

BENZENE

Product Summary

Benzene is a co-product of the ethylene manufacturing process at NOVA Chemicals' Corunna, Ontario facility. Benzene is also a component of some mixed hydrocarbon co-products (Aromatic Concentrates) shipped by rail from NOVA Chemicals' Joffre, Alberta facility. Benzene production occurs in closed systems and the co-product is transported by direct pipeline to other industrial sites in Canada for additional processing. Benzene is typically inventoried in bulk storage tanks equipped with floating roofs to reduce emissions.

Benzene is considered very toxic. Both the International Agency for Research on Cancer (IARC) and the U.S. Environmental Protection Agency (EPA) have determined that benzene is carcinogenic to humans. Long-term exposure to benzene can cause cancer of the blood-forming organs.

Environmental benzene exposure can occur through accidental spills, fugitive emissions, leakage or release of vapour to the atmosphere during tankage, delivery, or storage transfer. Exposure of workers is expected to be minimal because benzene is kept at all times in closed systems.

Product Use Information

NOVA Chemicals' benzene co-product is used only in industrial applications as a chemical feedstock for production of numerous organic chemicals. There are no known consumer uses for NOVA Chemicals' benzene.

Human Exposure

Occupational exposure to benzene is expected to be minimal. Exposure of workers may occur through inhalation and dermal contact at the workplace where benzene is produced or used. Any potential occupational exposure by inhalation of low level concentrations of benzene is restricted to storage, handling, sampling operations, fugitive emissions from process equipment (such as pumps or valves); or dermally by accidental releases. The maximum occupational exposure to benzene is 0.5 parts per million (ppm) averaged over 8-hours of work or a 40-hour work week in most of Canada and in the United States. Workplace air quality measurements taken by NOVA Chemicals in typical industrial operations indicate that good equipment design, maintenance and good operating practices and procedures minimize exposure to levels well below workplace exposure limits. The American Conference of Governmental Industrial Hygienists (ACGIH) has also established workplace biological exposure indices (BEI) for benzene.

General population exposure to benzene from industrial facilities is limited because industrial air emissions are subject to federal and state/provincial environmental regulations. The general population may be exposed to benzene through inhalation of gasoline vapours and automobile exhaust in high motor vehicle traffic areas and around gasoline service stations or in cigarette smoke environments. Although most public drinking water supplies are free of benzene or contain <0.3 parts per billion (ppb), exposure can be very high from the consumption of water drawn from wells contaminated by leaking gasoline storage tanks. EPA studies indicate that for chemicals such as benzene, "the most important sources of pollution are small and close to the person, and that exposures are not clearly correlated with emissions. For example, the Total Exposure Assessment Methodology (TEAM) study findings indicated that, although nearly 85% of atmospheric benzene in outdoor air is produced by cars burning petroleum products and the remaining 15% is produced by industry, about half of the total national exposure to benzene comes from cigarette smoke."¹

Health Information

As an acute poison, it has been estimated that 5 to 10 minutes of exposure to 20,000 ppm benzene in air is usually fatal. Lethality in humans has been attributed to asphyxiation, respiratory arrest, central nervous system depression or suspected cardiac collapse. Acute exposure >60 ppm causes mucous membrane irritation, sore throat and massive bleeding of the lungs.

People who inhale benzene vapours over a prolonged period may experience harmful effects in the tissues that form blood cells especially the bone marrow. This can lead to anemia. Also long-term exposure to benzene can cause cancer of the blood-forming organs. Exposure to benzene has been associated with the development of a particular type of leukemia called acute myeloid leukemia (AML). Since occupational benzene exposure has been shown to cause "leukemia", IARC, the U.S. EPA and ACGIH have determined that benzene is carcinogenic to humans. A Time-Weighted Average (TWA) of 0.5 ppm is recommended to protect against excess risk of leukemia due to the toxicity of benzene to the blood-forming organs. In addition, excessive exposure to benzene can be harmful to the immune system, increasing the chance for infections and perhaps lowering the body's defense against cancer.

It is not known what effects exposure to benzene might have on the developing foetus in pregnant women or on fertility in men. Studies with pregnant animals show that breathing benzene has harmful effects on the developing foetus. These effects include low birth weight, delayed bone formation, and bone marrow damage.

Environmental Exposure

Benzene enters the environment from the production, storage and transport of benzene itself. Gasoline may contain up to 1% benzene. Other sources result from its use as an intermediate in the production of other chemicals, from spills and from cigarette

¹ Lance Wallace. Environmental Exposure to Benzene: An Update. Environmental Health Perspective, Volume 104, Supplement 6, 1129-1136, December 1996. US Environmental Protection Agency, Reston, Virginia.

BENZENE

smoke. Although benzene is released into the environment, environmental levels are low because of efficient removal and degradation processes. Industrial volatile organic compound emissions and spills are regulated in Canada and in the United States and must be reported to regulatory agencies. The primary routes of environmental exposure to benzene are from contaminated air, especially in areas with high motor vehicle traffic or in the vicinity of gasoline service stations, and groundwater contamination from leaking underground gasoline storage tanks.

Ecological Information

Benzene is toxic to aquatic life. It is hazardous to waterfowl and animals. Based on the log K_{ow} , a bioconcentration factor (BCF) of 24 was estimated. Based on the reported and estimated BCF, benzene will not be expected to bioconcentrate in aquatic organisms. If benzene is released to the atmosphere, it will exist as a vapour for approximately 13.4 days. Benzene is slightly soluble in water and can be reduced in the atmosphere by rainfall. In water benzene will be subject to rapid volatilization. If benzene is released to the soil, it will be subject to rapid volatilization near the surface, and what does not evaporate will be highly to very highly mobile in soil and may leach into the ground water. The estimated half-life for volatilization in soil is 7.2 to 38.4 days. Therefore, benzene is not considered to be persistent in the air, water or soil.

Physical Hazards

Benzene is a volatile, stable/unreactive, colourless, extremely flammable liquid that does not dissolve easily in water. Benzene has a sweet odour and can be detected in the range of 34 to 119 ppm. Benzene poses a serious fire and explosive hazard when exposed to heat or flame. Benzene vapour is heavier than air and may collect in low areas. The vapours can travel for some distance; if it comes into contact with ignition sources, the flame may then be propagated along the vapour trail back to the source and cause an explosion. Industrially produced benzene is kept within closed systems during production, storage, transportation and use to help minimize these risks.

Risk Management at NOVA Chemicals

Risk management priorities focus efforts and improvements in process design, operation and maintenance of our industrial 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 releases from pump seals, valve packings, pipe connections or gaskets. Ongoing preventative Leak Detection and Repair (LDAR) programs are in place at both Joffre, Alberta and Corunna, Ontario production 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 benzene 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. Material Safety Data Sheets (MSDS) 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 benzene. 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.

Updated: June 10, 2015

For detailed information on this product, please review the product Material Safety Data Sheet (MSDS). 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.

NOVA Chemicals Corporation
PO Box 2518, Station M
Calgary, Alberta
Canada T2P 5C6
Tel: 403-750-3600

NOVA Chemicals Inc.
1555 Coraopolis Heights Road
Moon Township, PA
USA 15108
Tel: 412-490-4000
Toll Free: 1-866-ASK-NOVA

NOVA Chemicals (International) S.A.
Avenue de la Gare14
CH-1700 Fribourg
Switzerland
Tel: 41-26-426-57-57

THIS INFORMATION IS FURNISHED IN GOOD FAITH, WITHOUT WARRANTY, REPRESENTATION, INDUCEMENT OR LICENSE OF ANY KIND. ALL IMPLIED WARRANTIES AND CONDITIONS, INCLUDING WARRANTIES AND CONDITIONS OF QUALITY AND FITNESS FOR A PARTICULAR PURPOSE, ARE SPECIFICALLY EXCLUDED. NO FREEDOM FROM INFRINGEMENT OF ANY PATENT OWNED BY NOVA CHEMICALS OR OTHERS IS TO BE INFERRED.