

**Product Summary**  
**Butadiene**  
**Total Petrochemicals & Refining USA, Inc.**  
**March 2012**

**Product Overview**

Butadiene, also known as 1, 3-butadiene [butadiene], 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<sup>1</sup> Registry Number for butadiene is 106-99-0.

**Uses<sup>2,3</sup>**

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.

**Potential for Exposure**

Environmental Exposure<sup>4</sup>

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. 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 butadiene and

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<sup>1</sup> CAS Registry Number is a Registered Trademark of the American Chemical Society.

<sup>2</sup> "Butadiene," Kirk-Othmer: Encyclopedia of Chemical Technology, New York: John Wiley & Sons, Inc., 2006.

<sup>3</sup> Butadiene Market Perspectives ICIS.

<sup>4</sup> "ToxFAQs™" for butadiene," Agency for Toxic Substances and Disease Registry, September 1995.

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

#### Consumer/General Public Exposure<sup>5</sup>

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).<sup>6</sup> According to EPA, only 1.6 percent of total environmental releases nationally are due to butadiene production and use.<sup>7</sup>

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**<sup>8</sup>

Butadiene is listed as a known human carcinogen by the International Agency for Research on Cancer (IARC)<sup>9</sup> 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 causes a variety of reproductive and developmental effects in mice and rats. No direct human data on reproductive and developmental effects of butadiene is available.

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 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.

#### **Physical Hazards**<sup>10</sup>

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.

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<sup>5</sup> "ToxFAQs™" for butadiene," Agency for Toxic Substances and Disease Registry, September 1995.

<sup>6</sup> EPA TRI website: <http://www.epa.gov/tri/>.

<sup>7</sup> USEPA (2002). Environmental Protection Agency. Health assessment of 1,3-butadiene. EPA/600/P-98/001F. 2002.

<sup>8</sup> 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).

<sup>9</sup> IARC Monographs Programme on the Evaluation of Carcinogenic Risks to Humans, February 2008 (Volume 97).

<sup>10</sup> Butadiene Product Stewardship Guidance Manual, American Chemistry Council, March 2002.

## **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](#) by 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.

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

### **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.

Total Petrochemicals & Refining USA, Inc., as a member of the American Chemistry Council (ACC), actively participates in the Responsible Care® program. Since 1988, through [Responsible Care](#)® ACC's global industry performance initiative, 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.

### **Product Stewardship Contact Information**

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**Additional Information:**

Agency for Toxic Substances and Disease Registry (ATSDR) Tox FaQs™ for butadiene, 1995.  
(<http://www.atsdr.cdc.gov/toxfaqs/tf.asp?id=458&tid=81>).

Agency for Toxic Substances and Disease Registry (ATSDR) Toxicological Profile for butadiene. 2009  
(<http://www.atsdr.cdc.gov/toxprofiles/tp.asp?id=459&tid=81>).

American Chemistry Council Responsible Care® Website ([http://www.americanchemistry.com/s\\_responsiblecare](http://www.americanchemistry.com/s_responsiblecare)).

American Chemistry Council Butadiene Product Summary (<http://www.americanchemistry.com/butadiene>)

Butadiene Product Stewardship Guidance Manual, American Chemistry Council, April 2010  
(<http://www.americanchemistry.com/ProductsTechnology/Olefins/Butadiene-Product-Stewardship-Guidance-Manual.pdf>).

EU Risk Assessment document can be obtained from European Chemicals Bureau (ECB) website:  
<http://esis.jrc.ec.europa.eu/>. Look up either by EC# (203-450-8), CASRN (106-99-0), name (Buta-1,3-diene), or Molecular Formula (C<sub>4</sub>H<sub>6</sub>).

IARC Monograph: <http://monographs.iarc.fr/ENG/Classification/index.php> or link to Volume 97:  
<http://monographs.iarc.fr/ENG/Monographs/PDFs/index.php>.

National Institute of Health, Hazardous Substance Database – SEARCH Butadiene (<http://toxnet.nlm.nih.gov/cgi-bin/sis/htmlgen?HSDB>).

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/index.html>)

OECD (Organization for Economic Co-operation and Development  
([http://webnet.oecd.org/hpv/UI/SIDS\\_Details.aspx?Key=81d342e9-8c73-4151-b5a0-734cff1054af&idx=0](http://webnet.oecd.org/hpv/UI/SIDS_Details.aspx?Key=81d342e9-8c73-4151-b5a0-734cff1054af&idx=0)).

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](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://toxnet.nlm.nih.gov/cgi-bin/sis/htmlgen?IRIS>).

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

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