glycol.

**Product Uses**
Propylene oxide is an intermediate used in the manufacture of a wide variety of important chemical products such as:
- Polyether polyols (polyglycol ethers), primarily used to make flexible and rigid polyurethane foams and surface-active agents
- Propylene glycols used in the manufacture of unsaturated polyester resins, pharmaceuticals, cosmetics, food, heat-transfer fluids, antifreeze, and aircraft deicing fluids
- Propylene glycol ethers used in solvents and as coupling agents in paints and in the production of coatings, inks, resins, and cleaners
- Polyglycols and other propoxylated derivatives used to produce flame retardants, solvents, metal-working fluids, cosmetics, resins, coatings, varnishes, floorings, automotive parts, and many other products in the construction, paint, food, and pharmaceutical industries.

![Uses for Propylene Oxide (2012)](image)

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Exposure Potential\textsuperscript{14}

Propylene oxide is used in the production of industrial and consumer products. Based on the uses for this product, the public could be exposed through:

- **Workplace exposure** – Exposure can occur either in a facility that manufactures propylene oxide or in the various industrial or manufacturing facilities that use propylene oxide. It is produced, transported, stored, and consumed in closed systems. Those working with propylene oxide in manufacturing operations could be exposed during maintenance, sampling, testing, or other procedures. Each manufacturing facility should have a thorough training program for employees and appropriate work processes, ventilation, and safety equipment in place to limit exposure. See Health Information.

- **Consumer exposure to products containing propylene oxide** – Dow does not sell propylene oxide for consumer use, so direct consumer contact with this product is unlikely. However, propylene oxide is a raw material used to produce finished goods for consumers such as polyurethane foams, paints, cosmetics, and lubricants. Propylene oxide is consumed in the reaction to produce these products and would not be considered to present a risk to consumers. See Health Information.

- **Environmental releases** – In the event of a spill, the focus is on containing the spill to prevent contamination of soil, surface water, or groundwater. Respiratory protection is necessary for cleaning up spills and leaks. Eliminate all sources of ignition immediately. For small spills, wash the spill site with large quantities of water. Do not use absorbents. When released to soil, propylene oxide will quickly evaporate. Once in the atmosphere, it is photochemically degraded by hydroxyl radicals. When released into water, propylene oxide will tend to remain dissolved. It is not expected to adsorb to suspended solids or sediment. Propylene oxide is readily biodegradable, suggesting it will not persist in soil, surface water, and sediment, and will be efficiently removed by wastewater-treatment facilities. Propylene oxide is not expected to bioconcentrate in the environment and is nontoxic to slightly toxic to aquatic organisms. See Environmental, Health, and Physical Hazard Information.

- **Large release** – Industrial spills or releases are infrequent and generally contained. If a large spill does occur, dike the area to contain the spill. Do not use clay-based absorbents or vermiculite. Dilute with large quantities of water and capture, collect, and reprocess or dispose of the product according to applicable governmental requirements. An approved positive-pressure, self-contained breathing apparatus (SCBA) with a full-face mask is recommended for emergency work. Eliminate all sources of ignition immediately. Use only explosion-proof equipment; ground and bond all containers and handling equipment. See Environmental, Health, and Physical Hazard Information.

- **In case of fire** – Deny any unnecessary entry into the area and consider the use of unmanned hose holders. Use water spray or fog, carbon-dioxide or dry-chemical extinguishers, or foam to fight the fire. Use of a direct water stream may spread the fire. Firefighters should wear positive-pressure, self-contained breathing apparatus (SCBA) and protective firefighting clothing. The public should be warned of downwind vapor explosion hazards. Vapors are heavier than air and may travel a long distance and accumulate in low-lying areas. Keep vapors out of sewers. Immediately withdraw all personnel from the area in case of rising sounds from venting safety device or discolorations of the container. Keep fire water out of waterways and sewers to minimize the potential for environmental damage. Follow emergency procedures carefully. See Environmental, Health, and Physical Hazard Information.

For more information, request the relevant Safety Data Sheet from the Dow Customer Information Group.

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Health Information\textsuperscript{15,16,17}

- **Eye contact** – Contact with liquid may cause severe irritation with corneal injury, which may result in permanent impairment of vision, even blindness. Chemical burns may occur. Contact with vapor may cause irritation experienced as mild discomfort and redness.

- **Skin contact** – Prolonged contact is not likely to cause significant irritation unless the product is confined under clothing or gloves. Aqueous solutions may cause more severe effects, including burns. Prolonged or widespread contact may result in absorption of potentially harmful amounts.

- **Inhalation** – In confined or poorly ventilated areas, vapor can readily accumulate and cause unconsciousness and death. Prolonged excessive exposure may cause serious adverse effects, even death. In animal testing, effects have been reported on the lung and central nervous system. Excessive exposure may cause irritation to the upper respiratory tract (nose and throat).

- **Ingestion** – Propylene oxide is moderately toxic if swallowed. Small amounts swallowed incidental to normal handling operations are not likely to cause injury; however, swallowing larger amounts may cause serious injury, even death.
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**Repeated exposure** – In animal studies, effects of repeated exposure have been reported on the lung, upper respiratory tract, and eyes. Repeated excessive exposure may cause injury to nerves of the extremities.

**Cancer risk** – Inhalation studies in laboratory animals suggest that lifetime exposure to high levels of propylene oxide may cause cancer. The EU classifies propylene oxide under the Globally Harmonized System of Classification and Labelling of Chemicals (GHS) as a Category 1B carcinogen (H350: May cause cancer) based on rodent tests where chronic (2-year) inhalation exposure to high levels of propylene oxide resulted in nasal tumors. Based on the same data, it is classified as “B2 – probable human carcinogen” by the U.S. Environmental Protection Agency (EPA). The International Agency for Research on Cancer (IARC) classifies propylene oxide as Group 2B “possibly carcinogenic to humans” based on the same data.

**Other** – Studies of laboratory animals have shown propylene oxide to be toxic to the fetus, but only at doses that were toxic to the mother. It does not cause birth defects in laboratory animals.

For more information, request the relevant Safety Data Sheet from the Dow Customer Information Group.

**Environmental Information**

Propylene oxide is extremely volatile. When released to soil, it will quickly evaporate into the atmosphere. Once in the atmosphere, propylene oxide is photochemically degraded by hydroxyl radicals. Because it is highly soluble in water, once propylene oxide is introduced into water, it will tend to remain dissolved in water and is not expected to adsorb to suspended solids or sediment; in water propylene oxide reacts to form propylene glycol.

Propylene oxide is readily biodegradable, suggesting it will not persist in soil, surface waters, or sediment, and will be efficiently removed in wastewater-treatment facilities. Propylene oxide is not expected to bioconcentrate in the environment.

Propylene oxide is slightly toxic to non-toxic to aquatic organisms. The substance is not considered to be either PBT (persistent bioaccumulative toxic) or vPvB (very persistent and very bioaccumulative), and is not classified for any environmental hazards under the Globally Harmonized System of Classification and Labeling of Chemicals (GHS).

For more information, request the relevant Safety Data Sheet from the Dow Customer Information Group.

**Physical Hazard Information**

Propylene oxide is stable under recommended storage conditions.

Propylene oxide liquid and vapor are extremely flammable. Vapors may travel long distances and are heavier than air. Vapor may cause flash fire or explosion. Vapor concentrations between 1.6 percent and 42 percent in air can explode if an ignition source is present. Avoid exposure to an open flame or heat source. Aqueous mixtures with propylene oxide concentrations as low as 0.75% may be flammable.

Elevated temperatures can cause hazardous polymerization. Avoid temperatures above 50°C (122°F).

Avoid contact with acids, bases, alkali metal hydroxides, aluminum chloride, ferric chlorides, highly active catalytic surfaces, and iron chloride.

Avoid clay-based absorbents and vermiculite.

For more information, request the relevant Safety Data Sheet from the Dow Customer Information Group.
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Regulatory Information
Regulations may exist that govern the manufacture, sale, transportation, use, and/or disposal of propylene oxide. These regulations may vary by city, state, country, or geographic region. Information may be found by consulting the relevant Safety Data Sheet, Technical Data Sheet or Contact Us.

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Additional Information
- Safety Data Sheet (www.dow.com/webapps/msds/msdssearch.aspx)
- Contact Us (www.dow.com/propyleneoxide/contact/)
- “Methyloxirane,” European Chemicals Agency (ECHA) website (http://apps.echa.europa.eu/registered/data/dossiers/DISS-9d84891b-1f36-0270-e044-00144f67d249/DISS-9d84891b-1f36-0270-e044-00144f67d249.html)
- Dow Propylene Oxide website: About Propylene Oxide, The Dow Chemical Company, (www.dow.com/propyleneoxide/about/)
- Propylene Oxide Technical Data Sheet, The Dow Chemical Company, Form No. 117-01528 (www.dow.com/propyleneoxide/info/index.htm)
- Guidelines for the Distribution of Propylene Oxide, Revision 1, CEFIC (European Chemical Industry Council), Revision 2, July 2009 (www.petrochemistry.net/ftp/pressroom/Guidelines_PO_UK_WEB.pdf)
- “Significant Hazards Associated with the Use of Propylene Oxide as a Fuel Additive,” Propylene Oxide Safety Information, Propylene Oxide/Propylene Glycol Panel, American Chemistry Council, CHEMSTAR, May 2003 (www.dow.com/propyleneoxide/info/index.htm)

For more business information about propylene oxide, visit the Dow propylene oxide website at www.dow.com/propyleneoxide/.

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References
4 “1,2-Propylene Oxide CASRN: 75-56-9,” Hazardous Substance Data Bank (HSDB), TOXNET, U.S. National Library of Medicine, Human Exposure.
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19 Guidelines for the Distribution of Propylene Oxide, Propylene Oxide/Propylene Glycols Cefic Sector Group, CEFIC (European Chemical Industry Council), Revision 2, July 2009, page 9.
21 “1,2-Propylene Oxide CASRN: 75-56-9,” Hazardous Substance Data Bank (HSDB), TOXNET, U.S. National Library of Medicine, Environmental Fate.

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