

Product Safety Summary 1,3 Butadiene

Chemical Identity

Butadiene, also known as 1, 3-butadiene, is a colorless, non-corrosive gas that condenses to a liquid at -4.5°C 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.

Product Uses^(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.

Physical Information⁽³⁾

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.

Product Safety Summary 1,3 Butadiene

Health Information⁽⁴⁾

Butadiene is listed as a known human carcinogen by the International Agency for Research on Cancer (IARC)⁵ 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, 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.

Environmental Information⁽⁶⁾

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.

Modeling data predict that butadiene is moderately toxic to aquatic organisms. Modeling 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 have been shown to metabolize butadiene, biodegradation is not likely to contribute significantly to removal of butadiene from the soil.

Exposure Potential⁽⁷⁾

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 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)⁸. [According to EPA, only 1.6 percent of total environmental releases nationally are due to butadiene production and use.](#)⁹

Product Safety Summary 1,3 Butadiene

Workplace Exposure - Generally, exposure of personnel to butadiene in manufacturing facilities and industrial workplace is relatively low because the process, storage and handling operations are closed, with little potential for releases to the air. Typically industrial workplaces have control programs and work practices to limit exposure to butadiene. The American Conference of Government Industrial Hygienists recommends limiting occupational exposure to no more than 2 parts per million (ppm) over an 8-hour work day. Similarly, the U.S. Occupational Safety and Health Administration has limited worker exposure to no more than 1 ppm per an 8-hour work day.

Consumer Use - Butadiene is not sold to the general public and is not expected to be present in the polymers or synthetic rubbers made with it. Exposure to consumers would be expected to be low, far below the recommended occupational exposure level described above.

Environmental Releases - As a chemical manufacturer, we are committed to operating in an environmentally responsible manner. Our efforts are guided by understanding of the environmental impact of our operations, as well as by the social and economic needs of the communities in which we operate. Industrial spills or releases are rare; however a spill or release may pose a significant flammability issue. Our operational improvement targets and plans are based on driving incidents with real environmental impact to zero and delivering superior environmental performance.

Risk Management

Workplace Risk Management – A variety of risk management strategies 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 and explosion-proof equipment is used. 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.

Product Safety Summary 1,3 Butadiene

Consumer Risk Management - This chemical is not sold directly to the public for general consumer uses. As a result of its use in industrial chemical reactions, consumer exposure is highly unlikely. If exposure should occur, it is expected to be infrequent and of short duration. Always follow manufacturers' instructions, warnings and handling precautions when using their products. The best way to prevent exposure to vapors is to work in well-ventilated areas.

Transportation Information

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.

Additional Information

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

Agency for Toxic Substances and Disease Registry (ATSDR) Toxicological Profile for butadiene. 1993. (<http://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, April 2, 2010. (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>)

Product Safety Summary 1,3 Butadiene

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>)

References

1. Butadiene,” Kirk-Othmer: Encyclopedia of Chemical Technology, New York: John Wiley & Sons, Inc., 2006.
2. Butadiene Market Perspectives ICIS.
3. Butadiene Product Stewardship Guidance Manual, American Chemistry Council, March 2002
4. 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).
5. IARC Monographs Programme on the Evaluation of Carcinogenic Risks to Humans, February 2008 (Volume 97)
6. “ToxFAQsTM” for butadiene,” Agency for Toxic Substances and Disease Registry, September 1995.
7. ToxFAQsTM” for butadiene,” Agency for Toxic Substances and Disease Registry, September 1995
8. EPA TRI website: <http://www.epa.gov/tri/>.
9. USEPA (2002). Environmental Protection Agency. Health assessment of 1,3-butadiene. EPA/600/P-98/001F. 2002.