

Butadiene Product Summary

What is butadiene?

Butadiene, also known as 1, 3-butadiene, is a colorless, non-corrosive gas that condenses to a liquid at minus 4.5 degrees centigrade and has a mild aromatic odor. Butadiene is produced commercially by extractive distillation from crude butylene concentration (C4) stream, a by-product of ethylene and propylene production.

How is butadiene used?^{1,2}

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). However, the major use of butadiene is in the production of tires. Butadiene is consumed in the manufacture of polymers, latexes, and plastics.

Rubbers and latexes made from butadiene are used to make the following goods and materials:

- SBR and PBR are used to produce tires and plastic materials.
- Styrene-butadiene latex is used to produce carpet and paper coatings
- Neoprene is used in gloves, wetsuits, waders and foams
- Nitrile rubber is used in hoses, gloves, gaskets and seals.

Plastics made using butadiene-based rubbers are primarily acrylonitrile-butadiene-styrene (ABS) resins and styrene-butadiene latex. Butadiene is also used in the manufacture of adiponitrile, a precursor for nylon-6, 6, which is used to produce carpets, textiles and plastic parts.

What happens to 1, 3-butadiene when it enters the environment?³

Butadiene has high volatility and low-water solubility. When released to the environment from industrial or non-industrial sources, butadiene evaporates to the air, even from water and soil; and butadiene breaks down quickly in sunlight and degrades in the air with a half-life of less than two hours. Environmental sources include industrial releases from butadiene production and use, automobile exhaust, cigarette smoke and other combustion sources.

Modelling data predict that butadiene is moderately toxic to aquatic organisms. Modelling data also predict 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

¹ "Butadiene," Kirk-Othmer: Encyclopedia of Chemical Technology, New York: John Wiley & Sons, Inc., 2006.

² Butadiene Market Perspectives ICIS.

³ "ToxFAQs™ for butadiene," Agency for Toxic Substances and Disease Registry, September 1995.

have been shown to metabolize butadiene, biodegradation is not likely to contribute significantly to removal of butadiene from the soil.

How are persons exposed to butadiene?⁴

The primary route of potential human exposure to butadiene is by inhalation. Major sources of butadiene exposure in the ambient air are on-road and off-road vehicles and other combustion sources. Cigarette smoke is the major source of butadiene in indoor air, where smoking occurs. Industrial emissions of chemicals such as 1,3 -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)⁵. [According to EPA, only 1.6 percent of total environmental releases nationally are due to butadiene production and use.](#)⁶

There are no direct consumer uses of butadiene and it is not expected to be present in polymers and plastics made from butadiene. Workplace exposures to butadiene are confined to where butadiene is manufactured or used. Occupational exposure to butadiene is limited by Occupational Safety and Health Administration (OSHA) permissible exposure limits (PELs). The OSHA Butadiene Standard also establishes an Action Level of 0.5 ppm (8-hour TWA), which effectively limits occupational exposure to 1,3-butadiene further.

What are the potential health effects of butadiene?⁷

Butadiene is listed as a known human carcinogen by the International Agency for Research on Cancer (IARC)⁸ 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 workers are also exposed to other chemicals in these workplaces.

Butadiene has caused birth defects in laboratory animals only at doses toxic to the mother; however butadiene has been shown to be toxic to the fetus in laboratory animals at doses that are not toxic to the mothers. Butadiene has been shown to cause injury to reproductive organs in mice, although no reproductive effects were observed in rats following exposure to high levels of butadiene.

In poorly ventilated areas, butadiene vapors can accumulate, exclude oxygen and lead to asphyxiation. Short term exposure to concentrations > 10,000 ppm may cause irritation of the eyes,

⁴ “ToxFAQs™” for butadiene,” Agency for Toxic Substances and Disease Registry, September 1995.

⁵ EPA TRI website: <http://www.epa.gov/tri/>.

⁶ USEPA (2002). Environmental Protection Agency. Health assessment of 1,3-butadiene. EPA/600/P-98/001F. 2002.

⁷ USEPA (2002). Environmental Protection Agency, Health assessment of 1,3-butadiene. EPA/600/P-98/001F, 2002. Texas Commission on Environmental Quality. Effects Screening Level Development Support Document (2008).

⁸ IARC Monographs Programme on the Evaluation of Carcinogenic Risks to Humans, February 2008 (Volume 97).

nose, and throat. It may also cause drowsiness and lightheadedness. Direct contact with liquefied butadiene can cause frostbite-like burns to the eyes and skin.

Physical Hazard Information⁹

Butadiene is a significant fire and explosion hazard based on its physical properties, including flash point, vapor pressure, and boiling point. It can quite readily form explosive mixtures in air as a result of its high vapor pressure. Therefore, preventive measure must be taken to minimize potential for fire or explosion.

Even though butadiene is an extremely flammable liquid and vapor, it is stable under recommended storage conditions. If a release occurs, vapors may travel a long distance and ignition and/or flash back may occur.

Transport and Storage¹⁰

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.

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. Exposures in the workplace are controlled under the OSHA Butadiene Standard.

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.

In addition, through [Responsible Care](#)[®] ACC's global industry performance initiative, since 1988 ACC member companies in the United States have reduced emissions of core Hazardous Air Pollutants (HAPs) chemicals by 86 percent; and reduced emissions of all TRI listed HAPs chemicals by 79 percent. Responsible Care companies go above and beyond government requirements and openly communicate their results to the public.

⁹ Butadiene Product Stewardship Guidance Manual, American Chemistry Council, March 2002.

Additional Information:

Agency for Toxic Substances and Disease Registry (ATSDR) Tox FaQs™ for butadiene, 1995.
(<http://www.atsdr.cdc.gov/tfacts28.html>)

Agency for Toxic Substances and Disease Registry (ATSDR) Toxicological Profile for butadiene.
1993. (hppt://www.atsdr.cdc.gov/toxprofiles/tp28.html)

American Chemistry Council Responsible Care® Website

http://www.americanchemistry.com/s_responsiblecare

Butadiene Product Stewardship Guidance Manual, American Chemistry Council, March 2002.
(contact your supplier).

EU Risk Assessment document can be obtained from European Chemicals Bureau (ECB) website:
<http://ecb.jrc.ec.europa.eu/esis/>. Look up either by EC# (203-450-8), CASRN (106-99-0), name
(Buta-1,3-diene), or Molecular Formula (C4H6).

IARC Monograph: <http://monographs.iarc.fr/ENG/Classification/index.php> or link to Volume 97 article
published in Lancet: <http://monographs.iarc.fr/ENG/Meetings/index1.php> or
<http://www.iarc.fr/en/Publications> (Volume 97 not yet available)

National Institute of Health, Hazardous Substance Database; <http://toxnet.nlm.nih.gov/cgi-bin/sis/search/f?./temp/~z4KO6N:1>

North Carolina Department of Environment and Natural Resources Division of Air Quality.
(<http://daq.state.nc.us/Calendar/Planning/MarchAQC/AGENDAITEMS3-6.pdf>)

Occupational Safety and Health Administration (OSHA). Occupational Exposure to 1,3-Butadiene.
(<http://www.osha.gov/SLTC/butadiene/standards.html>)

OECD (Organization for Economic Co-operation and Development) (<http://cs3-hq.oecd.org/scripts/hpv/index.asp>)

Texas Commission on Environmental Quality. Effects Screening Level Development Support
Document: 1,3-Butadiene (2008).
(http://tceq.com/assets/public/implementation/tox/dsd/final/butadiene_1-3-106-99-0_final.pdf)

U.S. Environmental Protection Agency (EPA) Integrated Risk Information System (IRIS) web site –
SEARCH Butadiene (<http://www.epa.gov/iriswebp/iris/indix.html>)

U.S. Environmental Protection Agency (EPA) National Emissions Standards for Hazardous Air
Pollutants (HON). 40 CFR Part 63. (<http://www.epa.gov/ttn/atw/hon/fr24oca.txt>)