Propylene oxide
Product Stewardship Summary

CAS number: 75-56-9
Chemical formula: C3H6O

What is Propylene oxide?

Propylene oxide (PO) is a colourless, reactive liquid with an ether-like odour.

It is used primarily as a building block for the manufacture of a versatile range of derivative products. There are a number of known technologies to produce propylene oxide but Shell chemicals companies and their joint ventures employ the Shell proprietary ‘SM/PO’ technology.

How is Propylene oxide used?

Propylene oxide is used as a chemical building block in a range of products. Examples of these so-called PO-derivative products are:

- polyether polyols (poly-alcohols) for use in urethane applications such as rigid foam, flexible foam, and Coatings, Adhesives, Sealants & Elastomer (CASE) systems;
- polyether polyols for use in non-urethane applications such as surfactants and oil demulsifiers;
- propylene glycol for aeroplane de-icers, fibreglass-reinforced unsaturated polyester resins, and hydraulic fluids;
- propylene oxide glycol ethers and propylene carbonate solvents;
- butanediol for engineering plastics and fibres;
- polyalkylene glycol fuel additives and lubricants;
- modified starches and allyl alcohols.

Health, Safety and Environmental considerations

Propylene oxide is harmful by inhalation, contact with skin and if swallowed. Its vapours may have effects on the central nervous system. Propylene oxide is not an aspiration hazard. It is irritating to the eyes and the respiratory system, but not to skin as recent data have shown. Some cases of skin sensitisation (dermatitis) in humans have been reported, however, tests with laboratory animals did not indicate a sensitising potential.

Propylene oxide is classified as a germ cell mutagen as a consequence of its ability to form DNA adducts and positive results in genotoxicity test systems. However, none of the in vivo tests in laboratory animals has been positive.
Propylene oxide is classified as a presumed human carcinogen (category 1B) based on the formation of nasal tumours in rodents with a complex mode of action suggesting a threshold for carcinogenesis well above occupational or environmental exposure levels.

Propylene oxide is classified by the International Agency for Research on Cancer (IARC) as possibly carcinogenic to humans (category 2B) and listed by the US national toxicology program (NTP) as a reasonably anticipated human carcinogen. It has not been shown to be a developmental toxicant nor does it impair fertility.

The American Congress of Governmental Hygienists (ACGIH) Threshold Limit Value (TLV) is two parts per million (2 ppm). This is based on an eight-hour day or 40 hours per week.

Propylene oxide is an extremely flammable liquid based on a flashpoint of -38 °C and a boiling point of 35 °C. There is an extreme risk of vapour ignition at normal handling temperatures. The vapour density (=2.05) is heavier than air and will spread along the ground if released, so care needs to be taken to ensure that the vapour is not ignited by a distant source. It will float and can be ignited on surface water. Electrostatic charges may be generated during handling. Propylene oxide does not need to be classified as explosive, although the presence of the 1,2-epoxide indicates potential explosive properties, but the oxygen balance is -220 suggesting that it is non-explosive.

Hydrolysis of propylene oxide may occur in the presence of water and lead to polymerisation, which will have an impact on product quality. The aquatic toxicity of propylene oxide indicates low toxicity, with fish being the most sensitive species with an LC50 of around 50 mg/l. This leads under the terms of the EU CLP Regulation to no classification, under UN GHS criteria, however, to an acute aquatic hazard category 3 (H402).

Propylene oxide is readily biodegradable under aerobic conditions and does not bioaccumulate significantly on the basis of its low partition coefficient (log Kow) of 0.055. Therefore, it is not expected to be persistent in the environment.

Storing and transporting Propylene oxide

Propylene oxide is mainly transported by rail and road in dedicated containers made from stainless steel and fitted with nitrogen (inert/fire prevention) blanketing. The temperature during storage and transportation should not exceed 30°C/86°F.

Precautionary measures against static discharges must be undertaken during loading and unloading and all operators must wear personal protective equipment.

Storage tanks must be clean, dry and rust free and protected from direct sunlight, ignition sources or other sources of heat. Vapours from the storage tank should not be released to the environment but controlled through a suitable vapour treatment system. Propylene oxide nitrogen systems must not be shared with supplies of acids, amines, or catalysts in order to avoid accidental product
contamination and potential uncontrolled polymerisation. Likewise, the ingress of water has to be prevented.

Risk Characterization Summary

Risks associated with exposure to this product have been evaluated for the following “chain-of-commerce” activities: manufacture, storage, product transfer, transportation, and customers/markets. Due to health, safety and environmental considerations, it is only manufactured, stored and transported to customers in closed systems. Likewise, customers are limited to those who only use the product in closed systems as an intermediate for the manufacture of other chemicals. Proper equipment design and handling procedures maintain low risk from exposure to the product where the product is used as a chemical intermediate.

This product stewardship summary is intended to give general information about the chemical or categories of chemicals addressed. It is not intended to provide an in-depth discussion of health and safety information. Additional information is available through the chemical’s applicable Material Safety Data Sheet, which should be consulted before use of the chemical. This product stewardship summary does not supplant or replace required regulatory and/or legal communication documents.

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