Shell Chemicals

Ethylene Oxide

Safety Literature

SCSN:23-95

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Version 2

BE SAFE Read our product safety information and pass it on (product liability law requires it).

In case of accident or exposure, notify your supervisor immediately

DANGER! Ethylene oxide (EO) is an extremely flammable, highly reactive and toxic compound. The vapors are explosive. Contamination with many materials including metal oxides, metal halides, acids and alkali metal hydroxides can lead to runaway polymerization which always generates heat and can be explosively violent.

The liquid vaporizes very rapidly and can produce severe eye and skin burns. EO may cause delayed skin burns even if only dilute solutions remain on the skin. Short-term exposure to vapors can result in difficulty in breathing, coughing, lung irritation, dizziness, nausea, vomiting, unconsciousness, and even death. Longer exposure to lower concentrations may cause severe damage to the lungs, nervous system, reproductive system and other organs.

Ethylene oxide is also toxic to the developing fetus and is mutagenic, suggesting it may cause hereditary defects. EO is a known animal carcinogen and there is limited evidence that it may cause cancer in man. EO is regulated by OSHA as a cancer and reproductive hazard.

Training, proper protective equipment and strict adherence to recommended and precise workplace practices are essential whenever ethylene oxide is handled, used or stored.

Inhalation hazard

Do not breathe vapor.

EO vapor is strongly irritating to the eyes and respiratory passages. It is rapidly absorbed when inhaled. Prolonged or repeated exposure to high vapor concentrations may result in damage to lungs, central nervous system, reproductive and other organs, and can be fatal.

The Occupational Safety and Health Administration (OSHA) has established the following occupational exposure limits for EO vapor in air:

1. permissible exposure limit (PEL) of 1 part per million (1 ppm), determined as an 8-hour time-weighted average (TWA);

2. 15 minute excursion limit of 5 ppm.

If EO concentrations are found to exceed the action level of 0.5 ppm (8-hour TWA), requirements such as periodic employee exposure monitoring and medical surveillance are triggered. These low concentrations are not detectable by smell. Therefore, workplace air monitoring is required to be sure that EO concentrations are below the permissible levels.

Ethylene oxide has a sweet, pungent ether-like odor. It's odor threshold is above 250 ppm. Therefore, ***IF YOU SMELL ETHYLENE OXIDE, YOU ARE INDANGER.*** Put on your respirator or leave the area immediately. Notify your supervisor at once. ***REMEMBER,*** absence of EO odor does not assure low enough exposure levels; its vapor may deaden the sense of smell.

You must have good ventilation when working with ethylene oxide. Use local explosion-proof exhaust ventilation as necessary to keep vapor concentrations below the levels permitted by OSHA. For tasks such as sampling, loading and unloading of EO tank cars where engineering controls are generally infeasible, OSHA permits the use of respirator as primary protection.

If occupational exposure to EO may or does exceed 1 ppm, respiratory protection is required. Use a NIOSH-approved, atmosphere-supplying, full-facepiece respiratory in pressure-demand mode. NIOSH has approved a full-facepiece canister respirator equipped with an end-of-service life indicator for airborne concentrations of EO less than 50 ppm.

Extremely Flammable and Explosive

Eliminate all sources of ignition.

Ethylene oxide vapors can catch fire readily and explode. Even small amounts of ethylene oxide in air are flammable (as little as 3%). Spilled liquid EO should be water diluted to at least 22:1.

No smoking. Keep EO away from heat, sparks and flames of any sort. Concentrated vapors are invisible and heavier than air, and can travel along the ground to remote sources of ignition.

Ethylene oxide must be stored in approved pressure vessels in a cool, well ventilated area or in properly designed storage systems. Sprinkler systems in storage areas are highly desirable for fire control and to cool containers exposed to intense heat from fires.

If an EO storage vessel does become enveloped by fire, the vapor may be heated above the auto-ignition temperature. Ignition within the vessel may be initially prevented by proper dilution of vapor phase with an inert gas, such as nitrogen, which is free

of reactive contaminants like air, acetylene, sulfur, hydrogen sulfide, water, ammonia or carbon dioxide. If EO vapor in a storage vessel, enveloped by fire, is heated to its decomposition temperature, the vapor will decompose violently, causing the storage vessel to explode.

Containers must be well grounded when transferring liquid ethylene oxide.

Highly Reactive

Prevent contamination and uncontrolled reactions.

Ethylene oxide can react violently with highly active catalytic surfaces such as anhydrous chlorides of iron, tin and aluminum, pure oxides of iron and aluminum, metallic potassium, iron dust, alkali metal hydroxides, acids, organic bases and ammonia. These reactions give off heat and can become explosively violent.

The following metals must ***not*** be used in equipment that comes in contact with EO: copper and copper alloys, silver and silver alloys, magnesium and magnesium alloys, stainless steel (416 and 442 grades), cast iron and mercury. Natural rubber and asbestos should also ***not*** be used. Additionally, alkaline insulating materials, such as magnesia, should be avoided because they lower EO's auto-ignition temperature.

Closed process systems must be used when carrying out reactions with ethylene oxide. If at all possible, processes should be located outdoors. Explosion-resistant construction is recommended for areas in which ethylene oxide is used.

Reactions with ethylene oxide may speed up if the heat generated exceeds the heat removal capacity of the system. A runaway reaction may result unless there is adequate control. Small scale tests should be made to ensure the safety of the intended operation. Add the ethylene oxide to the other reactants.

Poison

Practice good personal hygiene.
Do not eat, drink or smoke in areas where ethylene oxide is handled, processed or stored. Wash your hands thoroughly with soap or mild detergent and water before eating, drinking, smoking or using toilet facilities.

Corrosive

Do not get on skin or in eyes.
If left in contact with the skin, ethylene oxide and even its dilute solutions may not be detected, and can produce severe chemical burns in a short period of time with poor or no warning properties.

Severe eye injury can occur on contact with ethylene oxide.

When there is danger of contact with EO, wear chemical goggles or full-facepiece respirator. Wear EO-resistant clothing and gloves where there is potential for contact. ***Cotton or leather goods are penetated easily and offer no protection.*** For recommendations on protective clothing, consult the Shell EO Material Safety Data Sheet.

Porous clothing that is wet with ethylene oxide must be removed immediately and affected body areas washed thoroughly with soap and water. This clothing should not be reworn until the ethylene oxide is removed completely.

Leather articles (including shoes) cannot be decontaminated and should be destroyed.

Containers

Hazardous when emptied.
Even though DOT regulations (49 CFR 173.323) require each empty EO tank car to be padded with dry nitrogen (or other suitable dry inert gas), such containers still contain residual vapor or liquid and are highly dangerous; all safety precautions must be observed. Containers should not be used for other service unless they have been decontaminated under conditions approved by a safety professional familiar with all the hazards.

In Case of Fire

Evacuate the area except for personnel involved in firefighting duties.
Personnel must be trained for firefighting and must wear full bunker gear (helmet with face shield, bunker coats and pants, gloves and rubber boots) and NIOSH-approved full-facepiece, atmosphere supplying, positive pressure, breathing apparatus.

Use dry chemical or CO2 on small fires. Use water fog or alcohol foam on large fires. If safe to do so, shut off source of ethylene oxide supply. Large fires should be fought from behind explosion-resistant barricades or with unmanned hose monitors.

Let the fire burn itself out unless the leak can be stopped immediately. If the fire is prolonged and uncontrollable and the material is confined in a container exposed directly to flame, evacuate the area. An explosion could occur. EO furnishes its own oxygen. Therefore, it can burn without air and, under certain conditions, it will burn in inert atmospheres.

EO must be water-diluted in an open area by at least 22:1 before the mixture is no longer flammable. Thus, fires involving large quantities of ethylene oxide are difficult to extinguish even though it is water soluble. Such fires may be extinguished, but can reignite and burn until extremely large volumes of water have been applied. Also, EO that is burning can flash back into containers resulting in an explosion.

Cool storage tanks and other containers with water if they are exposed to fire.

Keep unauthorized people away

Remember

Repeated or prolonged exposure to ethylene oxide can cause severe and lasting lung, central nervous system and reproductive system damage. High concentrations can cause death. Ethylene oxide is a cancer hazard, a reproductive hazard and is mutagenic to animals, plants and bacteria.

Notify your supervisor at once if you have been splashed with liquid ethylene oxide or have been exposed to unusual vapor concentrations.

If you have any questions about ethylene oxide, ask your supervisor before transporting or working with it.

In Case of Spills or Leaks

Evacuate the area.
Be ready for fire.
When in a spill area, wear protective suits and gloves that are recommended in the Shell EO Material Safety Data Sheet to prevent skin contact. Also wear a NIOSH-approved, atmosphere supplying, positive pressure, full-facepiece respirator. If safe to do so, shut off the ethylene oxide source.

Ethylene oxide vapors are explosive in air and, under certain conditions, in inert atmospheres. Eliminate source of ignition (heat, sparks and flames of any sort). Be prepared for ignition. Since the danger of fire is so great, bunker gear worn over protective clothing is highly recommended.

In case of large spills, DOT recommends evacuating in all directions at least 400 ft. Be ready for fire or explosion. Notify Authorities. DOT further recommends evacuation of downwind areas to at least 0.2 miles (day) and 0.6 miles (night). For small spills, DOT recommends evacuating in all directions at least 200 ft. and evacuation of downwind areas to at least 0.1 miles (day) and 0.2 miles (night).

Allow residue or small spills to evaporate or dilute with large amounts of water (>=22:1).

EVEN SMALL SPILLS SHOULD BE KEPT OUT OFSEWERS OR ANY PUBLIC WATER SUPPLY.
Notify authorities at once if this occurs or may be possible.

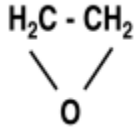
In Case of Exposure

Get medical attention.
If you smell ethylene oxide, immediately put on NIOSH-approved, atmosphere-supplying, positive pressure, full-facepiece respiratory equipment or leave the area.

If a person is overcome, move the victim to fresh air at once. If not breathing, give artificial respiration, preferably mouth to mouth. If respiration is difficult, administer oxygen. Remove contaminated clothing at once and wash affected areas. Avoid contamination from victim to rescuer.

In case of contact with liquid, remove contaminated clothing and shoes immediately. Flush eyes or skin with water for at least 15 minutes. Destroy contaminated shoes and other leather articles.

Ethylene Oxide



Properties	
Molecular weight	44.05
Specific gravity, 68/68 °F (liquid)	0.871
Density, 20 °C, lbs/gal (liquid)	7.25
Boiling point, 760 mm Hg, °F	50.9
Freezing point, 760 mm Hg, °F	-170
Decomposition temperature of vapor (in absence of air), 760 mm Hg, °F	1040
Auto-ignition temperature of vapor, 760 mm Hg, °F	804
Flash point	
Tag open cup, °F	below 20
Tag closed cup, °F	below 0
Solubility in water	complete
Flammable limits in air at 1 atm:	
Lower limit, % by vol.	3
Upper limit, % by vol.	100
Vapor pressure, mm Hg:	
at 32 °F	493
at 68 °F	1095
Critical pressure, psia (vapor)	1043
Critical temperature, °F (vapor)	385

For 24 hour EMERGENCY assistance in the US call CHEMTREC 800-424-9300. Please consult the country specific MSDS for other local emergency response numbers.

Remember

Use Protective Equipment

Practice Good Personal Hygiene

In case of accident or exposure act at once

If you have any question on the use of Ethylene Oxide and would like further information, call us at the appropriate number listed below. **Do not use emegency number, except for emergencies.**

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