

Global Product Strategy (GPS) Safety Summary

Butadiene

This Product Safety Summary is a high-level summary intended to provide the general public with an overview of product safety information on this chemical substance. It is not intended to provide emergency response, medical or treatment information, nor to provide an overview of all safety and health information. This summary is not intended to replace the Safety Data Sheet. For detailed guidance on the use or regulatory status of this substance, please consult the Safety Data Sheet, the Product Safety Bulletin and the Product Stewardship Affairs Bulletin (PSB).

Chemical Identity

Name: Butadiene

Brand names: Refined Butadiene, BD, Bivinyll, Erythrene, Vinylethylene

Chemical name (IUPAC): 1,3-Butadiene

CAS number: 106-99-0

EC number: 203-450-8

Molecular formula: C₄H₆

Uses and Applications

1,3-Butadiene is a major product of the petrochemical industry. Its simple chemical structure combined with its low molecular weight and high chemical reactivity makes it a very useful building block in the synthesis of other materials. Butadiene is used primarily as a monomer in the production of a wide range of polymers and co-polymers.

Butadiene is used to manufacture styrene-butadiene rubber and polybutadiene rubber, which are used in the manufacture of tires, hoses, gaskets and other rubber products. Butadiene is also used in the production of paints, adhesives, nylon clothing, carpets, paper coatings and engineered plastics

Physical / Chemical Properties

At ambient temperature and pressure, butadiene is a colorless, non-corrosive gas with a mild aromatic or gasoline-like odor.

Butadiene is extremely flammable with a flash point of -76°C (-105°F). The boiling point and melting point of Butadiene are -4.5°C (23.9°F) and -108.9°C (-164.02°F), respectively.

Butadiene is a highly reactive monomer. Pressurized butadiene (liquid) is normally supplied in a stabilized form with an appropriate level of P-TBC inhibitor (Tertiary Butyl Catechol).

Butadiene may react with oxygen to form unstable butadiene peroxides. Butadiene peroxides are thermally unstable, shock sensitive and may lead to the formation of popcorn polymer (popcorning). The formation of popcorn polymer can build sufficient mechanical force to rupture process equipment. Popcorn polymer may also plug safety venting devices. However, butadiene is stable under recommended handling and storage conditions.

Butadiene is classified as hazardous under the Globally Harmonized System (GHS) on classification and labeling for its extreme flammability.

Health Effects

The most likely route to exposure is inhalation as butadiene is a gas at standard temperature and pressure. Butadiene is of slight acute toxicity, although inhalation exposure to high concentrations well above recommended exposure levels may cause dizziness and central nervous system (CNS) depression.

Butadiene is classified as a mutagen and a known human carcinogen under GHS.

The table below gives an overview of the health effects assessment results for butadiene.

| Effect Assessment | Result |
|--|--|
| Acute Toxicity Oral / inhalation / dermal | Butadiene is of slight acute toxicity, although inhalation exposure to high concentrations may cause dizziness, CNS depression, loss of consciousness and cardiac sensitization. |
| Irritation / corrosion Skin / eye/ respiratory tract | Concentrated vapors may be irritating to the eye and respiratory tract. Rapid evaporation of the liquid may cause frostbite-like burns to the eyes and/or skin. |
| Sensitization | Not expected to cause sensitization. |
| Toxicity after repeated exposure Oral / inhalation / dermal | Repeated exposure caused toxicity to a range of tissues in the mouse but is of low toxicity to the rat and no chronic non-neoplastic effects have been reported in humans. |
| Genotoxicity / Mutagenicity | Classified as genotoxic. |
| Carcinogenicity | A multi-species animal carcinogen. Epidemiology studies suggest butadiene is carcinogenic in humans with concern for cancers of the hematopoietic system. |
| Toxicity for reproduction | Not a teratogen, however mild fetotoxicity (primarily retarded development) has been observed in rodents at maternally toxic exposures. Adverse changes in the reproductive system reported in the mouse (including testicular and ovarian atrophy, and altered sperm head morphology) but there was no detrimental effect on fertility or reproduction. |

Environmental Effects

In the environment, butadiene goes into the air and is rapidly degraded. As butadiene is a gas at normal temperature and pressure, water contamination and chronic aquatic toxicity are not expected.

The table below gives an overview of the environmental assessment results for butadiene.

| Effect Assessment | Result |
|--------------------------|----------------------------|
| Aquatic Toxicity | Non-toxic to aquatic life. |

| Fate and behaviour | Result |
|---------------------------|--|
| Biodegradation | This material is not expected to be readily biodegradable. |
| Bioaccumulation potential | This material has low potential to bioaccumulate. |
| PBT / vPvB conclusion | Not considered to be either PBT or vPvB. |

PBT = Persistent, Bio-accumulative and Toxic in the environment.

vPvB = very Persistent and very Bio-accumulative in the environment.

Exposure

Human health

Exposure to butadiene of personnel in manufacturing facilities is considered very low because the process, storage and handling operations are enclosed and continuous. It is not used in a widespread or dispersive manner. However, worker exposure can potentially occur during operations such as product transfer, product sampling, or maintenance / repair activities on product containing systems. The risk of accidental exposure should be controlled and mitigated by selecting and applying the appropriate Risk Management Measures.

Consumer exposure to commercially produced butadiene is unlikely as butadiene is intended for use in industrial applications only.

Environment

Butadiene is manufactured in a closed and automated process. Transfer operations such as loading/unloading and transportation are conducted with dedicated equipment and under recommended Safe Use guidance according to industrial best practices to reduce the risk of release to the environment.

Risk Management Measures

For detailed guidance on the use of butadiene, please consult the Safety Data Sheet.

Butadiene should only be handled by knowledgeable and trained personnel.

Flammability / Stability

Butadiene is an extremely flammable gas and should be kept away from any source of ignition. When heated under pressure, containers of butadiene in a fire may undergo rapid and uncontrolled polymerization resulting in an explosion.

Never direct water at source of leak or devices because icing may occur.

Vapor space above stored liquid may be flammable/explosive unless blanketed with inert gas. Metal containers involved in the transfer of butadiene should be grounded and bonded to reduce the risk of sparks from static electricity.

To avoid butadiene polymerization in the presence of oxygen, it is important to add an inhibitor and monitor the inhibitor's content to maintain appropriate concentration and make sure that dead ends (pipes) are flushed regularly. Storage vessels must be clean, dry and free of oxygen.

Human health

When using chemicals make sure there is adequate ventilation. Always use appropriate chemical resistant gloves to protect your hands and skin, wear eye protection such as chemical goggles, and wear flame retardant clothing. Do not eat, drink or smoke where chemicals are handled, processed or stored. Wash hands and skin following contact. If the substance gets into your eyes, rinse eyes thoroughly for at least 15 minutes with tap water and seek medical attention.

In the case of transfer or maintenance operations, always clear transfer lines prior to decoupling and flush/drain to a closed system for recycle prior to opening equipment.

In cases where engineering controls cannot maintain airborne substance concentrations at exposure limits, or in cases with a risk of accidental exposure, additional risk management measures may be needed for safe use such as a complete suit protecting against chemicals and supplied air, self-contained breathing apparatus or respirator.

Environmental

In case of accidental release or spill, prevent entry into confined areas.

Regulatory Information / Classification and Labeling

This substance has been registered under REACH by relevant companies of LyondellBasell in the European Union.

For a detailed overview of the regulatory status of this substance, please refer to the Product Stewardship Bulletin available on lyondellbasell.com.

Under the Globally Harmonized System (GHS) on classification and labeling, substances are classified according to their physical, health and environmental hazards. The hazards are communicated via specific labels on the product packaging and the (Material) Safety Data Sheet.

GHS attempts to standardize hazard communication so that the intended audience (customers, workers, consumers, transport workers, and emergency responders) can better understand the hazards of the chemicals in use.

For a detailed overview of the classification and labeling of this substance, please refer to the Safety Data Sheet found on lyondellbasell.com.

Conclusion Statements

- Butadiene is used as a chemical intermediate and/or monomer for industrial purposes.
- Butadiene has been classified as hazardous. The main hazards are its extreme flammability, mutagenicity and known human carcinogenicity.
- Exposure to human and environment is considered very low as butadiene manufacturing process, storage and handling operations are enclosed.

Contact Information within Company

For further information on this product in general, please consult lyondellbasell.com (www.lyb.com).

Date of issue:

Date of issue: 4 June 2015.

Disclaimer

Before using a product sold by a company of the LyondellBasell family of companies, users should make their own independent determination that the product is suitable for the intended use and can be used safely and legally.

SELLER MAKES NO WARRANTY; EXPRESS OR IMPLIED (INCLUDING ANY WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE OR ANY WARRANTY) OTHER THAN AS SEPARATELY AGREED TO BY THE PARTIES IN A CONTRACT.

This product(s) may not be used in:

- (i) any U.S. FDA Class I, Health Canada Class I, and/or European Union Class I medical devices, without prior notification to Seller for each specific product and application; or
- (ii) the manufacture of any of the following, without prior written approval by Seller for each specific product and application: U.S. FDA Class II Medical Devices; Health Canada Class II or Class III Medical Devices; European Union Class II Medical Devices; film, overwrap and/or product packaging that is considered a part or component of one of the aforementioned medical devices; packaging in direct contact with a pharmaceutical active ingredient and/or dosage form that is intended for inhalation, injection, intravenous, nasal, ophthalmic (eye), digestive, or topical (skin) administration; tobacco related products and applications, electronic cigarettes and similar devices, and pressure pipe or fittings that are considered a part or component of a nuclear reactor. Additionally, the product(s) may not be used in: (i) U.S. FDA Class III Medical Devices; Health Canada Class IV Medical Devices;

European Class III Medical Devices; (ii) applications involving permanent implantation into the body; (iii) life-sustaining medical applications; and (iv) lead, asbestos or MTBE related applications. All references to U.S. FDA, Health Canada, and European Union regulations include another country's equivalent regulatory classification.

Users should review the applicable Safety Data Sheet before handling the product.

All information ("Information") contained herein is provided without compensation and is intended to be general in nature. You should not rely on it in making any decision. LyondellBasell accepts no responsibility for results obtained by the application of this Information, and disclaims liability for all damages, including without limitation, direct, indirect, incidental, consequential, special, exemplary or punitive damages, alleged to have been caused by or in connection with the use of this Information. LyondellBasell disclaims all warranties, including, but not limited to, the implied warranties of merchantability and fitness for a particular purpose, that might arise in connection with this information.

Butadiene is a product of Basell Polyoléfines France SAS, Basell Polyolefine GmbH and Equistar Chemicals LP.