



TotalEnergies Petrochemicals & Refining USA, Inc.

Product Summary: Benzene

October 2021

Benzene is a member of the chemical family called “aromatics,” and is composed of a six carbon atom ring and six hydrogen atoms. It is a clear, colorless liquid that evaporates easily, releasing a characteristic sweet smell. It is a widely used chemical that may be formed by natural processes as well as human activity. Benzene may be purposely manufactured or recovered for use as a by-product of other processes in the steel and petroleum industries.

Chemical Identity:

Trade Name: Benzene
Also known as benzol, phenyl hydride
CAS#: 71-43-2

Uses

Benzene, an important chemical building block, ranks in the top 20 in production volume for chemicals produced in the United States. Benzene is not used directly by consumers. While benzene has limited use as a solvent, it is a raw material used in the production of many other industrial chemicals. Most benzene is used in the production of ethylbenzene, which is used to manufacture styrene. It is also used to produce cumene (for resins and adhesives), cyclohexane (for nylon), and aniline (for urethanes), among others. Most gasolines contain small amounts of benzene, typically less than 2 %.

Benefits of Products Manufactured Using Benzene

It is important to note that while benzene is a building block used during production of some of the following products, it is not present in significant amounts in the final products. Some typical products include:

- Clothing
- Food packaging
- Paints
- Vehicle tires
- Pharmaceuticals
- Shatterproof windows
- Detergents
- Pesticides
- Office equipment

Physical/chemical properties:

- Specific Gravity: 0.88 (Water = 1)
- Appearance: colorless liquid
- Boiling Point: 80°C (176°F)
- Freezing Point: 6°C (42°F)
- Flash Point: closed cup: -11°C (12°F)
- Lower Explosion Limit: 1.2 %
- Upper Explosion Limit: 7.8 %
- Vapor Pressure: 75 mm Hg (100 hPa) @20°C
- Solubility in water: 1.8 g/L @ 25°C

Benzene is classified as a Flammable Liquid, Category 2, under Occupational Safety and Health Administration (OSHA) Hazard Communication regulations. It is also classified as a Flammable Liquid by the United States Department of Transportation (DOT) and other global transportation authorities.

Health Effects:

The GHS health hazard classifications based on OSHA Hazard Communication regulations (29 CFR 1910.1200)¹ for benzene 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 | Benzene |
|---|---------|
| Aspiration hazard | Cat. 1 |
| Skin corrosion/irritation | Cat. 2 |
| Serious eye damage/eye irritation | Cat. 2A |
| Carcinogenicity | Cat. 1A |
| Germ cell mutagenicity | Cat. 1B |
| STOT (Single Exposure) - Narcotic Effects | Cat. 3 |
| STOT (Repeated Exposure) | Cat. 1 |

Benzene can enter the body easily through the lungs and digestive tract, but it does not pass readily through skin. Benzene passes into the bloodstream, where it travels throughout the body. It may be temporarily stored in bone marrow and fat. Benzene is generally metabolized, or broken down by the body into other chemicals, quickly. While some of the harmful effects of benzene are caused by these metabolites, they are generally released from the body through urine within 2 days.

Short (also called acute) exposures to extremely high levels of benzene in air can result in death. Intentional misuse involving repeated and prolonged inhalation exposure to high concentrations of vapor can result in central nervous system (CNS) damage, and eventually death.

Breathing lower, but still high, levels of benzene can cause CNS effects such as headache, drowsiness, dizziness, or unconsciousness. Usually, people recover from these effects quickly when they breathe fresh air.

Ingestion of benzene causes the same CNS effects seen with inhalation, as well as diarrhea and vomiting, and may be harmful or fatal. When benzene is swallowed or vomited, it may enter the lungs (aspiration), causing damage and possible pneumonia.

Skin contact can cause redness and irritation. Contact with eyes may cause irritation or damage to the cornea. Acute Toxicity Values for benzene are provided in the table below.

¹ OSHA does not provide GHS hazard classifications for a chemical. 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). 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.

Acute Toxicity Values for Benzene

| LD50 oral (rat) | LD50 dermal (rabbit) | LC50 inhalation (rat) |
|---------------------------------|---------------------------|------------------------|
| 930 – 6400 mg/kg ^{2,3} | > 8270 mg/kg ⁴ | > 34 mg/L ⁵ |

Long-term (also called chronic) exposures to benzene in the air may be harmful to blood, to the tissues that form the components of blood, and to the immune system. This may result in anemia, which may go away after the exposure stops. Chronic inhalation exposure to benzene vapors has been associated with development of a particular type of leukemia, a cancer of the blood or bone marrow, called acute myeloid leukemia.

Many governmental and non-governmental agencies rate the cancer-causing potential (carcinogenicity) of chemicals. Some results for benzene include:

| Agency | Carcinogenicity of Benzene |
|--|----------------------------|
| International Agency for Research on Cancer (IARC) | Known Human Carcinogen |
| National Toxicity Program (NTP) | Known Human Carcinogen |
| Occupational Safety and Health Administration (OSHA) | Known Human Carcinogen |

Potential for Exposure

Environmental Exposure:

While benzene is harmful or toxic to many aquatic organisms such as fish, algae, and some invertebrates, it is not expected to bioaccumulate. Benzene is not readily soluble in water, and if released as a liquid will rapidly evaporate from soil and water into the air. Under normal conditions, it degrades within a few days due to the action of sunlight and microorganisms. The federal government has set limits for the allowable amount of benzene in water through the EPA's Clean Water Act.

Industrial Worker Exposure:

The risk of exposure to benzene is generally highest among workers that make or use benzene in an industrial setting. Benzene is a recognized toxic substance with established limits, or standards, for workplace exposure. Furthermore, benzene vapors are heavier than air, and travel across the ground. When released as a liquid, benzene will float on water. Benzene is extremely flammable, and care must be taken to prevent ignition of these vapors, even at normal working temperatures. In the U.S., OSHA regulates the exposure to benzene (see 29 CFR 1910.1028). Ventilation must be provided for industrial workers in order for exposure levels to stay below established standards. If inhalation above established standards is possible, an appropriate respirator must be worn. Additionally, workers are required to wear splash goggles, safety glasses, fire retardant clothing covering the entire body, and chemical resistant gloves, as appropriate for the work being done.

Consumer/General Public Exposure:

The major man-made sources of benzene exposure to consumers and the general public are from

2 LD50 oral (rat) 930 mg/kg: Toxicology and Applied Pharmacology. V.1- 1959- 7, 767, 1965; LD50 oral (rat) >2000 mg/kg Toxic. Appl. Pharmac. 19, 699-704, 1971; LD50 oral (rat) 6400 mg/kg : Toksikologiya Novykh Promyshlennykh Khimicheskikh Veshchestv. Toxicology of New Industrial Chemical Substances - for English translation, see TNICS. (Izdatel'stvo Meditsina, Moscow, USSR) No.1- 1961- 15,136,1979.

3 While LD50 (oral, rat) values for benzene below 2000 mg/kg have been reported, most reported LD50 (oral, rat) values are greater than 2000 mg/kg indicating that benzene is of low acute toxicity when orally administered, which is consistent with many other aromatic hydrocarbons. For this reason, we do not classify benzene as an acute toxicity hazard under OSHA GHS.

4 Toxicol. Appl. Pharmacol. 7, 599-565, 1965. Converted from 9.4 ml/kg using a density of 0.88 g/ml.

5 Toxicology and Biochemistry of Aromatic Hydrocarbons," Gerarde, H., New York, Elsevier, 1960 -,113, - 7-hour exposure. Converted from 10,000 ppm gas using MW of 78.1.

inhalation of benzene vapors in tobacco smoke, fuel evaporation from gasoline filling stations, motor vehicle exhaust, and industrial emissions. A less significant source of exposure includes products containing traces of benzene, such as glues, paints and furniture wax. Natural sources of benzene include gases released from volcanoes and forest fires, and natural oil seeps. Benzene is emitted to the environment by various activities including industrial and natural sources in the U.S., but benzene is found in very low concentrations in water and air due to natural degradation.

On average, about 50% of the exposure to benzene in the U.S. results from smoking tobacco or inhaling tobacco smoke, while 20% is due to motor vehicle exhaust and industrial emissions. Specifically, smoking tobacco or inhaling tobacco smoke is the greatest single source of benzene exposure in the U.S.: the average smoker (32 cigarettes per day) takes in about 10 times the average daily intake by nonsmokers. In comparison, motor vehicle exhaust has accounted for over 70% of the nonsmoking population's exposure to benzene in a California study.⁶

Storing and Transporting Benzene

Bulk quantities of benzene should be stored in tanks equipped with floating roofs to reduce emissions. Storage containers for benzene should be made of steel. Storage tanks should be engineered to prevent contact with water resources, as this material could contaminate the water resources. Surface spills can reach groundwater through porous soil or cracked surfaces. The storage tanks should be monitored regularly for leaks. Facilities which store these products should have a comprehensive response plan for spills or leaks. Small containers may be made of glass. Plastic storage containers should not be used.

Benzene is transported mainly by sea or inland waterway and is subject to international guidelines for safe handling of cargoes. These include the International Maritime Dangerous Goods (IMDG) from the International Maritime Organisation (IMO), the International Safety Guidelines for Oil Tankers and Terminals (ISGOTT) and the ADNR (Accord europeen relatif au transport international des marchandises Dangereuses par voie de Navigation interieure au Rhine) regulations. In the US, marine transport must be in compliance with the US Coast Guard Benzene Standard.

When transported by road, rail, or air, benzene is regulated worldwide as a Flammable Liquid.

Static charges can accumulate during shipping, unloading, pouring, or transferring operations. Take precautionary measures against electrostatic discharges. To avoid fire or explosion, dissipate static electricity during transfer by grounding and bonding containers and equipment before transferring material.

Product Stewardship Contact Information:

TotalEnergies Petrochemicals & Refining USA, Inc.
P O Box 674411
Houston, TX 77267-4411
product.stewardship@totalenergies.com

⁶ Cal EPA. 1987. Residential population exposure to ambient benzene in California. Sacramento, CA: Air Resource Board. ARB/TS87001.

References and Other Benzene Information Sources (links are subject to change):

TotalEnergies Petrochemicals & Refining USA, Inc. Safety Data Sheet for Benzene.
<https://corporate.totalenergies.us/product-stewardship>

United States Department of Labor, Occupational Safety and Health Administration.
<https://www.osha.gov/benzene>

National Toxicology Program (NTP). Report on carcinogens (11th edition). 2005. Research Triangle Park, NC: National Toxicology Program (NTP); National Institutes of Health; Public Health Service; U.S. Department of Health and Human Services. <https://ntp.niehs.nih.gov/ntp/roc/content/profiles/benzene.pdf>

Agency for Toxic Substances and Disease Registry (ATSDR). "[TOXICOLOGICAL PROFILE FOR BENZENE \(cdc.gov\)](#)" 2007. Atlanta, GA:

U.S. Department of Health and Human Services, Public Health Service.
<https://www.atsdr.cdc.gov/toxprofiledocs/index.html>

United States Environmental Protection Agency (USEPA). "[EPA Office of Compliance Sector Notebook Project - Profile of the Organic Chemical Industry 2nd Edition \(2002\) | US EPA ARCHIVE DOCUMENT](#)" 2002. EPA/310-R-02-001.

Centre de Documentation, de Recherche et d'Expérimentations sur les Pollutions Accidentelles des Eaux (Cedre). [Benzene Chemical Response Guide](#)
<https://www.cedre.fr/en/content/download/2780/140117/file/Extract-benzene.pdf>

TotalEnergies Refining & Chemicals (EU). [GPS Safety Summary – BENZENE](#)
<https://polymers.totalenergies.com/certificates-documents/gps>

The European Chemical Industry Council (CEFIC) AromaticsOnline. "Frequently asked Questions – Benzene" <https://www.aromaticsonline.eu/aromatics/faq>

NOTICE: This information is furnished in good faith by TotalEnergies Petrochemicals & Refining USA, Inc. and provides general, non-specific information on the product reviewed, therefore TotalEnergies Petrochemicals & Refining USA, Inc., shall not be liable for any damages resulting from use of or reliance upon the information provided in this document. Nothing contained in this document shall be construed as a recommendation. TotalEnergies Petrochemicals & Refining USA, Inc. makes no representation or warranty of any kind, express or implied, as to the completeness, accuracy, quality, or fitness for a particular purpose, of the information contained herein, and such implied warranties are specifically excluded. No license of any patent owned by TotalEnergies Petrochemicals & Refining USA, Inc. or others is to be inferred.