Product Safety Assessment
Ethylene

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Select a Topic:

Names

- CAS No. 74-85-1
- Ethylene
- Ethene
- Acetene
- Bicarburretted hydrogen
- Olefiant gas

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Product Overview

- Ethylene ($H_2C=CH_2$) is one of the largest volume organic chemicals produced globally. It is the simplest of the family of hydrocarbons called olefins, which are characterized by a carbon-carbon double bond. Ethylene is produced commercially from petroleum and natural-gas feedstocks. For further details, see Product Description.
- Ethylene is primarily used as a reactive monomer to make polyethylene. It is also used as an intermediate in the production of compounds, such as ethylene dichloride, ethylene oxide, ethyl benzene, and other organic chemicals.[1] For further details, see Product Uses.
- Ethylene occurs naturally in the environment and is produced by natural sources such as vegetation, agricultural wastes and refuse, forest fires, cigarette smoke, and the incomplete combustion of fossil fuels. Ethylene is produced in closed systems to minimize release to the environment. Ethylene is not sold to or used directly by consumers. However, the public is exposed to ethylene present in the air from both natural and man-made sources and could also be exposed by an accidental release of ethylene from manufacturing facilities.[2] For further details, see Exposure Potential.
- Exposure to high concentrations of ethylene (thousands of parts per million) may cause headache, dizziness, anesthesia, drowsiness, or other central nervous system effects. In confined or poorly ventilated areas, ethylene vapor can accumulate and result in unconsciousness or asphyxiation by displacing oxygen. Eye or skin contact with liquefied ethylene can cause frostbite.[3] For further details, see Health Information.
- Ethylene tends to migrate to the atmosphere because of its high vapor pressure. In the presence of oxygen, it biodegrades with an estimated half-life of 1.9 days. It degrades more quickly in sunlight. It does not persist. Ethylene is slightly toxic to aquatic organisms and has a low bioconcentration potential.[3] For further details, see Environmental Information.
- Ethylene is an extremely flammable liquid or vapor.[3] For further details, see Physical Hazard Information.

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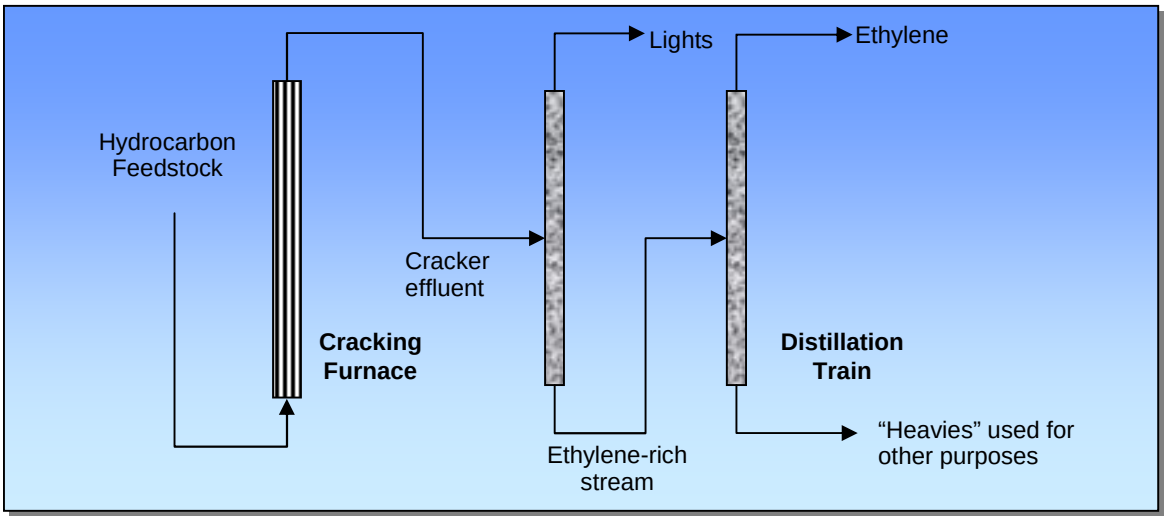
Manufacture of Product[4]

- **Capacity** – The Dow Chemical Company and its foreign affiliates have the capacity to produce 9.8 million metric tonnes of ethylene annually (2010) at production facilities in Freeport, Seadrift, and Texas City, Texas; Plaquemine and Taft, Louisiana; Fort Saskatchewan, Alberta, Canada; Bahia Blanca, Argentina; Boehlen, Germany; Terneuzen, The Netherlands; and Tarragona, Spain. Additionally, Dow participates in multiple ethylene production joint ventures around the world.
- **Process** – Ethylene is produced commercially by gas-phase steam/thermal cracking of light petroleum and natural-gas feedstocks at 800 to 870°C in a tubular reactor, followed by a series of purification steps to separate heavy and light components for recycle or for use as other products. A simplified process flow diagram is shown below.



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Product Description[1]

Ethylene ($H_2C=CH_2$) is a colorless, noncorrosive, nonirritating gas with a slightly sweet odor at room temperature. It is the simplest of the family of hydrocarbons called olefins, which are characterized by a carbon-carbon double bond.

It can be cooled and pressurized to be stored as a liquid. The normal boiling point of ethylene is –104°C (–155°F) and the freezing point is –169°C (–272°F). Ethylene is a major product of the petrochemical industry. It is one of the highest volume chemicals produced globally.

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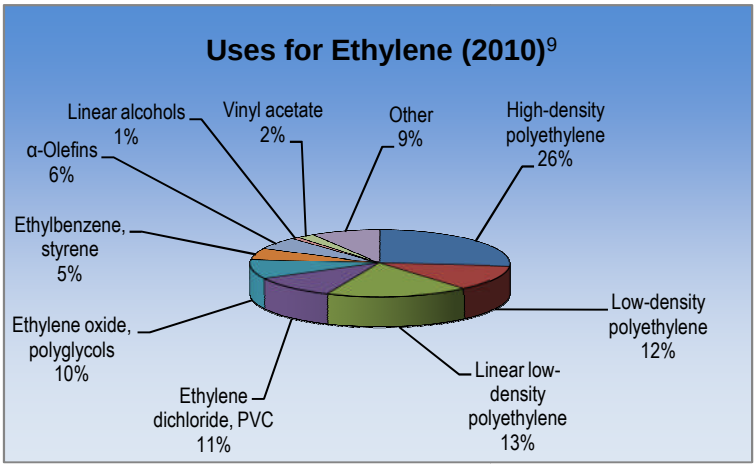
Product Uses[1,4]



Ethylene is primarily used as a reactive monomer (chemical building block) to make polyethylene and as an intermediate in the production of other organic compounds, such as ethylene dichloride and ethylene oxide. Products produced from ethylene are used to make chemicals and plastics used in other industrial processes and in consumer products such as detergents, automotive antifreeze, and many types of plastic articles. The approximate percentages of total use are shown in the chart on the next page. Some end uses for materials produced from ethylene are described below.

- High-density polyethylene (HDPE), low-density polyethylene (LDPE), and linear low-density polyethylene (LLDPE) – used to make bins, pails, crates, bottles, piping, food-packaging films, caps, trash liners, sacks, bags, wire and cable sheathing, insulation, and surface coatings for paper and cardboard.
- Ethylene dichloride, vinyl chloride, and polyvinyl chloride – used to produce packaging films and bottles, and pipe, tile, and flooring for building and construction.
- Ethylene oxide – used as a chemical intermediate to produce: ethylene glycol, which is used to make automobile antifreeze and polyethylene terephthalate polyester (PET) for fibers, films and bottles; glycol ethers for solvents; surfactants and detergents; polyglycols; and ethanolamines.
- Ethylbenzene and styrene – used to make plastic products used in toys, construction pipe, foam, boats, latex paints, tires, luggage, food-grade film, insulation, and furniture.

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Exposure Potential[1,2,5,6,7]

Ethylene exists naturally in the environment, where it is produced by vegetation and other natural sources. It is also a combustion product from natural and man-made sources such as motor vehicle exhaust, forest fires, and cigarette smoke. Based on its uses, exposure could occur through:

- **Workplace exposure** – Exposure can occur either in facilities that recover or produce ethylene, during transport, or in facilities that use ethylene. Workplace exposure to elevated levels of ethylene is limited due to concerns for flammability. Ethylene is produced, distributed, stored, and consumed in closed systems. Those working with ethylene in manufacturing operations could be exposed during maintenance, sampling, testing, or other procedures. The American Conference of Governmental Industrial Hygienists (ACGIH) has adopted a Threshold Limit Value (TLV) of 200 ppm for ethylene as an 8-hour time-weighted average (TWA). Workers should consult with the appropriate regulatory agencies for exposure guidelines. 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 ethylene** – No consumer uses of ethylene are known, so consumer exposure to commercially produced ethylene is unlikely. However, it is used to make plastics and other materials used in consumer products. For example, plastic milk jugs and plastic bags are made from high-density polyethylene, a polymer made from ethylene. Ethylene is naturally present in the environment, and the highest environmental concentrations are found in urban areas. Because ethylene is produced by natural sources and present in ambient air, the general public is exposed to very low concentrations of

ethylene. Ambient ethylene concentrations can vary, but are typically less than 0.5 ppm, as determined by air samples taken from U.S. cities. See Health Information.

- **Environmental releases** – Ethylene emissions from industrial facilities are subject to governmental requirements. As a result of these regulations and production facility operating conditions, the typical ambient air levels of ethylene will be significantly less than 1 ppm. Ethylene has a high vapor pressure and if released will tend to volatilize from water and soil and accumulate in the atmosphere. In the presence of oxygen, ethylene biodegrades with an estimated half-life of 1.9 days. It degrades more quickly in sunlight. This material is considered slightly toxic to aquatic organisms on an acute basis. See Environmental, Health, and Physical Hazard Information.
- **Large release** – Industrial spills or releases are infrequent and generally contained. If a large spill does occur, the area should be isolated until the released gas has dispersed. Respiratory protection may be necessary for clean up. The primary hazard from a large release of ethylene is fire. Eliminate all sources of ignition immediately. Use only explosion-proof equipment; ground and bond all containers and handling equipment. Prevent entry into soil, ditches, sewers, waterways and/or groundwater. See Environmental, Health, and Physical Hazard Information.
- **In case of fire** – Deny any unnecessary entry into the area. Do not attempt to extinguish the fire. Stop flow of material if possible and allow the fire to burn out. Extinguish small fires with water spray or fog, carbon-dioxide or dry-chemical extinguishers, or foam. If possible, fight the fire from a protected area or safe location. Firefighters should wear positive-pressure, self-contained breathing apparatus (SCBA) and protective firefighting clothing. The public should be warned of any downwind vapor explosion hazards. Vapors may travel a long distance and ignition or vapor flash-back may occur. Immediately withdraw all personnel from the area in case of rising sounds from venting safety device or discolorations of the container. Follow emergency procedures carefully. See Environmental, Health, and Physical Hazard Information

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

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Health Information[1,2,3]

Eye contact – Contact with liquefied ethylene can cause frostbite.

Skin contact – Contact with liquefied ethylene can cause frostbite. No adverse effects are expected from absorption through the skin.

Inhalation – Because ethylene is a gas at normal temperatures and pressures, inhalation is the primary route of exposure. Ethylene has a low level of toxicity. No risk to human health has been identified from occupational exposure or exposure of the general public to atmospheric levels of ethylene. However, excessive exposure by inhalation may cause headache, dizziness, anesthesia, drowsiness, unconsciousness, or other central nervous system effects. In confined or poorly ventilated areas, the gas can accumulate and result in unconsciousness due to displacement of oxygen. The American Conference of Governmental Industrial Hygienists (ACGIH) has established a Threshold Limit Value (TLV) for occupational exposure to ethylene of 200 parts per million (ppm) as a time-weighted average (TWA). The odor threshold for ethylene is reported to be from 270 to 600 ppm, so odor is not an adequate warning property to prevent excessive exposure to ethylene. Consult governmental regulations for exposure guidelines for the geographic region of interest.

Ingestion – Ingestion is unlikely because ethylene is a gas at normal temperatures. Ingestion of liquefied gas can cause frostbite of the lips, mouth, and throat.

Other – Screening and long-term studies in laboratory animals suggest that exposure to ethylene does not affect fetal development or reproduction and does not cause cancer. Both *in vivo* and *in vitro* mutagenicity studies were negative for genetic toxicity. However, metabolic studies in animals and humans have revealed that ethylene is metabolized to ethylene oxide, which is known to have carcinogenic and mutagenic effects.

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Environmental Information[3,7,8]

If released, ethylene tends to accumulate in the atmopsphere because of its high vapor pressure. In the presence of oxygen in the atmosphere, ethylene biodegrades with an estimated half-life of 1.9 days. It degrades even more quickly in sunlight.

Ethylene is slightly toxic to aquatic organisms in the most sensitive species tested. The minute amounts of ethylene measured in water represent little, if any, environmental hazard to aquatic animals. Ethylene has a low bioconcentration potential. Because ethylene has low toxicity and low potential for exposure, it is not likely to have adverse effects on terrestrial wildlife.

Ethylene exists naturally in the environment and is produced by plants as part of their life cycle and the ripening process. Ethylene also acts as a plant hormone in regulation of plant growth and development. Ethylene effects on plants appear to be complex, depend upon environmental conditions and stage of growth, and vary by species and cultivar.

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Physical Hazard Information[1,3]

Ethylene is an extremely flammable gas or pressurized liquid and should be used only in well-ventilated areas. It should be kept away from heat and sources of ignition.

Ethylene is stable at recommended storage conditions of less than 52°C (126°F). Decomposition with rapid pressure build-up can occur at storage conditions above 180°C (356°F) and 1136 kPa (150 psig). Avoid contact with oxidizing materials (such as chlorine and oxygen), mineral acids, metals, and metal chlorides. Hazardous polymerization can also occur at high temperatures or in the presence of free-radical initiators or activated materials, such as activated carbon or molecular sieves.

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Regulatory Information

Regulations may exist that govern the manufacture, sale, transportation, use, and/or disposal of ethylene. These regulations may vary by city, state, country, or geographic region. Information may be found by requesting the relevant Safety Data Sheet or Contact Us.

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Additional Information

- Request the Safety Data Sheet from the Dow Customer Information Group (www.dow.com/assistance/index.htm)
- Contact Us (www.dow.com/assistance/index.htm)
- *Ethylene Product Stewardship Guidance Manual*, American Chemistry Council, December 2004 (www-static.shell.com/static/chemicals/downloads/products_services/ethylene_product_stewardship_manual.pdf)
- "Ethylene, CAS No. 74-85-5," Screening Information Data Set (SIDS) Initial Assessment Profile, Organization for Economic Co-operation and Development (OECD), United Nations Environmental Programme (UNEP) (http://www.chem.unep.ch/irptc/sids/oecdsids/74851.pdf)
- Devanney, Michael T., "Marketing Research Report: Ethylene," *Chemical Economics Handbook*, IHS Chemical, July 2011 (http://www.ihs.com/products/chemical/planning/ceh/ethylene.aspx)
- NIOSH National Occupational Exposure Survey (1981–1983), National Institute of Occupational Health and Safety (http://www.cdc.gov/noes/noes4/81826sco.html)
- *Ethylene: TLV Chemical Substances*, American Conference of Governmental Industrial Hygienists, Cincinnati, Ohio (http://www.acgih.org/Store/ProductDetail.cfm?id=965)
- "Alberta Ambient Air Quality Objectives and Guidelines," Alberta Environment, Air Policy Branch, Alberta, Canada, April 2011, (http://environment.gov.ab.ca/info/library/5726.pdf)
- Abeles, F.B., Morgan, P.W., Saltveit, M.E., Jr., *Ethylene In Plant Biology, 2nd Edition,* Academic Press, Inc.: San Diego, California, 1992

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References

1. *Ethylene Product Stewardship Guidance Manual*, American Chemistry Council, December 2004
2. "Ethylene CAS No: 74-85-1," *Screening Information Data Set (SIDS) Initial Assessment Report*
3. *Ethylene Material Safety Data Sheet*, The Dow Chemical Company
4. Devanney, Michael T., "Marketing Research Report: Ethylene," *Chemical Economics Handbook,* IHS Chemical, July 2011
5. "Alberta Ambient Air Quality Objectives and Guidelines Summary," Alberta Environment, Air Policy Branch, Alberta, Canada, April 2011, Table 1. (http://environment.gov.ab.ca/info/library/5726.pdf)
6. NIOSH National Occupational Exposure Survey (1981–1983), National Institute of Occupational Health and Safety (http://www.cdc.gov/noes/noes4/81826sco.html)
7. *Ethylene: TLV Chemical Substances*, American Conference of Governmental Industrial Hygienists, Cincinnati, Ohio.
8. Abeles, F.B., Morgan, P.W., Saltveit, M.E., Jr., *Ethylene In Plant Biology, 2nd Edition,* Academic Press, Inc.: San Diego, California, 1992.

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NOTICES:

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