Chemicals: Sorting through the known, the unknown and the need to know

Charlotte Brody, RN
Director of Chemicals, Public Health and Green Chemistry
BlueGreen Alliance
www.bluegreenalliance.org
14 unions and environmental organizations with 14 million members

- United Steelworkers (USW)
- Sierra Club
- Amalgamated Transit Union (ATU)
- American Federation of Teachers (AFT)
- Communication Workers of America (CWA)
- Laborers International Union of America (LiUNA)
- National Wildlife Federation (NWF)
- Natural Resources Defense Council (NRDC)
- Service Employees International Union (SEIU)
- Sheet Metal Workers International Union
- Union of Concerned Scientists
- United Automobile Workers of America (UAW)
- United Food and Commercial Workers International Union (UFCW)
- Utility Workers Union of America
Good Jobs: The Loss of Manufacturing Jobs

Counties with at least 50% employment in manufacturing in 1970 and 2006
Clean and Healthy Environment
Green Economy
Can it hurt me? What if I’m pregnant? Are there alternatives?
Ethylene Oxide

NIOSH Pocket Guide to Chemical Hazards

Search the Pocket Guide

Enter search terms separated by spaces.

Ethylene oxide

Synonyms & Trade Names  Dimethylene oxide; 1,2-Epoxy ethane; Oxirane

<table>
<thead>
<tr>
<th>CAS No.</th>
<th>RTECS No.</th>
<th>DOT ID &amp; Guide</th>
</tr>
</thead>
<tbody>
<tr>
<td>75-21-8</td>
<td>KX2450000</td>
<td>1040 119P</td>
</tr>
</tbody>
</table>

Formula  C₂H₄O  Conversion  1 ppm = 1.80 mg/m³

IDLH  Ca [800 ppm]  See: 75218

Exposure Limits

<table>
<thead>
<tr>
<th>NIOSH REL</th>
<th>OSHA REL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ca TWA &lt;0.1 ppm (0.18 mg/m³) C 5 ppm (9 mg/m³) [10-min/day] See Appendix A</td>
<td>OSHA [1910.1047] TWA 1 ppm 5 ppm [15-minute Excursion]</td>
</tr>
</tbody>
</table>

Physical Description  Colorless gas or liquid (below 51°F) with an ether-like odor.

<table>
<thead>
<tr>
<th>MW</th>
<th>BP</th>
<th>FRZ</th>
<th>Sol</th>
<th>VP</th>
<th>IP</th>
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</thead>
<tbody>
<tr>
<td>44.1</td>
<td>51°F</td>
<td>-171°F</td>
<td>Niscible</td>
<td>1.46 atm</td>
<td>10.56</td>
</tr>
</tbody>
</table>

Measurement Methods

<table>
<thead>
<tr>
<th>NIOSH 1514</th>
<th>OSHA 3800</th>
</tr>
</thead>
<tbody>
<tr>
<td>See: NMAM or OSHA Methods</td>
<td></td>
</tr>
</tbody>
</table>

Order NIOSH Publications

Order Online 1-800-CDC-INF0  Order from NTIS

Contact Us:

Centers for Disease Control and Prevention National Institute for Occupational Safety and Health (NIOSH)

800-CDC-INFO (800-232-4636) TTY: (888)
**Sp.Gr:** 0.82 (Liquid at 50°F)  
**FLP:** NA (Gas) - 20°F (Liquid)  
**UEL:** 100%  
**LEL:** 3.0%  
**RGasD:** 1.49

**Flammable Gas**

**Incompatibilities & Reactivities**  Strong acids, alkanes & oxidizers; chlorides of iron, aluminum & tin; oxides of iron & aluminum; water

**Exposure Routes**  inhalation, ingestion, (liquid), skin and/or eye contact

**Symptoms**  irritation eyes, skin, nose, throat; peculiar taste; headache; nausea, vomiting, diarrhea; dyspnea (breathing difficulty), cyanosis, pulmonary edema; drowsiness, lassitude (weakness, exhaustion), incoordination; EKG abnormal; eye, skin burns (liquid or high vapor concentration); liquid: frostbite; reproductive effects; [potential occupational carcinogen]; in animals: convulsions; liver, kidney damage

**Target Organs**  Eyes, skin, respiratory system, liver, central nervous system, blood, kidneys, reproductive system

**Cancer Site**  [peritoneal cancer, leukemia]

**Personal Protection/Sanitation**  (See protection codes)  
**Skin:** Prevent skin contact (liquid)  
**Eyes:** Prevent eye contact (liquid)  
**Wash skin:** When contaminated (liquid)  
**Remove:** When wet (flammable)  
**Change:** No recommendation  
**Provide:** Quick drench (liquid)

**Respirator Recommendations**  (See Appendix E)

**NIOSH**

**Up to 5 ppm:**  
(APF = 50) Any air-purifying, full-facepiece respirator (gas mask) with a chin-style, front- or back-mounted canister providing protection against the compound of concern†  
(APF = 50) Any self-contained breathing apparatus with a full facepiece  
(APF = 50) Any supplied-air respirator with a full facepiece

**Emergency or planned entry into unknown concentrations or IDLH conditions:**  
(APF = 10,000) Any self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode
Ethylene Oxide

Most ethylene oxide is used to make other chemicals, but smaller amounts are used to sterilize medical equipment and fumigate spices.

What is ethylene oxide?

Ethylene oxide is a manufactured colorless, flammable gas with a sweet odor. The chemical formula for ethylene oxide is $\text{C}_2\text{H}_4\text{O}$.

Ethylene oxide is primarily used to make ethylene glycol, which is used to make antifreeze and polyester. Smalls mounts of ethylene oxide are used in pesticides, insecticides, and fumigants for spices, books, leather, paper, furniture, beekeeping equipment, and transportation vehicles. It is used to sterilize medical equipment and supplies, and to purify cocoa, flour, coconut, fruits, dehydrated vegetables, and cosmetics. Ethylene oxide is also an ingredient in textiles, detergents, polyurethane foam, solvents, and adhesives. Ethylene oxide was one of the pesticides used to decontaminate anthrax spores in the bioterrorism attacks of October 2001.

Burning fuels such as petroleum, natural gas, and coal may release ethylene oxide. Because ethylene oxide has been used in growing tobacco leaves, tobacco smoke is another source of ethylene oxide emissions.

How might I be exposed to ethylene oxide?

Exposure to ethylene oxide occurs primarily in the workplace. You can be exposed to ethylene oxide by inhaling, swallowing, or touching it.

At home, you can be exposed to low levels of ethylene oxide if you use products that have been sterilized or fumigated with it, including medical products; articles from libraries, museums, and research laboratories; beekeeping equipment; some foods and dairy products; cosmetics; and transportation vehicles.

You can be exposed to ethylene oxide at work if you work in a hospital, medical lab, farm, fumigation facility, or
You can be exposed to ethylene oxide at work if you work in a hospital, medical lab, farm, fumigation facility, or chemical plant that manufactures ethylene oxide or ethylene glycol. If you are a health care worker or technician, you may be exposed through equipment that has been sterilized with ethylene oxide, or through a sterilizing machine.

You can be exposed if you smoke tobacco products or are near to someone who is smoking, and if you breathe automobile exhaust.

**How can ethylene oxide affect my health?**

Ethylene oxide is classified as a human carcinogen, according to the Eleventh Report on Carcinogens, published by the National Toxicology Program, because it causes cancer, particularly leukemia, cancer of the pancreas, Hodgkin’s disease, and stomach cancer.

The effects of exposure to ethylene oxide become more severe as the exposure level increases. Exposure to ethylene oxide can cause a pregnant woman to have a miscarriage, and may damage the male reproductive glands.

Exposure to high levels of ethylene oxide can cause seizures, paralysis, and coma, and damage the liver and kidneys. It can cause harmful lung injury, emphysema, pneumonia, pulmonary edema, headache, nausea, vomiting, weakness, lack of coordination, memory loss, diarrhea, and numbness. It can severely irritate the eyes, skin, throat, lungs, and respiratory passage. Long-term exposure can cause brain and nervous system problems and cataracts.

Breathing low levels of ethylene oxide can cause the same health problems but to a lesser degree. Skin contact with ethylene oxide can cause dermatitis, blisters, and burns. Skin contact with large amounts can cause frostbite.

If you think your health has been affected by exposure to ethylene oxide, contact your health care professional.

For poisoning emergencies or questions about possible poisons, please contact your local poison control center at 1-800-222-1222.

This description is based on the information found in the Web links listed with this topic.

**More Links**

- Ethylene Oxide (Environmental Protection Agency)
- Ethylene Oxide (Occupational Safety and Health Administration)
- Ethylene Oxide, Haz-Map (National Library of Medicine)
Ethylene Oxide

Hazard Summary - Created in April 1992; Revised in January 2000

The major use for ethylene oxide is as a chemical intermediate in industry. The acute (short-term) effects of ethylene oxide in humans consist mainly of central nervous system (CNS) depression and irritation of the eyes and mucous membranes. Chronic (long-term) exposure to ethylene oxide in humans can cause irritation of the eyes, skin, and mucous membranes, and problems in the functioning of the brain and nerves. Some human cancer data show an increase in the incidence of leukemia, stomach cancer, cancer of the pancreas, and Hodgkin's disease in workers exposed to ethylene oxide. However these data are considered to be limited and inconclusive due to uncertainties in the studies. EPA has classified ethylene oxide as a Group B1, probable human carcinogen.

Please Note: The main source of information for this fact sheet is the Agency for Toxic Substances and Disease Registry's (ATSDR's) Toxicological Profile for Ethylene Oxide. Other secondary sources include the Hazardous Substances Data Bank (HSDB), a database of summaries of peer-reviewed literature, and the Registry of Toxic Effects of Chemical Substances (RTECS), a database of toxic effects that are not peer reviewed.

Uses

- Ethylene oxide is used mainly as a chemical intermediate in the manufacture of textiles, detergents, polyurethane foam, antifreeze, solvents, medicinals, adhesives, and other products. (1)
- Relatively small amounts of ethylene oxide are used as a fumigant, a sterilant for food (spices) and cosmetics, and in hospital sterilization of surgical equipment and plastic devices that cannot be sterilized by steam. (1)

Sources and Potential Exposure
Ethylene Oxide
CAS No. 75-21-8

Known to be a human carcinogen
First Listed in the Fourth Annual Report on Carcinogens (1985)

Carcinogenicity
Ethylene oxide is known to be a human carcinogen based on sufficient evidence of carcinogenicity from studies in humans, including a combination of epidemiological and mechanistic investigations which indicate a causal relationship between exposure to ethylene oxide and human cancer.

Ethylene oxide was first listed in the Fourth Annual Report on Carcinogens in 1985 as reasonably anticipated to be a human carcinogen based on limited evidence of carcinogenicity in humans and sufficient evidence in experimental animals; however, the listing was revised to known to be a human carcinogen in the Ninth Report on Carcinogens in 2000. Epidemiological evidence demonstrating this risk has come from studies of workers using ethylene oxide as a sterilant for medical devices and spices and in chemical synthesis and production. Evidence for a common mechanism of carcinogenesis in humans and experimental animals comes from studies that have demonstrated similar genetic damage in cells of exposed animals and workers. The DNA damaging activity of ethylene oxide provides its effectiveness as a sterilant, and it is this same property that accounts for its carcinogenic risk to humans.

Several epidemiological studies, some of which were reviewed in exposures to other chemicals is generally lower in sterilization workers than in chemical synthesis and production workers.

The evidence that ethylene oxide is a human carcinogen is supported by studies in laboratory animals that have demonstrated that ethylene oxide is carcinogenic at multiple organ sites in rats and mice, likely due to its direct alkylating activity. Sites of tumor induction in mice include the hematopoietic system, lung, hardener gland, mammary gland, and uterus. Sites of tumor induction in rats included the hematopoietic system, brain, and mesothelium (NTP 1987, IARC 1994).

Additional Information Relevant to Carcinogenicity
Ethylene oxide is a direct-acting alkylating agent that forms adducts with biological macromolecules including hemoglobin and DNA. Measurements of hemoglobin adducts (hydroxyethyl histidine and hydroxyethyl valine) have been used to monitor worker exposure to ethylene oxide. Ethylene oxide causes a dose-related increase in the frequency of hemoglobin adducts in exposed humans and rodents (IARC 1994).

The major DNA adduct of ethylene oxide is $N^7$-(2-hydroxyethyl)guanine. Dose-related increases in this adduct, as well as smaller amounts of $O^6$-(2-hydroxyethyl)guanine and $N^3$-(2-hydroxyethyl)adenine, have been measured in rodents exposed to ethylene oxide. Background levels of hemoglobin and DNA adducts of ethylene oxide in humans and experimental animals have been suggested to arise from endogenous production of ethylene by gut flora or metabolism of unsaturated dietary lipids (Torsvik 1996).

Ethylene oxide is genotoxic in all species studied, including prokaryotic and lower eukaryotic organisms, as well as in vitro and in vivo mammalian systems. Ethylene oxide causes gene mutations and heritable translocations in germ cells of exposed rodents. Significant...
What is ethylene oxide?

Ethylene oxide (EtO) is a flammable, colorless gas at temperatures above 51.3 °F (10.7 °C) that smells like ether at toxic levels. EtO is found in the production of solvents, antifreeze, textiles, detergents, adhesives, polyurethane foam, and pharmaceuticals. Smaller amounts are present in fumigants, standards for spices and cosmetics, as well as during hospital sterilization of surgical equipment.

How can ethylene oxide harm workers?

In addition to eye pain and sore throat, exposure to EtO can cause difficult breathing and blurred vision. Exposure can also cause dizziness, nausea, headache, convulsions, blisters, and can result in vomiting and coughing. Both human and animal studies show that EtO is a carcinogen that may cause leukemia and other cancers. EtO is also linked to spontaneous abortion, genetic damage, nerve damage, peripheral paralysis, muscle weakness, as well as impaired thinking and memory. In liquid form, EtO can cause severe skin irritation upon prolonged or confined contact.

What should employers know about ethylene oxide?

Employee exposure is limited to one part EtO per million parts of air (1 ppm) measured as an 8-hour time-weighted average (TWA). Employee exposure may not exceed the short-term excursion limit of 5 ppm EtO averaged over any 15-minute sampling period. These limits are called permissible exposure limits (PELs).

Most occupational exposures to EtO are covered by the OSHA standard. The standard does not apply; however, when employers can demonstrate that the processing, use, or handling of products containing EtO will not release airborne concentrations of EtO at or above the standard’s action level of 0.5 ppm. The action level is calculated as an 8-hour TWA and is the threshold for increased compliance activities (e.g., air monitoring, medical examinations, labeling employee.

- Establish and implement a written compliance program to reduce exposures to or below the TWA and exposure limit.
- Establish personal air monitoring as well as information and training programs for employees exposed to EtO at or above the action level or above the excursion limit. Conduct training upon initial job assignment and annually.
- Establish a regulated area wherever airborne concentrations of EtO are expected to exceed the 8-hour TWA or the excursion limit.
- Establish a medical surveillance program for employees exposed to EtO at concentrations above the action level of 0.5 ppm, measured as an 8-hour TWA, for more than 30 days per year.
- Place warning labels on all containers that might cause employee exposures at or above the action level or excursion limit.
- Remember that employee rotation is prohibited as a means of compliance with the 8-hour TWA or exposure limit.
- Select, provide, and maintain appropriate personal protective equipment and ensure that employees use it to prevent skin and eye contact.

When must employers require workers to use respirators?

Employers must ensure that workers use respirators to control EtO exposure in the following circumstances:

- During installation or implementation of feasible engineering controls and work practices;
- During maintenance, repair, and certain operations when engineering and work practice controls are not feasible;
process or materials used, and if the change could increase employee exposures.

Note: If the exposure level is maintained below the action level, you may discontinue TWA monitoring until there is a change in production, equipment, processes, personnel, or control measures that may result in new or additional exposure to EtO.

Employers must also do the following:

- Allow affected employees or their designated representatives to observe the monitoring.
- Notify affected employees of the results of the monitoring within 15 working days of receiving the results.

**Do all businesses where EtO is present need medical surveillance programs?**

Employers must implement a medical surveillance program, conducted or supervised by a licensed physician, for an employee under the following circumstances:

- If the employee is assigned to an area where exposure to EtO may be or above the action level for 30 days or more during the year.
- If the employee has been exposed to EtO in an emergency situation.

**What steps must employers take to communicate with workers about EtO exposure?**

Employers must do the following to communicate information to affected workers:

- Establish regulated areas where occupational exposure to EtO exceeds the 8-hr TWA or excursion limit, and clearly mark them to limit the number of workers in the regulated area and to allow only authorized persons to enter.
- Provide the signs and labels specified by the standard clearly indicating EtO’s carcinogenic and reproductive hazards in regulated areas.

To contact OSHA, call (202) 693-6378 (toll-free in the U.S.), or (604) 693-6378 (in Canada). OSHA hotlines are available 24 hours, 7 days a week. Additional information is available on the OSHA web site, www.osha.gov/etoxide.

- Keep employee medical records for the duration of employment plus 30 years.
- Keep records of objective data supporting any claimed exemption from the requirements of the OSHA standard.

**What should employees do to protect themselves from EtO exposure?**

To protect against EtO exposure, follow these safety precautions:

- Wear goggles and skin protection at all times in areas where there is a risk of splashes from liquid EtO.
- Wear proper protective clothing and other approved personal protective equipment when working with EtO.
- Discard clothing that has been degraded by EtO.
- See a doctor if you are exposed to EtO.
- Do not eat, drink, or smoke while working with EtO.

**How can you get more information on safety and health?**

OSHA has various publications, standards, technical assistance, and compliance tools to help you, and offers extensive assistance through workplace consultation, voluntary protection programs, grants, strategic partnerships, state plans, training, and education. OSHA’s Safety and Health Program Management Guidelines (Federal Register 54:3904-3916, January 26, 1989) detail elements critical to the development of a successful safety and health management system. This and other information are posted on OSHA’s website.

- For a free copy of OSHA publications, send a self-addressed mailing label to OSHA Publications Office, 200 Constitution Avenue N.W., N-3101, Washington, DC 20210; or send a request to our fax at (202) 693-2498, or call us at (202) 693-1888.

To order OSHA publications online, go to Publications and follow the instructions for ordering.
<table>
<thead>
<tr>
<th><strong>Half Life</strong></th>
<th>No reports found; [TDR, p. 694]</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Reference Link</strong></td>
<td>ATSDR Medical Management - Ethylene oxide</td>
</tr>
<tr>
<td><strong>Flammability (NFPA)</strong></td>
<td>4: burns readily</td>
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</table>

### Adverse Effects

<table>
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<tr>
<th><strong>Asthma</strong></th>
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<tbody>
<tr>
<td><strong>Toxic Pneumonitis</strong></td>
<td>Yes</td>
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<tr>
<td><strong>Dermatotoxin</strong></td>
<td>Skin Burns</td>
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<tr>
<td><strong>Skin Sensitizer</strong></td>
<td>Yes</td>
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<tr>
<td><strong>Neurotoxin</strong></td>
<td>Sensorimotor Neuropathy</td>
</tr>
<tr>
<td><strong>Hepatotoxin</strong></td>
<td>Hepatotoxin, Secondary</td>
</tr>
<tr>
<td><strong>Reproductive Toxin</strong></td>
<td>Yes</td>
</tr>
<tr>
<td><strong>IARC Carcinogen</strong></td>
<td>Known Carcinogen</td>
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### Links to Other NLM Databases

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<th><strong>Health Studies</strong></th>
<th>Human Health Effects from Hazardous Substances Data Bank: ETHYLENE OXIDE</th>
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<tr>
<td><strong>Toxicity Information</strong></td>
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<tr>
<td><strong>Chemical Information</strong></td>
<td>Search ChemiDplus</td>
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<tr>
<td><strong>Biomedical References</strong></td>
<td>Search PubMed</td>
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### Related Information in Haz-Map

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<tr>
<th><strong>Diseases</strong></th>
<th>Occupational diseases associated with exposure to this agent:</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>• Asthma, occupational</td>
</tr>
<tr>
<td></td>
<td>• Cataract, chemical or radiation induced</td>
</tr>
<tr>
<td></td>
<td>• Contact dermatitis, allergic</td>
</tr>
<tr>
<td></td>
<td>• Fumigants, acute toxic effect</td>
</tr>
<tr>
<td></td>
<td>• Leukemia</td>
</tr>
<tr>
<td></td>
<td>• Neuropathy, toxic</td>
</tr>
<tr>
<td></td>
<td>• Pneumonitis, toxic</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Processes</strong></th>
<th>Industrial Processes with risk of exposure:</th>
</tr>
</thead>
</table>
Evidence for Carcinogenicity:
A2: Suspected human carcinogen.

[American Conference of Governmental Industrial Hygienists TLVs and BEIs. Threshold Limit Values for Chemical Substances and Physical Agents and Biological Exposure Indices. Cincinnati, OH, 2008, p. 30] **PEER REVIEWED**

Evaluation: There is limited evidence in humans for the carcinogenicity of ethylene oxide. There is sufficient evidence in experimental animals for the carcinogenicity of ethylene oxide. In making the overall evaluation, the Working Group took into consideration the following supporting evidence. Ethylene oxide is a directly acting alkylating agent that: (1) induces a sensitive, persistent dose-related increase in the frequency of chromosomal aberrations and sister chromatid exchange in peripheral lymphocytes and micronuclei in bone marrow cells of exposed workers; (2) has been associated with malignancies of the lymphatic and hematopoietic system in both humans and experimental animals; (3) induces a dose related increase in the frequency of hemoglobin adducts in exposed humans and dose related increases in the numbers of adducts in DNA and hemoglobin in exposed rodents; (4) induces gene mutations and heritable translocations in germ cells of exposed rodents; and (5) is a powerful mutagen and clastogen at all phylogenetic levels. Overall evaluation: Ethylene oxide is carcinogenic to humans (Group 2).


**PEER REVIEWED**

Ethylene Oxide: known to be a human carcinogen.

TOXNET - Databases on toxicology, hazardous chemicals, environmental health, and toxic releases.

Select Database
- ChemIDplus
- HSDB
- TOXLINE
- CCRIS
- DART
- GENETOX
- IRIS
- ITER
- LactMed
- Multi-Database
- TRI
- Haz-Map
- Household Products
- TOXMAP

Search All Databases

Ethylene oxide
(e.g. asthma air pollution, ibuprofen fever, vinyl chloride)

References from Biomedical Literature
- TOXLINE Toxicology Literature Online 5465
- DART Developmental Toxicology Literature 221

Chemical, Toxicological, and Environmental Health Data
- HSDB Hazardous Substances Data Bank 194
- IRIS Integrated Risk Information 5
- ITER International Toxicity Estimates for Risk 6
- GENETOX Genetic Toxicology Data 2
- CCRIS Chemical Carcinogenesis Information 11
- TRI Toxics Release Inventory 121
- TOXMAP Environmental Health e-Maps Map It
Ethylene oxide
RN: 75-21-8

For more information about this substance, you may select from the links below.

**File Locator**

- CCRIS
- DART
- DrugPortal
- EINECS
- EMIC
- GENETOX
- HSDB
- Haz-Map
- Household Products
- ITER
- MeSH
- MeSH Heading
- MedlinePlusAll

- NCI Chem Carcino Res Info Sys
- Developmental and Reprod.Tox.
- NLM Drug Information Portal
- EU Inv of Exist. Comm. Chem Sub
- Env. Mutagen Info. Center
- EPA GENetic TOxicology
- Hazardous Substances Data Bank
- Occ. Exposure to Haz. Agents
- Household Products Database
- International Tox. Est. for Risk
- Medical Subject Headings File
- Medical Subject Headings
- Search Consumer Health Info
Results: 1 to 20 of 192

1. Occupational exposure to ethylene oxide and risk of lymphoma.
   - PMID: 20811284 [PubMed - indexed for MEDLINE]
   - Related citations

2. An integrated occupational health consultation model for the medical supply manufacturing industry.
   - Lin YK, Lee LH, Sheu SH.
   - PMID: 20616473 [PubMed - indexed for MEDLINE]
   - Related citations

3. Quantitative cancer risk assessment based on NIOSH and UCC epidemiological data for workers exposed to ethylene oxide.
   - Valdez-Flores C, Sielken RL Jr, Teta MJ.
   - PMID: 19840826 [PubMed - indexed for MEDLINE]
   - Related citations

4. Allergic contact dermatitis to ethylene oxide.
   - Kerre S, Goossens A.
Ethylene Oxide

CAS ID #: 75-21-8

Affected Organ Systems: Dermal (Skin), Developmental (effects during periods when organs are developing), Neurological (Nervous System), Ocular (Eyes), Renal (Urinary System or Kidneys)

Cancer Effects: Known to be a Human Carcinogen

Chemical Classification: None

Summary: Ethylene oxide is a flammable gas with a somewhat sweet odor. It dissolves easily in water. Ethylene oxide is a man-made chemical that is used primarily to make ethylene glycol (a chemical used to make antifreeze and polyester). A small amount (less than 1%) is used to control insects in some stored agricultural products and a very small amount is used in hospitals to sterilize medical equipment and supplies.

Community Members

ToxFAQs™

Fact sheet that answers the most frequently asked questions about a substance. Available for download or printing.
How can ethylene oxide affect my health?

Breathing low levels of ethylene oxide for several months to years has caused irritation of the eyes, skin, and respiratory passages and affected the nervous system (headache, nausea, vomiting, memory loss, numbness, etc.). At higher levels of exposure for shorter periods, effects are similar but may be more severe. There is some evidence that exposure to ethylene oxide can cause a pregnant woman to have a miscarriage.

Animal studies indicate that in addition to irritation of the respiratory passages, nervous system effects, and reproductive effects, the kidneys, adrenal gland, and skeletal muscles may be affected from long-term exposure to ethylene oxide.

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How likely is ethylene oxide to cause cancer?

Increased incidences of leukemia and stomach cancer have been reported for workers exposed to ethylene oxide; however, the data are not considered conclusive. The carcinogenicity of ethylene oxide has been evaluated in rats and mice that breathed it. Leukemia, brain tumors, lung tumors, and other cancers were observed. The Department of Health and Human Services (DHHS) has determined that ethylene oxide may reasonably be anticipated to be a human carcinogen.
1. PUBLIC HEALTH STATEMENT

1.4 HOW CAN ETHYLENE OXIDE AFFECT MY HEALTH?

Ethylene oxide can cause a wide variety of harmful health effects in exposed persons. In general, with higher levels of exposure to this chemical, more severe effects will occur. The major effects seen in workers exposed to ethylene oxide at low levels for several months or years are irritation of the eyes, skin, and mucous membranes and problems in the functioning of the brain and nerves. At higher levels of exposure to ethylene oxide, which may result from accidents or equipment breakdown, the types of effects are similar, but they are more severe and harmful. There is also some evidence that exposure to ethylene oxide can cause an increased rate of miscarriages in female workers exposed to ethylene oxide.

Studies in animals have shown that breathing ethylene oxide at high levels can interfere with their ability to reproduce. Litter sizes have been smaller than usual, and the babies of exposed animals have weighed less than normal and have had delayed bone formation.

Some studies of workers exposed to ethylene oxide in ethylene oxide factories or hospital sterilizing rooms have shown an increased incidence of leukemia, stomach cancer, cancer of the pancreas and Hodgkin's disease. Ethylene oxide has also been shown to cause cancer in laboratory animals. Leukemia, brain tumors, lung tumors and tumors of the tear glands of the eye have been found.
Can it hurt me? I think so. What if I’m pregnant? Seems to be a reproductive toxin, but maybe not. Are there alternatives? No?
ETHYLENE OXIDE

Given the incomplete information made available by companies and the government, EWG provides additional information on personal care product ingredients from the published scientific literature. The chart below indicates that research studies have found that exposure to this ingredient -- not the products containing it -- caused the indicated health effect(s) in the studies reviewed by Skin Deep researchers. Actual health risks, if any, will vary based on the level of exposure to the ingredient and individual susceptibility -- information not available in Skin Deep. Legal Disclaimer

This ingredient:

- **Cancer**
- **Developmental/reproductive toxicity**
- **Allergies/immunotoxicity**
- **Use restrictions**
- **Contamination concerns**
- **Other strong concerns for this ingredient:**
  - Organ system toxicity (non-reproductive), Irritation (skin, eyes, or lungs), Occupational hazards

Score:

- **10** high hazard
- **45%** data gap

Also listed as:

OXIRANE; 1,2-EPOXYETHANE; AETHYLENOXID (GERMAN); ALPHA.BETA-OXIDOETHANE; AMPROLENE, AMPROLENE, AMPROLENE; DIIHYDROOXIRENE; DIMETHYLENE OXIDE; E.O.
<table>
<thead>
<tr>
<th>Type of Concern</th>
<th>Product Conditions</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Known human carcinogen</td>
<td>Int'l Agency for Research on Cancer (IARC) – Carcinogens</td>
<td></td>
</tr>
<tr>
<td>Possible human carcinogen</td>
<td>Amer Conf of Gov't Industrial Hygienists – Carcinogens</td>
<td></td>
</tr>
<tr>
<td>Possible human carcinogen</td>
<td>NTP – Tumor Induction in Mammary Gland</td>
<td></td>
</tr>
<tr>
<td>Limited evidence of carcinogenicity</td>
<td>NIOSH Occupational Carcinogens</td>
<td></td>
</tr>
<tr>
<td>Cancer – moderate evidence – reproductive</td>
<td>CHE Toxicant and Disease Database</td>
<td></td>
</tr>
<tr>
<td>Cancer – moderate evidence – skin</td>
<td>CHE Toxicant and Disease Database</td>
<td></td>
</tr>
<tr>
<td>Cancer – moderate evidence – gastrointestinal</td>
<td>CHE Toxicant and Disease Database</td>
<td></td>
</tr>
</tbody>
</table>
CHE Toxicant and Disease Database

Displaying diseases linked to ethylene oxide (grouped by strength of evidence).

**Strong:**

- Adult-onset Leukemias *
- Contact dermatitis - Irritant
- Fetal toxicity (Miscarriage/spontaneous abortion, stillbirth)
- Peripheral neuropathy

**Good:**

- Asthma - allergen, sensitizer
- Cataracts
- Leukoderma (hypopigmentation)
- Pre-term delivery
- Psychiatric disturbances (disorientation, hallucinations, psychosis, delirium, paranoias, anxiety/depression, emotional lability, mood changes, euphoria).
- Pulmonary edema
- Skin cancer (non-melanoma)
- Stomach cancer
MOVING TOWARDS SAFER ALTERNATIVES

Tools Description

1. Column Model for Chemical Substitutes Assessment
2. COSHH Essentials
3. Technical Rules for Hazardous Substances (TRGS) 600
4. Green Screen for Safer Chemicals
5. Determination and work with code numbered products (MAL Code)
6. Pollution Prevention Options Analysis System (P2OASys)
7. Priority-Setting Guide (PRIO)
8. Quick Scan
9. Stockholm Convention Alternatives Guidance
10. Stoffenmanager

Last update: 24.03.2011
safer alternatives to ethylene oxide

12-3 LOW-TEMPERATURE OXIDATIVE STERILIZATION METHODS FOR ...
Overview: Low-temperature oxidative sterilization for medical devices and surgical instruments is a safe alternative to ethylene oxide (EtO) sterilization ...
www.p2sustainabilitylibrary.mil/p2_opportunity.../12_3.html - Cached - Similar

[PDF] Note for Guidance on Limitations to the use of Ethylene Oxide in ...
File Format: PDF/Adobe Acrobat - Quick View
Ethylene oxide sterilisation should be used only where safer alternatives cannot be used. For containers filled with aqueous products, e.g. pre-filled ...

Endoscope decontamination: where do we go from here?
by JR Babb - 1995 - Cited by 44 - Related articles
There is also no proven safe alternative to ethylene oxide for sterilizing invasive heat labile flexible endoscopes. It is important that ...
www.ncbi.nlm.nih.gov/pubmed/7560997

[PDF] Janet Brown - hawaii.gov
File Format: Microsoft Powerpoint - Quick View
Replace the sterilant ethylene oxide with safer alternatives for a minimum of 90% of the equipment requiring sterilization. Reference Standards - IAQ ...
hawaii.gov/health/environmental/waste/.../JanetBrownSterilization.ppt - Similar

Ethylene Oxide (EtO) - Toxipedia
by OT Page - Related articles
Ethylene Oxide (EtO) is a commonly used biocide both in the healthcare and food ... Safer alternatives for sterilization are beginning to replace EtO ...
toxipedia.org/display/toxipedia/Ethylene+Oxide+(EtO) - Cached

Joint Services P2 Handbook
No alternatives listed
Sporox – 7.5% Hydrogen Peroxide, Sultan Chemists
Sterrad – J&J, hydrogen peroxide plasma
Steris 20, Steris Corporation .2% peracetic acid
EndoSpor Plus Sterilizing and Disinfecting Solution – Cottrell Limited, 7.35% hydrogen peroxide, .23% peracetic acid
Peract 20 Liquid Sterilant/Disinfectant, Minntech Corp, 1.0% hydrogen peroxide, .08% peracetic acid.
Sterilox Liquid High Level Disinfectant System, Sterilox, Technologies, Inc, hypochlorite and hypochlorous acid.
Cidex OPA concentrate, Advanced Sterilization Products 5.75% ortho phthalaldehyde
Cidex OPA Solution, Advanced Sterilization Products, .55% orthophthalaldehyde
EO Gas System, Anderson Products (100% EtO gas cartridges and plastic sterilization bags.)
Ethylene Oxide is a known human carcinogen, one of 1200 chemicals for which there is enough scientific evidence to make a finding of toxicity.

For the vast majority of the 80,000 chemicals in commerce, we have little or no testing information.
Coming in summer 2011: Find information about the known hazards of thousands of chemicals, from scientific and regulatory authoritative sources. Search and filter information in a variety of ways, depending on your needs.

- **Transparency and Curation:** Up-to-date information that is actively maintained and curated at UC Berkeley. Complete transparency of data sources and methodology.

- **Open Access:** Plum is offered completely freely by UC Berkeley.

- **Machine-Readable Data:** An open-source platform for other web-based tools and applications to fully and freely use these authoritative data.

BCGC aims to encourage **collaborative or independent projects** that make use of Plum as an **open data resource**. We hope it will be used to create tools for things like:

- Alternatives assessment
- Hazard communication
- Product safety assessment/scoring
- Inventory screening
- Private/corporate chemicals policies
- Customized design tools...
For More Information

- cbrody@bluegreenalliance.org
- www.bluegreenalliance.org
- http://www.healthandenvironment.org/initiatives/sciencewg
- www.healthandenvironment.org