

Product Safety Summary

Ethylene Oxide

This Product Safety Summary is intended to provide a general overview of Ethylene Oxide. The information on the Summary is basic information and is not intended to provide emergency response information, medical information or treatment information. The summary should not be used to provide in-depth safety and health information. In-depth safety and health information can be found on the current Material Safety Data Sheet (MSDS) for Ethylene Oxide.

Chemical Identity

Abbreviations:	EO, EtO
CAS Number:	75-21-8
Formula:	CH ₂ CH ₂ O
Common Names:	Epoxyethane Dimethylene oxide Oxirane Oxacyclopropane

Product Overview

- Ethylene oxide is primarily used as a chemical intermediate for the production of ethylene glycol, nonionic surfactants, glycol ethers, ethanol amines, and multifunctional ethylene glycols.
- Ethylene oxide is also used as a sterilant and fumigant in the medical and health product fields. As a fumigant it is used in spices, packaged cereals, tobacco, clothing and for valuable packaged documents.
- Like any reactive chemicals, ethylene oxide can create hazards if handled carelessly. All persons associated with the production, transportation, storage or handling of ethylene oxide must understand the hazards. This includes training in the recommended handling procedures for both non-emergency and emergency situations.
- Primary physical hazards associated with ethylene oxide are that it is extremely flammable and highly reactive.
- The primary health hazards with ethylene oxide are from inhalation of its vapors or direct contact with the skin. Airborne limits have been established for ethylene oxide vapor concentrations in the work environment. The American Conference of Governmental Industrial Hygienists (ACGIH) has established a threshold limit value (TLV) of 1 ppm for an eight hour time-weighted average basis. The Occupational Health and Safety Administration (OSHA) has set a permissible exposure limit (PEL) of 1 ppm for an eight hour time-weighted average.
- The odor threshold for ethylene oxide is 700 ppm, so over exposure to ethylene oxide can occur before its odor can be detected.
- For detailed safety and health information, please reference the current Material Safety Data Sheet (MSDS) for this substance.

Physical/Chemical Properties

- Ethylene oxide is a colorless gas with a sweet odor.
- Ethylene oxide is lighter than water, the specific gravity of ethylene oxide is 0.88.
- Ethylene oxide is completely soluble in water and is soluble in most organic solvents.
- Ethylene oxide is heavier than air, the vapor density of ethylene oxide is 1.52 .
- The Boiling point of ethylene oxide is 11°C (51°F) and the Freezing point is -112°C(-169°F).
- The Flash point, the temperature at which its vapors can be ignited, of ethylene oxide is -30°C (-22°F).
- At room temperature, ethylene oxide is an extremely flammable and reactive gas.
- Ethylene oxide is highly reactive and potentially explosive when heated or in the presence of ammonia, amines, alkali metal hydroxides and highly active catalytic surfaces.

Health Information

Ethylene oxide is a potentially hazardous material. A thorough knowledge of potential dangers, with strict adherence to recommended safety practices, is essential before ethylene oxide products are handled, stored or used. Workers must be properly instructed and supervised in the handling of ethylene oxide.

Acute Hazards

The primary health hazards with ethylene oxide are from inhalation of its vapors or direct contact with the skin. Limits have been established for allowable vapor concentrations in the work environment. ACGIH has a threshold limit value (TLV) of 1 ppm for an eight hour time-weighted average basis. OSHA has a permissible exposure limit (PEL) of 1 ppm for an eight hour time-weighted average. Note that the odor threshold, the minimum concentration that can be detected by odor, for ethylene oxide is 700 ppm - 700 times higher than allowable work place vapor concentrations,

Ethylene oxide exposure may produce central nervous system depression and immediate local irritation of the skin, eyes, nose, throat and lungs. At high doses, ethylene oxide may cause accumulation of fluid in the lungs, immediately or up to 12 hours or more after exposure.

Effects on Respiratory System:

Exposure to ethylene oxide mists or vapors at levels above the recommended exposure limits may cause irritation to the respiratory tract. Exposure to concentrations as low as 200 ppm, can produce rapid onset of nose and throat irritation. Higher concentrations may cause inflammation of the trachea and bronchi. High exposure could result in pulmonary edema, an accumulation of fluid in the lungs. Acute pulmonary edema may evolve up to 12 hours or more after exposure.

Effects on Eyes:

Ethylene oxide is considered to be an eye irritant and may cause redness and swelling. Contact directly with the eye can result in severe corneal burns and may result in irreversible injury.

Effects on Skin:

Skin contact with ethylene oxide gas or in solutions with water may cause may result in irritation and a mild discoloration. Repeated or prolonged contact may cause redness, swelling, blistering or burns. Skin reactions may be delayed up to 12 hours or more after exposure. Contact with liquefied ethylene oxide can result in frostbite.

Effects on Ingestion:

Ingestion of ethylene oxide is unlikely because it is a gas at room temperature. The effects of ingestion include the irritation and burning of the mouth, throat, esophagus and stomach. Ethylene oxide is considered to be moderately toxic by ingestion and may cause nausea, vomiting and abdominal pain. Drink large quantities of water and DONOT induce vomiting.

Chronic Hazards

Ethylene oxide may cause heritable genetic damage; EO was mutagenic in various test systems with microorganisms, mammalian cell culture and mammals. Ethylene oxide may cause cancer, in long term studies in rats and mice exposed by inhalation, a carcinogenic effect was observed. The results of animal studies gave no indication of a reproductive effect but the potential to cause developmental toxicity can not be excluded when exposed to high doses. The current ACGIH TLV/OSHA PEL of 1 ppm, which include a suspected human carcinogen notation, protects against potential adverse health effects.

Environmental Information

Because of its reactivity, ethylene oxide is generally not persistent in the environment. It disperses via a combination of mechanisms, including biodegradation, oxidation, and volatilization.

Ethylene oxide is acutely harmful to aquatic life and organisms, but due to rapid oxidation, is not persistent in aquatic environments.

A variety of federal, state and local regulations govern the release of any material to the land, air or surface waters. Any release or discharge of ethylene oxide must be evaluated in reference to these regulations to determine appropriate response actions and reporting requirements.

A regulation called the Resource Conservation and Recovery Act (RCRA) governs the disposal of ethylene oxide or material contaminated with ethylene oxide. Based on RCRA criteria, ethylene oxide or materials contaminated with ethylene oxide will likely be considered a "Hazardous Waste" upon disposal and certain storage, handling and disposal restrictions outlined in RCRA must be followed. Strict adherence to these restrictions, as well as proper characterization and labeling of the material is the responsibility of the generator and handler of the waste material.

Emphasis should be placed on the prevention of releases through careful design of equipment and sound operating procedures. If ethylene oxide is lost from containment through a leak or spill, care should be taken to use the proper personal protective equipment, decontamination procedures and other safety considerations. It is important to remember that spills of ethylene oxide and materials contaminated by ethylene oxide must be handled as RCRA hazardous wastes.

Any release of ethylene oxide greater than 10pounds, the "reportable quantity" designated by the EPA in CERCLA or SARA, should be reported immediately on discovery to the National Response Center and State Emergency Response Agency

In the event of accidental spillage of ethylene oxide to surface waters or to a municipal water system, contact the local and state pollution control agencies immediately.

Additional Hazard Information

The National Fire Protection Association (NFPA) standard provides a readily recognized, easily understood system for identifying specific hazards and their severity using a numerical rating, ranking hazards from 0, lowest, to 4, highest, to describe in simple terms the relative hazards of a material. It addresses the health, flammability, instability, and related hazards that may be presented as short-term, acute exposures that are most likely to occur as a result of fire, spill, or similar emergency. Under NFPA criteria, Ethylene oxide is classified with the codes Health: 3, Fire: 4 and Reactivity: 3.

The Hazardous Materials Identification System, HMIS III, was developed to help employers comply with OSHA's Hazard Communication HMIS uses a similar 0 to 4 rating system as the NFPA ratings, however while NFPA is meant primarily for fire fighters and other emergency responders, HMIS attempts to convey full health warning information to all employees. Ethylene oxide is classified with the codes Health: 3*, Flammability: 4 and Physical Hazard: 3.

Ethylene Oxide is classified by the US Department of Transportation (DOT) as a primary poison gas hazard (Division 2.3) with a subsidiary hazard as a flammable gas (Division 2.1) and carries the designation of "materials poisonous by inhalation" (PIH).

Ethylene oxide is stable when stored and handled under recommended conditions. However, shelf life is reduced exponentially with increasing temperature, so exposure to high temperatures must be avoided.

The polymerization of ethylene oxide can be very violent, evolving considerable heat and pressure and ejecting hot vapor and polymer, which may auto ignite. An explosion hazard may exist with rapid pressure build up in closed containers.

Exposure Potential

Consumers are not generally exposed to these compounds in finished products. Although potential for exposure does exist during ethylene oxide manufacture, transportation and use, enclosed systems limit the exposure to worker populations and nearby communities. Exposure to the general public may occur in accidental situations. Ethylene oxide is not intended for the general use by the general public.

Ethylene oxide should only be handled by knowledgeable, well-trained personnel who thoroughly understand the hazards associated with the transportation, storage and use of the chemical.

Workplace exposure should be limited by the use of engineering controls. Ethylene oxide vapors must be monitored and controlled below applicable regulatory limits. Ethylene oxide should be processed within a closed system. Worker exposure can potentially happen from leaks in piping system, during repair or replacement of the piping system or during removal of a sample for quality control purposes.

Regulations involving hazardous chemicals are continually evolving and thus exposure guidelines are reviewed regularly and modified whenever new information dictates a change. It is important that all companies handling ethylene oxide are aware of the current legislative requirements.

The guidelines established by OSHA, ACGIH, NIOSH and others, represent current thinking and are believed to be conservative and protective of occupational workers. There is not guarantee of absolute safety.

Risk Management

Consumers are not generally exposed to Ethylene Oxide. The potential workplace hazards associated with ethylene oxide can be avoided if workers are adequately instructed in supervised on the proper procedures of handling ethylene oxide.

Personal protective equipment (PPE) should be selected based on the potential for exposure to particular chemical(s), and the unique properties of that chemical. In general, PPE is not an adequate substitute for appropriate workplace controls (such as ventilation), or other safe work practices. There may be situations when the only practical means of preventing employee exposure is through the effective use of PPE. When PPE is provided to employees, they must be trained in how, where, when, and why the equipment should be used. The facility must also have provisions for decontaminating and replacing such equipment as necessary.

Eye protection in the form of chemical splash goggles should be worn to prevent ethylene oxide from accidentally splashing in an employee's eye. Goggles should be non-vented, and designed specifically to protect against chemical splash. If an employee wears corrective lenses, chemical goggles should be worn over the lenses. Contact lenses are not recommended for use in areas where there is a potential for exposure to ethylene oxide. Vapors can collect behind contact lenses and may cause severe damage to the eye and/or cause the contact lenses to adhere to the eyes.

Skin protection may be found in many forms and proper equipment should be selected on the basis of potential exposure. Hand protection such as chemical resistant gloves, protective arm sleeves, aprons, full body coveralls, boots, and head coverings are among the types available. Skin protection must be made of a material impervious to ethylene oxide. Skin protection for the purpose of preventing chemical exposure may be worn in conjunction with other types of PPE. For example, steel toe safety shoes may be required to prevent a person's foot from being crushed, but an additional boot cover may be required to prevent ethylene oxide permeation into the safety shoe. Skin protection PPE is available in a variety of sizes, and should be available in a size that fits the employee wearing it. Improperly sized PPE may compromise its effectiveness and create additional safety hazards. When skin protection PPE is used, there must be a means of cleaning or disposing of used PPE.

Respiratory protection should be worn if there is potential to ethylene oxide inhalation. The appropriate type of respirator must be selected to provide the appropriate level of protection for the anticipated degree of exposure to airborne ethylene oxide vapor. Detailed guidance for the selection of respiratory protection can be found in The American National Standards Institute Document Z88.2. Respiratory protective equipment should be approved by NIOSH. It must be carefully maintained, inspected, and cleaned. All employees required to wear respiratory protection must be medically cleared to do so (this ensures their physical capability to wear a respirator) and trained to use and care for the equipment. OSHA requirements for respiratory protection can be found in 29 CFR 1910.134.

Properly designed emergency showers and eyewash fountains should be placed in convenient locations wherever ethylene oxide is used. All employees should know the location and operation of this equipment. All equipment must be frequently inspected to make sure they are in proper working condition.

Federal/Science Findings

U.S. Environmental Protection Agency

<http://www.epa.gov/ttn/atw/hlthef/ethylene.html>

U.S Department of Labor – Occupational Safety and Health Administration (OSHA)

<http://www.osha.gov/SLTC/ethyleneoxide/standards.html>

http://www.osha.gov/dts/chemicalsampling/data/CH_240450.html

American Conference of Governmental Industrial Hygienists (ACGIH)

<http://www.acgih.org>

Contact Information

<http://www.basf.com>

References

"Ethylene Oxide (CH_2O)", BASF Chemical Emergency Medical Guidelines, November 1998.

"Ethylene Oxide Chemical Background", National Safety Council (NSC) website, June 29, 2002.

"Ethylene Oxide", Technology Transfer Network Air Toxics Web site, U.S. EPA website, January 2000.

"Ethylene Oxide", Safety Data Sheet, BASF Corporation, Version 2.1, August 31, 2007

"Ethylene Oxide, Product Stewardship Guidance Manual", American Chemistry Council, Third Edition, May 2007.

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