TotalEnergies Petrochemicals & Refining USA, Inc.

Product Summary: Butadiene

November 2021

Product Overview

Butadiene, also known as 1,3-butadiene or buta-1,3-diene, is a colorless, non-corrosive, flammable gas that condenses to a liquid at -4.5°C (23.9°F) and has a mild aromatic odor. High purity butadiene, greater than 99 %, is obtained by extractive distillation from a mixed butylene stream, which is a by-product of ethylene and propylene production. The CAS Registry Number for butadiene is 106-99-0.[1]

Uses

There are no consumer uses of butadiene. Butadiene is used primarily as a chemical intermediate and as a monomer in the manufacture of polymers such as synthetic rubbers or elastomers, including styrene-butadiene rubber (SBR), polybutadiene rubber (PBR), polychloroprene (neoprene) and nitrile rubber (NR). The primary end-use of polybutadiene rubber and other materials made from butadiene is in the production of tires. Some other uses of polybutadiene rubber include the use as an impact modifier in plastics and as a component of adhesives.

Potential for Exposure

Environmental Exposure

Butadiene has high volatility and low water solubility. When released to the environment from industrial or non-industrial sources, butadiene breaks down quickly in sunlight and degrades in the air with a half-life of less than two hours. This evaporation occurs even when released into water or soil. Environmental sources include industrial releases from butadiene production and use, automobile exhaust, cigarette smoke and other combustion sources. 2 When released to the atmosphere, butadiene is a known ozone precursor. Modelling data predict that butadiene is moderately toxic to aquatic organisms. This data also predicts that butadiene has a low potential to bioaccumulate, suggesting that toxicity from long-term exposure to aquatic organisms is of low concern. Although microorganisms isolated from the soil have been shown to metabolize butadiene, biodegradation is not likely to contribute significantly to removal of butadiene from the soil.

Industrial Worker Exposure

Workplace exposures to butadiene are confined to where butadiene is manufactured or used. Manufacturing and transport involving butadiene are usually conducted in closed and pressurized systems, so human exposure is expected to be very limited. Occupational exposure may occur during sampling or due to unexpected leakages resulting from equipment failure.

Occupational exposure to butadiene is limited by Occupational Safety and Health Administration (OSHA). The OSHA Butadiene Standard (29 CFR §1910.1051) mandates measures to limit worker exposure to

[1] CAS Registry Number is a Registered Trademark of the American Chemical Society.

butadiene and establishes an Action Level of 0.5 ppm (8-hour work day). The OSHA Permissible Exposure Limit (PEL) is 1 ppm per an 8-hour workday.

Consumer/General Public Exposure

The primary route of potential human exposure to butadiene is by inhalation. On-road and off-road vehicles and other combustion sources are major sources of butadiene exposure in the ambient air. Cigarette smoke is the major source of butadiene in indoor air. Industrial emissions of chemicals, such as butadiene, are reported annually to the U.S. Environmental Protection Agency (EPA) and made available by EPA to the public in the Toxics Release Inventory (TRI).[2] According to EPA, only 1.6 percent of total environmental releases of butadiene are due to butadiene production and use.[3]

There are no direct consumer uses of butadiene and it is not expected to be present at levels of concern in polymers and plastics made from butadiene.

Health Effects

Butadiene is listed as a known human carcinogen by the International Agency for Research on Cancer (IARC)[4] and other agencies. It has been shown to cause cancer in laboratory animals. Butadiene epidemiology studies have linked employment in two different chemical operations each with a different type of cancer. The factors causing these excess cancers have not been determined because the affected workers were also exposed to other chemicals in these workplaces.

Animal studies provide no indication of fertility impairment or adverse developmental effects at doses which did not produce maternal toxicity. However, effects on fetuses, primarily in the form of retarded development, were observed in rodents at maternally toxic exposure levels.

Butadiene demonstrates low acute toxicity by inhalation. The LC50 (rat, 4 hours) is 285 mg/l[5], which is equivalent to 129,000 ppm. In poorly ventilated areas, butadiene vapors can accumulate, exclude oxygen and lead to asphyxiation. Short term exposure to concentrations greater than 10,000 ppm may cause slight irritation of the eyes, nose, and throat. Direct contact with liquefied butadiene can cause frostbite-like burns to the eyes and skin.

The GHS health hazard classifications based on OSHA Hazard Communication regulations (29 CFR 1910.1200)[6] for butadiene are provided in the table below. For additional information including GHS Hazards statement, Precautionary statements, and information on Specific Target Organ Toxicity (STOT), the Safety Data Sheet for the specific product should be consulted.

OSHA GHS Health Hazard Classifications	Butadiene
Simple Asphyxiant	-

[2] EPA TRI website: http://www.epa.gov/tri/

[3] USEPA (2002). Environmental Protection Agency. Health assessment of 1,3-butadiene. EPA/600/P-98/001F. 2002

[4] IARC Monographs Programme on the Evaluation of Carcinogenic Risks to Humans, February 2008 (Volume 97). https://publications.iarc.fr/115

[5] Russian Pharmacology and Toxicology (English Translation). Translation of FATOAO. (Euromed Pub., 33, Woodlands Rd., Surbiton, Surrey, UK) V.30- 1967-31, 162, 1968

[6] OSHA does not provide GHS hazard classifications for a chemical or a substance. OSHA places the responsibility of GHS hazard classification upon the manufacturers (or importers) of the chemical (see 21 CFR 1910.1200(d)). Therefore, GHS hazard classification in the United States may differ from manufacturer (or importer) to manufacturer (or importer). Additionally, these GHS hazard classifications may differ from other internationally established GHS classifications, such as those in the Europe Union or Japan.
The provided GHS classifications are current as of the date of this document. However, the GHS classifications are subject to change as new information is obtained. The user should always refer to the most recent product SDS to confirm the GHS classifications.

Germ cell mutagenicity	Cat. 1B
Carcinogenicity	Cat. 1A
STOT (Single Exposure) – Respiratory irritation	Cat. 3
STOT (Repeated Exposure)	Cat. 2

Physical Hazards

Butadiene is a significant fire and explosion hazard based on its physical properties, including flash point (-76°C), vapor pressure (2,110 torr at 25°C), and boiling point (-4.5°C). It can form explosive mixtures in air quite readily, as a result of its high vapor pressure. Therefore, preventive measure must be taken to minimize potential for fire or explosion. If a release occurs, vapors may travel a long distance and ignition and/or flash back may occur. Even though butadiene is an extremely flammable liquid and vapor, it is stable under recommended storage conditions.[7]

The GHS physical hazard classifications based on OSHA Hazard Communication regulations (29 CFR 1910.1200) for butadiene are provided in the table below.

OSHA GHS Physical Hazard Classifications	Butadiene
Flammable gases	Cat. 1
Gases under pressure liquefied gas	-

Hazardous Polymerization

Under certain conditions, butadiene can spontaneously polymerize, producing heat and high pressures. The resulting polymer can plug pressure relief valves. It is important to maintain appropriate inhibitor levels to avoid undesired polymerization and to avoid conditions which lead to uncontrolled polymerization.

Conditions to avoid

- Elevated temperatures
- Contact with air and oxygen, which leads to peroxide formation
- Contact with peroxides and rust
- Static Electricity

Additional information concerning polymerization and safe handling of butadiene during storage and is available in the Butadiene Product Stewardship Guidance Manual from the American Chemistry Council (ACC).

Transport and Storage

Butadiene is transported commercially by barge or ship, rail, truck, and pipeline.

To prevent peroxide formation, which could lead to uncontrolled polymerization, an inhibitor is added and the product is stored under an inert gas. The inhibitor content of stored butadiene should be monitored on a frequent and routine basis. The recommended inhibitor is tertiary-butylcatechol (TBC), added at a concentration of 50 - 150 ppm. TBC is only effective in the liquid phase of butadiene.

Pressure relief valves on butadiene storage containers should be inspected on a frequent and routine basis to ensure there is no buildup of polymer in the valve.

[7] Butadiene Product Stewardship Guidance Manual, American Chemistry Council, April 2010

Risk Management

A variety of risk management techniques are used in butadiene manufacturing and use facilities. Releases of butadiene to the environment are controlled under the Clean Air Act. In the USA, exposures in the workplace are controlled under the OSHA Butadiene Standard (29 CFR 1910.1051).

Processes are designed to eliminate ignition sources. Polymerization is controlled by adding polymerization inhibitors and by maintaining process conditions to minimize the potential for polymerization. Processing, storage, and transport are conducted in closed systems and systems are designed to minimize the potential for exposure or releases to the environment. Personal protective equipment is used in the workplace to prevent exposure in situations where exposure cannot be controlled using engineering controls or other methods.

TotalEnergies Petrochemicals & Refining USA, Inc., as a member of the American Chemistry Council (ACC), actively participates in Responsible Care®, ACC's global industry performance initiative.[8]

Product Stewardship Contact Information:

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[8] American Chemistry Council webpage – https://www.americanchemistry.com/chemistry-in-america/responsible-care-driving-safety-industry-performance

Additional Information:

Agency for Toxic Substances and Disease Registry (ATSDR) Toxicological Profile for butadiene. https://wwwn.cdc.gov/TSP/ToxProfiles/ToxProfiles.aspx?id=459&tid=81

American Chemistry Council Butadiene Product Summary https://www.americanchemistry.com/industry-groups/olefins/resources/butadiene-product-summary

European Chemicals Agency (ECHA) Substance Infocard https://echa.europa.eu/substance-information/-/substanceinfo/100.003.138

IARC Monograph https://publications.iarc.fr/115

National Institute of Health, PubChem https://pubchem.ncbi.nlm.nih.gov/compound/1_3-Butadiene

Occupational Safety and Health Administration (OSHA) https://www.osha.gov/butadiene

OECD (Organization for Economic Co-operation and Development https://hpvchemicals.oecd.org/UI/SIDS_Details.aspx?id=08a4e621-6f5b-440a-990a-a47ad57b1e0e

Texas Commission on Environmental Quality. Effects Screening Level Development Support Document: 1,3-Butadiene (2008, Revised 2015) https://www.tceq.texas.gov/assets/public/implementation/tox/dsd/final/butadiene,%201,3-.pdf

U.S. Environmental Protection Agency (EPA) Integrated Risk Information System (IRIS) web site https://iris.epa.gov/AdvancedSearch/?keyword=1,3-butadiene

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