

ETHYLENE

This Product Risk Profile is intended to provide the general public with an overview of product safety information. This document is not intended to replace Safety Data Sheets (SDS). It is not intended to provide emergency response; medical or treatment information or provide discussion of all safety and health information.

Product Summary

Ethylene is the industrial petrochemical gas produced in the largest quantity worldwide. It is also produced in nature by plants. Ethylene is manufactured at NOVA Chemicals in well-controlled high temperature (thermal cracking) furnaces using ethane, propane and in some locations, naphtha as feedstocks.

Ethylene is considered to pose a low risk for potential adverse impacts in the workplace and to the public when risk management controls are in place to minimize accidental releases. Since it is highly flammable and explosive, it must be protected from contact with direct heat, flames or sparks. Ethylene is manufactured in closed equipment systems designed for safe handling, processing, storage and transport. It is shipped as a compressed gas or as a gas under high pressure by pipeline to other industrial processors that produce other chemicals or polyethylene plastic resins. Potential exposure to ethylene in the workplace or releases to the environment are strictly controlled to well below applicable regulatory limits. There are no identified consumer product uses for ethylene sold by NOVA Chemicals.

Product Use Information

NOVA Chemicals' ethylene is used primarily in the manufacture of plastic resins, styrene and other industrial chemicals. Ethylene is also used in making alcohols (ethanol), surfactants, elastomers and other fine chemicals. It can also be used as a fuel gas in welding and cutting operations, in petrochemical industries as a refrigerant and in greenhouse operations as a ripening agent for fruits and vegetables.

Human Exposure

Ethylene is ubiquitous in the environment, arising from both natural and man-made sources. There is very limited routine industrial workplace exposure to ethylene as it is handled in closed product systems meeting stringent industry design and operating standards. Any potential occupational exposure is restricted to accidental releases, emissions from process flares, storage and handling operations and fugitive emissions from process equipment (such as pumps or valves). Since 2004, industry has adopted an occupational exposure limit for ethylene of less than 200 parts per million (ppm) averaged over 8-hours of work or a 40-hour workweek. Workplace air quality measurements taken by NOVA Chemicals indicate that good facility design, maintenance and good operating practices and procedures minimize general workplace exposures to levels well below the occupational exposure limit. There is no established workplace biological exposure index for ethylene.

General population exposure to ethylene from industrial facilities is limited since industrial air emissions are subject to federal and state/provincial environmental regulations for volatile organic compounds. Measurements of emissions around industrial facilities during normal operations find levels ranging from not detectable to low parts per billion (ppb). Other exposures of the general population to ethylene occurs naturally from vegetation of all types; the burning of vegetation, refuse and the incomplete combustion of fuels.

Health Information

Ethylene is a gas or vapour that in a confined space can reduce the percent oxygen in air. Inhalation exposures to high concentrations of ethylene can cause headache, dizziness, nausea, heartbeat irregularities, unconsciousness, and/or suffocation by asphyxiation. Based on animal studies, the toxicity from a single (acute) exposure to ethylene is considered very low. Ethylene gas is not irritating to the skin and eyes; however contact with liquefied ethylene can cause severe frostbite. Ethylene is listed as a simple asphyxiant by the U.S. Occupational Safety and Health Administration (OSHA) and the American Conference of Governmental Industrial Hygienists (ACGIH).

Studies of long-term exposure to ethylene indicate that it has a low repeat exposure (chronic) toxicity. No risk to human health has been identified from occupational exposure, or exposure of the general public. Neither reproductive toxicity nor developmental toxicity (birth defects) was observed in rats exposed to ethylene. The International Agency for Research on Cancer (IARC), in its evaluation of ethylene in 1994, concluded that there is inadequate evidence for the carcinogenicity of ethylene in humans.

Environmental Exposure

Environmental exposure to ethylene is limited since it is only processed in closed systems in industrial facilities. Ethylene is highly volatile and is not expected to remain in water or on the soil surface. The lifetime of ethylene in the atmosphere ranges from 0.4 to 4 days, with an average of 1.5 days, and is strongly dependent on the amount of sunlight. Industrial volatile organic compound emissions and spills are regulated in Canada and in the United States and must be reported to regulatory agencies. Air emissions from these products can contribute to photochemical formation of ground level ozone and possible

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smog formation. These products contain no sulphur and no halogens and therefore are not associated with acid rain, stratospheric ozone depletion or with climate change.

Ecological Information

Due to its physical and chemical properties, ethylene released from industrial processes distributes mainly into the atmosphere. Ethylene is a natural hormone produced by plants at all stages of growth in varying amounts. Terrestrial plants such as fruit, flowers and nursery stock show diverse effects from ethylene exposure. For example, grasses and grassy vegetables such as lettuce are resistant to ethylene. However, several species of flowers (orchids, carnations, etc.), and vegetables such as tomatoes, potatoes, peppers, beans and peas are sensitive to ethylene exposure. The Alberta Crop Study co-sponsored by NOVA Chemicals demonstrated that while the field pea was relatively insensitive to a 26-day exposure to ethylene at 50 ppb, barley yields were reduced significantly by 3 days to the same exposure.

There is little to no concern for potential adverse effects in terrestrial wildlife due to very low toxicity and low exposure potential to ethylene. The minute amounts of ethylene measured in water represent little, if any, environmental hazard to aquatic organisms.

Physical Hazards

Ethylene is a colourless, extremely flammable gas with a faintly sweet odour that can be detected at 270 ppm. The major hazard is due to its flammable and explosive character. Ethylene is easily ignited and on release can quickly form a flammable mixture in air. Containers may explode when heated or exposed to direct flames. Industrially produced ethylene is kept within closed systems during production, storage, transportation and use.

Risk Management at NOVA Chemicals

Risk management priorities focus efforts on controls and improvements in process design, operation and maintenance of our ethylene facilities and transportation pipelines to prevent accidental releases and minimize the potential for fires or explosion. Use of suitable packing materials and sealing technology minimizes ethylene releases from pump seals, valve packings, pipe connections or gaskets. Ongoing preventative Leak Detection and Repair (LDAR) programs are in place at NOVA Chemicals' Joffre, Alberta, Corunna, Ontario, and Geismar, Louisiana ethylene producing and storage facilities. Emergency response teams are prepared and equipped to rapidly respond to on-site and off-site incidents. Processes are designed to eliminate possible ignition sources and undergo periodic detailed Process Hazard and Risk Assessment reviews (HAZOPs).

All processing, storage, and transport are conducted in closed systems designed to minimize the potential for exposure or releases to the environment. Industrial Hygiene programs periodically review all workplace potential exposures to ensure controls are in place and effective. Personal protective equipment is used to prevent exposure in those situations where exposure cannot be controlled using engineering controls or other methods.

NOVA Chemicals continues to carefully review all relevant information on the safety and suitability of ethylene and other petrochemical products for their known and intended end uses. In addition, NOVA Chemicals is committed to sharing information on the safe handling and end use of our products with customers and other interested parties. Safety Data Sheets (SDS) are provided to our customers and can be accessed by interested members of the public electronically at the NOVA Chemicals' website at www.novachemicals.com.

NOVA Chemicals is a member of the American Chemistry Council (ACC) and the Chemistry Industry Association of Canada (CIAC). Through these and other industry associations, we actively monitor and participate in public regulatory processes impacting ethylene. We also seek to better understand health and environmental challenges related to all of our products. We actively support industry-sponsored product testing initiatives and other industry initiatives supporting responsible actions, sound science and life cycle stewardship of our products.

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For detailed information on this product, please review the product Safety Data Sheet (SDS). In the case of an emergency involving this product, please call our 24-hour hotline at 1-800-561-6682 or 1-403-314-8767.

For more information on this product risk profile, please contact us at 1-412-490-4063 or email us at stewardp@novachem.com.

For more information on any NOVA Chemicals' product, please contact us at the nearest location below during business hours or visit our website at www.novachemicals.com:

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