SAFETY DATA SHEET

Updated on 20/07/2024

1. Material Identification

Product Name : Benzene a
Catalog Number : io-1788
CAS Number : 71-43-2
Identified uses : Laboratory chemicals, manufacture of chemical compounds
Company : Ionz

>> R&D Use only

2. Hazards Identification

GHS Classification:

Flammable liquid (category 2)
Acute toxicity, oral (Category 3)
Acute toxicity, dermal (Category 3)
Acute toxicity, inhalation (Category 3)
Specific target organ toxicity, single exposure (Category 1)

Pictogram(s)

GHS Hazard Statements

>> H225 (99.84%): Highly Flammable liquid and vapor [Danger Flammable liquids]

>> H304 (99.42%): May be fatal if swallowed and enters airways [Danger Aspiration hazard]

>> H315 (99.95%): Causes skin irritation [Warning Skin corrosion/irritation]

>> H319 (99.95%): Causes serious eye irritation [Warning Serious eye damage/eye irritation]

>> H340 (99.9%): May cause genetic defects [Danger Germ cell mutagenicity]

>> H350 (99.9%): May cause cancer [Danger Carcinogenicity]

>> H372 (100%): Causes damage to organs through prolonged or repeated exposure [Danger Specific target organ toxicity, repeated exposure]

>> H412 (16.44%): Harmful to aquatic life with long lasting effects [Hazardous to the aquatic environment, long-term hazard]

Precautionary Statement Codes

>> P203, P210, P233, P240, P241, P242, P243, P260, P264, P264+P265, P270, P273, P280, P301+P316, P302+P352, P303+P361+P353, P305+P351+P338, P318, P319, P321, P331, P332+P317, P337+P317, P362+P364, P370+P378, P403+P235, P405, and P501

NFPA 704 Diamond

NFPA Health Rating

>> 1 - Materials that, under emergency conditions, can cause significant irritation.

NFPA Fire Rating

>> 3 - Liquids and solids that can be ignited under almost all ambient temperature conditions. Materials produce hazardous atmospheres with air under almost all ambient temperatures or, though unaffected by ambient temperatures, are readily ignited under almost all conditions.

NFPA Instability Rating

>> 0 - Materials that in themselves are normally stable, even under fire conditions.

Health Hazards:

>> Dizziness, excitation, pallor, followed by flushing, weakness, headache, breathlessness, chest constriction, nausea, and vomiting. Coma and possible death. (USCG, 1999)

ERG 2024, Guide 130 (Benzene)

>> May cause toxic effects if inhaled or absorbed through skin.

>> Inhalation or contact with material may irritate or burn skin and eyes.

>> Fire will produce irritating, corrosive and/or toxic gases.

>> Vapors may cause dizziness or asphyxiation, especially when in closed or confined areas.

>> Runoff from fire control or dilution water may cause environmental contamination.

>> Behavior in Fire: Vapor is heavier than air and may travel considerable distance to a source of ignition and flash back. (USCG, 1999)

ERG 2024, Guide 130 (Benzene)

>> HIGHLY FLAMMABLE: Will be easily ignited by heat, sparks or flames.

>> Vapors may form explosive mixtures with air.

>> Vapors may travel to source of ignition and flash back.

>> Most vapors are heavier than air. They will spread along the ground and collect in low or confined areas (sewers, basements, tanks, etc.).

>> Vapor explosion hazard indoors, outdoors or in sewers.

>> Those substances designated with a (P) may polymerize explosively when heated or involved in a fire.

>> Runoff to sewer may create fire or explosion hazard.

>> Containers may explode when heated.

>> Many liquids will float on water.

>> Highly flammable. Vapour/air mixtures are explosive. Risk of fire and explosion. See Chemical Dangers.

3. Composition/Information On Ingredients

Chemical name : Benzene a
CAS Number : 71-43-2
Molecular Formula : C6H6
Molecular Weight : 78.1100 g/mol

4. First Aid Measures

First Aid:

>> EYES: First check the victim for contact lenses and remove if present. Flush victim's eyes with water or normal saline solution for 20 to 30 minutes while simultaneously calling a hospital or poison control center. Do not put any ointments, oils, or medication in the victim's eyes without specific instructions from a physician. IMMEDIATELY transport the victim after flushing eyes to a hospital even if no symptoms (such as redness or irritation) develop.

>> SKIN: IMMEDIATELY flood affected skin with water while removing and isolating all contaminated clothing. Gently wash all affected skin areas thoroughly with soap and water. IMMEDIATELY call a hospital or poison control center even if no symptoms (such as redness or irritation) develop. IMMEDIATELY transport the victim to a hospital for treatment after washing the affected areas.

>> INHALATION: IMMEDIATELY leave the contaminated area; take deep breaths of fresh air. IMMEDIATELY call a physician and be prepared to transport the victim to a hospital even if no symptoms (such as wheezing, coughing, shortness of breath, or burning in the mouth, throat, or chest) develop. Provide proper respiratory protection to rescuers entering an unknown atmosphere. Whenever possible, Self-Contained Breathing Apparatus (SCBA) should be used; if not available, use a level of protection greater than or equal to that advised under Protective Clothing.

>> INGESTION: DO NOT INDUCE VOMITING. Volatile chemicals have a high risk of being aspirated into the victim's lungs during vomiting which increases the medical problems. If the victim is conscious and not convulsing, give 1 or 2 glasses of water to dilute the chemical and IMMEDIATELY call a hospital or poison control center. IMMEDIATELY transport the victim to a hospital. If the victim is convulsing or unconscious, do not give anything by mouth, ensure that the victim's airway is open and lay the victim on his/her side with the head lower than the body. DO NOT INDUCE VOMITING. IMMEDIATELY transport the victim to a hospital.

>> OTHER: Since this chemical is a known or suspected carcinogen you should contact a physician for advice regarding the possible long term health effects and potential recommendation for medical monitoring. Recommendations from the physician will depend upon the specific compound, its chemical, physical and toxicity properties, the exposure level, length of exposure, and the route of exposure. (NTP, 1992)

ERG 2024, Guide 130 (Benzene)

>> General First Aid:

>> Call 911 or emergency medical service.

>> Ensure that medical personnel are aware of the material(s) involved, take precautions to protect themselves and avoid contamination.

>> Move victim to fresh air if it can be done safely.

>> Administer oxygen if breathing is difficult.

>> If victim is not breathing:

>> DO NOT perform mouth-to-mouth resuscitation; the victim may have ingestedor inhaled the substance.

>> If equipped and pulse detected, wash face and mouth, then give artificial respiration using a proper respiratory medical device (bag-valve mask, pocket mask equipped with a one-way valve or other device).

>> If no pulse detected or no respiratory medical device available, provide continuouscompressions. Conduct a pulse check every two minutes or monitor for any signs of spontaneous respirations.

>> Remove and isolate contaminated clothing and shoes.

>> For minor skin contact, avoid spreading material on unaffected skin.

>> In case of contact with substance, remove immediately by flushing skin or eyes with running water for at least 20 minutes.

>> For severe burns, immediate medical attention is required.

>> Effects of exposure (inhalation, ingestion, or skin contact) to substance may be delayed.

>> Keep victim calm and warm.

>> Keep victim under observation.

>> For further assistance, contact your local Poison Control Center.

>> Note: Basic Life Support (BLS) and Advanced Life Support (ALS) should be done by trained professionals.

>> Specific First Aid:

>> Wash skin with soap and water.

>> In case of burns, immediately cool affected skin for as long as possible with cold water. Do not remove clothing if adhering to skin.

First Aid Measures

Inhalation First Aid

>> Fresh air, rest. Refer for medical attention.

Skin First Aid

>> Remove contaminated clothes. Rinse skin with plenty of water or shower. Refer for medical attention .

Eye First Aid

>> First rinse with plenty of water for several minutes (remove contact lenses if easily possible), then refer for medical attention.

Ingestion First Aid

>> Rinse mouth. Do NOT induce vomiting. Refer for medical attention .

5. Fire Fighting Measures

>> Vapors are heavier than air and may travel to a source of ignition & flash back. Liquid floats on water and may travel to a source of ignition and spread fire.

>> Excerpt from ERG Guide 130 [Flammable Liquids (Water-Immiscible / Noxious)]:

>> CAUTION: The majority of these products have a very low flash point. Use of water spray when fighting fire may be inefficient.

>> SMALL FIRE: Dry chemical, CO2, water spray or regular foam. If regular foam is ineffective or unavailable, use alcohol-resistant foam.

>> LARGE FIRE: Water spray, fog or regular foam. If regular foam is ineffective or unavailable, use alcohol-resistant foam. Avoid aiming straight or solid streams directly onto the product. If it can be done safely, move undamaged containers away from the area around the fire.

>> FIRE INVOLVING TANKS, RAIL TANK CARS OR HIGHWAY TANKS: Fight fire from maximum distance or use unmanned master stream devices or monitor nozzles. Cool containers with flooding quantities of water until well after fire is out. Withdraw immediately in case of rising sound from venting safety devices or discoloration of tank. ALWAYS stay away from tanks in direct contact with flames. For massive fire, use unmanned master stream devices or monitor nozzles; if this is impossible, withdraw from area and let fire burn. (ERG, 2024)

>> Use foam, water spray, carbon dioxide, powder. In case of fire: keep drums, etc., cool by spraying with water.

>> Benzene is highly flammable.

>> The agent will be easily ignited by heat, sparks, or flames.

>> Fire will produce irritating, corrosive, and/or toxic gases.

>> Benzene reacts violently with oxidants and halogens, causing a fire hazard.

>> Vapors may travel to the source of ignition and flash back.

>> Run-off to sewers may create a fire hazard.

>> Caution: The agent has a very low flash point. Use of water spray when fighting fires may be inefficient.

>> For small fires, use dry chemical, carbon dioxide, water spray, or regular foam.

>> For large fires, use water spray, fog, or regular foam. Do not use straight streams. Move containers from the fire area if it is possible to do so without risk to personnel.

>> For fire involving tanks or car/trailer loads, fight the fire from maximum distance or use unmanned hose holders or monitor nozzles. Cool containers with flooding quantities of water until well after the fire is out. Withdraw immediately in case of rising sound from venting safety devices or discoloration of tanks. Always stay away from tanks engulfed in fire.

>> For massive fire, use unmanned hose holders or monitor nozzles; if this is impossible, withdraw from the area and let the fire burn.

>> Run-off from fire control or dilution water may cause pollution.

>> If the situation allows, control and properly dispose of run-off (effluent).

6. Accidental Release Measures

Isolation and Evacuation:

Isolation and evacuation measures to take when a large amount of this chemical is accidentally released in an emergency.

>> Excerpt from ERG Guide 130 [Flammable Liquids (Water-Immiscible / Noxious)]:

>> IMMEDIATE PRECAUTIONARY MEASURE: Isolate spill or leak area for at least 50 meters (150 feet) in all directions.

>> LARGE SPILL: Consider initial downwind evacuation for at least 300 meters (1000 feet).

>> FIRE: If tank, rail tank car or highway tank is involved in a fire, ISOLATE for 800 meters (1/2 mile) in all directions; also, consider initial evacuation for 800 meters (1/2 mile) in all directions. (ERG, 2024)

Evacuation: ERG 2024, Guide 130 (Benzene)

>> Immediate precautionary measure

>> Isolate spill or leak area for at least 50 meters (150 feet) in all directions.

>> Large Spill

>> Consider initial downwind evacuation for at least 300 meters (1000 feet).

>> Fire

>> If tank, rail tank car or highway tank is involved in a fire, ISOLATE for 800 meters (1/2 mile) in all directions; also, consider initial evacuation for 800 meters (1/2 mile) in all directions.

Spillage Disposal:

Methods for containment and safety measures to protect workers dealing with a spillage of this chemical.

>> Remove all ignition sources. Evacuate danger area! Consult an expert! Personal protection: complete protective clothing including self-contained breathing apparatus. Do NOT wash away into sewer. Do NOT let this chemical enter the environment. Collect leaking and spilled liquid in sealable containers as far as possible. Absorb remaining liquid in sand or inert absorbent. Then store and dispose of according to local regulations.

Accidental Release Measures

Public Safety: ERG 2024, Guide 130 (Benzene)

>> CALL 911. Then call emergency response telephone number on shipping paper. If shipping paper not available or no answer, refer to appropriate telephone number listed on the inside back cover.

>> Keep unauthorized personnel away.

>> Stay upwind, uphill and/or upstream.

>> Ventilate closed spaces before entering, but only if properly trained and equipped.

Spill or Leak: ERG 2024, Guide 130 (Benzene)

>> ELIMINATE all ignition sources (no smoking, flares, sparks or flames) from immediate area.

>> All equipment used when handling the product must be grounded.

>> Do not touch or walk through spilled material.

>> Stop leak if you can do it without risk.

>> Prevent entry into waterways, sewers, basements or confined areas.

>> A vapor-suppressing foam may be used to reduce vapors.

>> Absorb or cover with dry earth, sand or other non-combustible material and transfer to containers.

>> Use clean, non-sparking tools to collect absorbed material.

>> Large Spill

>> Dike far ahead of liquid spill for later disposal.

>> Water spray may reduce vapor, but may not prevent ignition in closed spaces.

7. Handling And Storage

Safe Storage:

>> Fireproof. Separated from food and feedstuffs, oxidants and halogens. Store in an area without drain or sewer access.

Storage Conditions:

>> Keep in well closed containers in a cool place and away from fire.

8. Exposure Control/ Personal Protection

REL-TWA (Time Weighted Average)

>> 0.1 ppm

REL-STEL (Short Term Exposure Limit)

>> 1 ppm

>> Ca TWA 0.1 ppm ST 1 ppm See Appendix A

>> 1.0 [ppm], STEL(OSHA) = 5 ppm (see CFR 1910.1028)

PEL-TWA (8-Hour Time Weighted Average)

>> 1 ppm

PEL-STEL (Short Term Exposure Limit)

>> 5 ppm

>> 0.5 [ppm]

TLV-STEL

>> 2.5 [ppm]

>> 0.5 ppm as TWA; 2.5 ppm as STEL; (skin); A1 (confirmed human carcinogen); BEI issued.

TLV-TWA (Time Weighted Average)

>> 0.5 ppm [1996]

TLV-STEL (Short Term Exposure Limit)

>> 2.5 ppm [1996]

EU-OEL

>> 3.25 mg/m

MAK (Maximale Arbeitsplatz Konzentration)

>> carcinogen category: 1; germ cell mutagen group: 3A; skin absorption (H)

Emergency Response: ERG 2024, Guide 130 (Benzene)

>> CAUTION: The majority of these products have a very low flash point. Use of water spray when fighting fire may be inefficient.

>> Small Fire

>> Dry chemical, CO2, water spray or regular foam. If regular foam is ineffective or unavailable, use alcohol-resistant foam.

>> Large Fire

>> Water spray, fog or regular foam. If regular foam is ineffective or unavailable, use alcohol-resistant foam.

>> Avoid aiming straight or solid streams directly onto the product.

>> If it can be done safely, move undamaged containers away from the area around the fire.

>> Fire Involving Tanks, Rail Tank Cars or Highway Tanks

>> Fight fire from maximum distance or use unmanned master stream devices or monitor nozzles.

>> Cool containers with flooding quantities of water until well after fire is out.

>> Withdraw immediately in case of rising sound from venting safety devices or discoloration of tank.

>> ALWAYS stay away from tanks in direct contact with flames.

>> For massive fire, use unmanned master stream devices or monitor nozzles; if this is impossible, withdraw from area and let fire burn.

>> ERPG-1: 50 ppm - one hour exposure limit: 1 = mild transient health effects or objectionable odor [AIHA]

>> ERPG-2: 150 ppm - one hour exposure limit: 2 = impaired ability to take protective action [AIHA]

>> ERPG-3: 1,000 ppm - one hour exposure limit: 3 = life threatening health effects [AIHA]

Inhalation Risk:

>> A harmful contamination of the air can be reached very quickly on evaporation of this substance at 20 °C.

Effects of Short Term Exposure:

>> The substance is irritating to the eyes, skin and respiratory tract. If this liquid is swallowed, aspiration into the lungs may result in chemical pneumonitis. The substance may cause effects on the central nervous system. This may result in lowering of consciousness. Exposure far above the OEL could cause unconsciousness and death. If swallowed the substance easily enters the airways and could result in aspiration pneumonitis.

>> Benzene is carcinogenic to humans. It has been associated with cancer of the blood (leukemia), which may occur with chronic exposures to benzene of 10 ppm. Information is inconclusive but suggestive of developmental toxicity and reproductive toxicity risk with chronic or repeated exposure to benzene. Adverse health effects due to long-term benzene exposure are non-specific. Effects include fatigue, headache, dizziness, nausea, loss of appetite, loss of weight, and weakness. Repeated or prolonged skin contact with liquid benzene can remove the natural oils from the skin, causing it to crack and peel. Repeated exposure to levels of benzene below 200 ppm may cause chronic CNS effects (headache, drowsiness, and nervousness). Chronic benzene exposure in the workplace has been associated with blood (hematologic) disorders, such as low platelet counts (thrombocytopenia), absence of red blood cells (aplastic anemia), and loss of all types of blood cells due to bone marrow damage.

Effects of Long Term Exposure:

>> The substance defats the skin, which may cause dryness or cracking. The substance may have effects on the central nervous system and immune system. The substance may have effects on the bone marrow. This may result in anaemia. This substance is carcinogenic to humans. May cause heritable genetic damage to human germ cells.

Acceptable Daily Intakes:

An estimate of the amount of a chemical in food or drinking water that can be consumed daily over a lifetime without presenting an appreciable risk to health. It is usually expressed as milligrams of the substance per kilogram of body weight per day and applies to chemicals such as food additives, pesticide residues and veterinary drugs.

>> Insufficient data are available to calculate a one-day Health Advisory for benzene. The Ten-day Health Advisory (0.235 mg/l) is considered to be adequately protective for a one-day exposure as well. ... Longer-term Health Advisories have not been calculated because of the carcinogenic potency of benzene.

Fire Prevention

>> NO open flames, NO sparks and NO smoking. Closed system, ventilation, explosion-proof electrical equipment and lighting. Do NOT use compressed air for filling, discharging, or handling. Use non-sparking handtools. Prevent build-up of electrostatic charges (e.g., by grounding).

Exposure Prevention

>> AVOID ALL CONTACT!

Inhalation Prevention

>> Use ventilation, local exhaust or breathing protection.

Skin Prevention

>> Protective gloves. Protective clothing.

Eye Prevention

>> Wear face shield or eye protection in combination with breathing protection.

Ingestion Prevention

>> Do not eat, drink, or smoke during work.

Exposure Control and Personal Protection

Protective Clothing: ERG 2024, Guide 130 (Benzene)

>> Wear positive pressure self-contained breathing apparatus (SCBA).

>> Structural firefighters' protective clothing provides thermal protection but only limited chemical protection.

Exposure Summary

>> Biological Exposure Indices (BEI) [ACGIH] - S-phenylmercapturic acid in urine = 25 ug/g creatinine; t,t-Muconic acid in urine = 500 ug/g creatinine; sample at end of shift;

9. Physical And Chemical Properties

Molecular Weight:

>> 78.11

Exact Mass:

>> 78.0469501914

Physical Description:

>> Benzene appears as a clear colorless liquid with a petroleum-like odor. Flash point less than 0 °F. Less dense than water and slightly soluble in water. Hence floats on water. Vapors are heavier than air.

>> COLOURLESS LIQUID WITH CHARACTERISTIC ODOUR.

Color/Form:

>> Clear, colorless liquid

Odor:

>> Aromatic odor

Taste:

The sensation of flavor perceived in the mouth and throat on contact with a substance.

>> Taste threshold in water is 0.5-4.5 mg/l.

Boiling Point:

>> 176.2 °F at 760 mmHg (NTP, 1992)

>> 80 °C

Melting Point:

>> 41.9 °F (NTP, 1992)

>> 6 °C

Flash Point:

>> 12 °F (NTP, 1992)

>> -11 °C c.c.

Solubility:

>> 1 to 5 mg/mL at 64 °F (NTP, 1992)

>> Solubility in water, g/100ml at 25 °C: 0.18

Density:

>> 0.879 at 68 °F (USCG, 1999) - Less dense than water; will float

>> Relative density (water = 1): 0.88

Vapor Density:

>> 2.77 (NTP, 1992) - Heavier than air; will sink (Relative to Air)

>> Relative vapor density (air = 1): 2.7

Vapor Pressure:

>> 60 mmHg at 59 °F ; 76 mmHg at 68 °F (NTP, 1992)

>> Vapor pressure, kPa at 20 °C: 10

LogP:

>> log Kow = 2.13

>> 2.13

Stability/Shelf Life:

>> Stable under recommended storage conditions.

Autoignition Temperature:

>> 1097 °F (USCG, 1999)

>> 498 °C

Viscosity:

>> 0.604 mPa.s at 25 °C

Heat of Combustion:

>> -3267.6 kJ/mol (liquid)

Heat of Vaporization:

>> 33.83 kJ/mol at 25 °C

Surface Tension:

>> 28.22 mN/m at 25 °C

Ionization Potential:

>> 9.24 eV

Odor Threshold:

>> Odor Threshold Low: 34.0 [mmHg]

>> Odor Threshold High: 119.0 [mmHg]

>> Detection odor thresholds from AIHA

Refractive Index:

>> Index of refraction: 1.5011 at 20 °C/D

Relative Evaporation Rate:

The rate at which a material will vaporize (evaporate, change from liquid to vapor), compared to the rate of vaporization of a specific known material.

>> 2.8 (Ether = 1)

10. Stability And Reactivity

>> Highly flammable. Slightly soluble in water.

>> Highly Flammable

11. Toxicological Information

Toxicity Summary:

>> IDENTIFICATION AND USE: Benzene is a clear, colorless liquid with a sweet aromatic odor. It is used mainly as a starting material in manufacturing other chemicals, including detergents, pesticides, plastics and resins, synthetic rubber, aviation fuel, pharmaceuticals, dye, explosives, PCB gasoline, flavors and perfumes, paints and coatings, nylon intermediates, photographic chemicals. HUMAN EXPOSURE AND TOXICITY: Immediate signs and symptoms of exposure to benzene: People who breathe in high levels of benzene may develop drowsiness, dizziness, rapid or irregular heartbeat, headaches, tremors, confusion unconsciousness, death. Eating foods or drinking beverages containing high levels of benzene can cause vomiting, irritation of the stomach, dizziness, sleepiness, convulsions, rapid or irregular heartbeat, death. Long-term (a year or more) exposure to benzene causes harmful effects on the bone marrow, resulting in anemia and excessive bleeding. It can also affect the immune system, increasing the chance for infection. Some women who breathed high levels of benzene for many months had irregular menstrual periods and a decrease in the size of their ovaries. Acute deaths from benzene exposure at high concentrations have been due to ventricular fibrillation caused by exertion and release of epinephrine. Benzene causes cancer in humans. A retrospective cohort study was conducted in 233 benzene factories and 83 control factories in 12 cities in China. The benzene cohort and the control cohort consisted of 28,460 benzene exposed workers and 28,257 control workers. The leukemia mortality rate was 14/100,000 person-years in the benzene cohort and 2/100,000 person-years in the control cohort. Most (76.6%) cases of benzene leukemia were of the acute type. The mortality due to benzene leukemia was high in organic synthesis plants followed by painting and rubber synthesis industries. The concentration of benzene to which patients with a leukemia were exposed ranged from 10 to 1000 mg/cu m (mostly from 50 to 500 mg/cu m). Benzene is genotoxic in humans: a significantly increased frequency of chromatid and isochromatid breaks in the cultured lymphocytes of exposed workers has been reported, as well as a significant increase of peripheral blood lymphocyte chromosomal aberrations. Metabolic activation of benzene by rat liver microsomes induced sister chromatid exchanges and cell division delays in cultured human lymphocytes. Occupational exposure to benzene may occur through inhalation and dermal contact. The general population may be exposed to benzene via inhalation of ambient air, ingestion of food and drinking water, and dermal contact with consumer products containing benzene. ANIMAL TOXICITY STUDIES: Experimental animal studies, both inhalation and oral, also support the evidence that exposure to benzene increases the risk of cancer in multiple organ systems, including the hematopoietic system, oral and nasal cavities, liver, forestomach, preputial gland, lung, ovary, and mammary gland. Rats exposed to 3,526-8,224 ppm of benzene in a closed chamber for 15 minutes exhibited an increased number of ectopic ventricular beats. In developmental study, rats exposed to 10, 50, or 500 ppm (32, 160 & 1600 mg/cu m) of benzene for 7 hr/day had low incidence of brain and skeletal defects. Rats exposed continuously to 209.7 ppm for 10 days prior to breeding showed a complete absence of

pregnancy. 1/10 rats exposed to 19.8 ppm had resorbed embryos. Genotoxicity studies have demonstrated the induction of chromosomal aberrations in bone-marrow cells from mice, rats, and rabbits treated with single or multiple daily doses of benzene ranging from about 0.2 to 2.0 mL/kg per day given either sc or ip. The major metabolites of benzene are phenol, hydroquinone, and catechol. The route of exposure has little effect on the subsequent metabolism of benzene to hemotoxic metabolites. ECOTOXICITY STUDIES: Young Coho salmon mortality was 12/20 at 50 ppm after 24 hr up to 96 hr and 30/30 at 100 ppm after 24 hr in artificial seawater at 8 °C. Herring and anchovy larvae studies showed that 35-45 ppm caused delay in development of eggs and produced abnormal larvae; 10-35 ppm caused delay in development of larvae, decrease in feeding and growth, and increase in respiration. Blue crab juveniles when exposed to sublethal concentrations of benzene (0.1 or 5.0 ppm) in a static system showed an increase in the time needed to complete a molt cycle (50 days in case of benzene-exposed crab, as compared to 33 days for controls), a slower rate of growth of regenerating limb buds, and a depressed activity of ATPase in mitochrondria. Oxygen consumption by the crab decreased from exposure to 1.0 ppm benzene.

Evidence for Carcinogenicity:

Evidence that this chemical does or may cause cancer. The information here is collected from various sources by the Hazardous Substances Data Bank (HSDB).

>> Classification of carcinogenicity: 1) evidence in humans: sufficient; 2) evidence in animals: sufficient; Overall summary evaluation of carcinogenic risk to humans is group 1: The chemical is carcinogenic to humans. /From table/

Carcinogen Classification:

This section provides the International Agency for Research on Cancer (IARC) Carcinogenic Classification and related monograph links. In the IARC Carcinogenic classification, chemicals are categorized into four groups: Group 1 (carcinogenic to humans), Group 2A (probably carcinogenic to humans), Group 2B (possibly carcinogenic to humans), and Group 3 (not classifiable as to its carcinogenicity to humans).

IARC Carcinogenic Agent

>> Benzene

IARC Carcinogenic Classes

>> Group 1: Carcinogenic to humans

IARC Monographs

>> Volume 29: (1982) Some Industrial Chemicals and Dyestuffs

>> Volume Sup 7: Overall Evaluations of Carcinogenicity: An Updating of IARC Monographs Volumes 1 to 42, 1987; 440 pages; ISBN 92-832-1411-0 (out of print)

>> Volume 100F: (2012) Chemical Agents and Related Occupations

>> Volume 120: (2018) Benzene

>> 1, carcinogenic to humans. (L135)

Health Effects:

>> Benzene causes harmful effects on the bone marrow and also decreases blood cell counts, leading to blood disorders such as anemia. It can also cause excessive bleeding and affect the immune system, increasing the chance for infection. Benzene is also a known carcinogen, as chronic exposure to high levels has been shown to cause leukemia, particularly acute myelogenous leukemia. (L5)

Exposure Routes:

>> The substance can be absorbed into the body by inhalation, through the skin and by ingestion.

>> inhalation, skin absorption, ingestion, skin and/or eye contact

Inhalation Exposure

>> Dizziness. Drowsiness. Headache. Nausea. Shortness of breath. Convulsions. Unconsciousness.

Skin Exposure

>> MAY BE ABSORBED! Dry skin. Redness. Pain. Further see Inhalation.

Eye Exposure

>> Redness. Pain.

Ingestion Exposure

>> Abdominal pain. Sore throat. Vomiting. Further see Inhalation.

>> irritation eyes, skin, nose, respiratory system; dizziness; headache, nausea, staggered gait; anorexia, lassitude (weakness, exhaustion); dermatitis; bone marrow depression; [potential occupational carcinogen]

Target Organs:

Organs that are affected by exposure to this chemical. Information in this section reflects human data unless otherwise noted.

>> Cancer, Gastrointestinal (Stomach and Intestines, part of the digestive system), Hematological (Blood Forming), Immunological (Immune System), Neurological (Nervous System)

>> Immune

Cancer Sites:

The site in which cancer develops due to exposure to this compound. Cancers are casually referred to based on their primary sites (e.g., skin, lung, breasts, prostate, colon and rectum).

>> Hematologic

>> [leukemia]

Adverse Effects:

An adverse effect is an undesired harmful effect resulting from a medical treatment or other intervention.

>> Neurotoxin - Acute solvent syndrome

>> Aplastic anemia - The presence of increased methemoglobin in the blood; the compound is classified as primary toxic effect.

>> Reproductive Toxin - A chemical that is toxic to the reproductive system, including defects in the progeny and injury to male or female reproductive function. Reproductive toxicity includes developmental effects. See Guidelines for Reproductive Toxicity Risk Assessment.

>> IARC Carcinogen - Class 1: International Agency for Research on Cancer classifies chemicals as established human carcinogens.

>> NTP Carcinogen - Known to be a human carcinogen.

>> ACGIH Carcinogen - Confirmed Human.

Toxicity Data:

>> LC50 (rat) = 10,000 ppm/7h

Minimum Risk Level:

The minimal risk level (MRL) is an estimate of the amount of a chemical a person can eat, drink, or breathe each day without a detectable risk to health

>> Acute Inhalation: 0.009 ppm (L134) Intermediate Inhalation: 0.006 ppm (L134) Chronic Inhalation: 0.003 ppm (L134) Chronic Oral: 0.0005 mg/kg/day (L134)

Treatment:

Treatment when exposed to toxin

>> There is no known antidote for benzene and poisoning is first treated by preventing further exposure. If inhaled, respiratory assist may be necessary. If ingested, gastric lavage may be performed, or activated charcoal can be administered. (T8)

Interactions:

>> Dimethyl sulfoxide (DMSO) enhanced the hypertaurinuria produced by benzene, chlorobenzene, and toluene in rats. Undiluted DMSO was more effective than DMSO diluted with water in potentiating the toxicity of benzene in both rats and mice. Supernatants (9000g) prepared from livers of rats treated with DMSO 24 hours earlier metabolized more benzene than those from control rats.

Antidote and Emergency Treatment:

>> Immediate first aid: Ensure that adequate decontamination has been carried out. If patient is not breathing, start artificial respiration, preferably with a demand-valve resuscitator, bag-valve-mask device, or pocket mask, as trained. Perform CPR as necessary. Immediately flush contaminated eyes with gently flowing water. Do not induce vomiting. If vomiting occurs, lean patient forward or place on left side (head-down position, if possible) to maintain an open airway and prevent aspiration. Keep patient quiet and maintain normal body temperature. Obtain medical attention. /Benzene and Related Compounds/

Human Toxicity Excerpts:

>> /SIGNS AND SYMPTOMS/ Direct exposure of the eyes, skin, or lungs to benzene can cause tissue injury and irritation.

Non-Human Toxicity Excerpts:

>> /LABORATORY ANIMALS: Acute Exposure/ The effect of a single dose of benzene (0.5 mL/kg body wt ip) on the heme saturation of tryptophan pyrrolase activity in liver was examined /in female albino rats/. There was a significant decrease in the heme saturation of hepatic tryptophan pyrrolase, suggesting depletion of regulatory heme. After benzene

administration there was significant increase in delta-aminolevulinate synthetase activity while delta-aminolevulinate dehydratase activity was significantly decreased, however, ferrochelatase and heme oxygenase activities were unaltered. Administration of tryptophan to benzene pretreated rats showed a reversal of benzene effects on heme synthesizing enzymes: there is an increase in the heme saturation of tryptophan pyrrolase and decrease in delta-aminolevulinate synthetase. However, there was no significant alteration in the activity of delta-aminolevulinate dehydratase.

Human Toxicity Values:

Quantitative human toxicity values (e.g., lethal dose) for this compound.

>> Estimated oral doses from 9-30 g have proved fatal.

Non-Human Toxicity Values:

>> LD50 Mice ip 0.34 mL/kg

National Toxicology Program Studies:

Reports from the National Toxicology Program, an interagency program supported by three government agencies (NIH, FDA, and CDC) within the Department of Health and Human Services. This program plays a critical role in generating, interpreting, and sharing toxicological information about chemicals of public health concerns.

>> During the 17-week studies, groups of 10 or 15 male and female F344/N rats and B6C3F1 mice were gavaged 5 days per week with benzene in corn oil (5 mL/kg) at doses of 0 to 600 mg/kg. No benzene- related deaths occurred; in rats that received benzene, final mean body weights were 14%-22% lower compared with vehicle controls and in mice, slight dose-related reductions were observed (less than 10% differences).

TSCA Test Submissions:

Under the Toxic Substances Control Act (TSCA), EPA has broad authority to issue regulations designed to require manufacturers (including importers) or processors to test chemical substances and mixtures for health and environmental effects. This section provides information on test reports submitted for this chemical under TSCA.

>> An evaluation of fertility was made in female Charles River CD rats (26/group) exposed by inhalation to benzene at 0, 1, 10, 30 and 300 ppm for 6 hrs/day, 5 days/week during a 10 week pre-mating treatment period and ensuing mating period, and continued exposure for mated females daily for 6 hrs/day during gestation to day 20. Daily exposure was resumed on day 5 of lactation until weaning (day 21 of lactation). There were significant differences between treated and control animals in the following: decrease in pup survival index (for lactation day 4-21 at 10 ppm, no dose-response), decreased mean pup weights (days 14 and 21 of lactation for high-dose level), and decreased mean absolute liver weights (high-dose female pups). There were no significant differences between treated and control animals in the following: maternal mortality, body weights, in-life observations, pregnancy rates, mean number dead pups, mean liver weights (male pups at all levels), mean relative liver weights (female pups at all levels), mean relative and absolute kidney weights (all female pups), or gross postmortem examinations of adult females or pups.

Populations at Special Risk:

>> ... /It has been observed/ that levels of leukocyte agglutins were elevated in selected individuals exposed to benzene. ... /This/ suggested that in some people benzene toxicity may be accounted for in part by an allergic blood dyscrasia.

12. Ecological Information

Resident Soil (mg/kg)

>> 1.20e+00

Industrial Soil (mg/kg)

>> 5.10e+00

Resident Air (ug/m3)

>> 3.60e-01

Industrial Air (ug/m3)

>> 1.60e+00

Tapwater (ug/L)

>> 4.60e-01

MCL (ug/L)

>> 5.00e+00

Risk-based SSL (mg/kg)

>> 2.30e-04

MCL-based SSL (mg/kg)

>> 2.60e-03

Oral Slope Factor (mg/kg-day)-1

>> 5.50e-02

Inhalation Unit Risk (ug/m3)-1

>> 7.8e-06

Chronic Oral Reference Dose (mg/kg-day)

>> 4.00e-03

Chronic Inhalation Reference Concentration (mg/m3)

>> 3.00e-02

Volatile

>> Volatile

Mutagen

>> Mutagen

Fraction of Contaminant Absorbed in Gastrointestinal Tract

>> 1

Soil Saturation Concentration (mg/kg)

>> 1.82e+03

ICSC Environmental Data:

>> The substance is toxic to aquatic organisms. The substance may cause long-term effects in the aquatic environment.

Sediment/Soil Concentrations:

Concentrations of this compound in sediment/soil.

>> SEDIMENT: Surface sediments taken from Walvis Bay (off Capetown, South Africa) contained benzene ranging from 0-20 ppb(1). In the US EPA STORET database, out of 355 samples, 9% tested positive for benzene at a median concentration of <5.0 ppb(2).

Fish/Seafood Concentrations:

Concentrations of this compound in fish or seafood.

>> Benzene was detected in 5 oyster samples from the Inner Harbor Navigational Canal in Lake Pontchartrain, LA at 220 ppb wet weight(1). Composite clam samples from Chef Menteur Pass in Lake Pontchartain, LA contained benzene at 260 ppb wet weight; however clam samples from The Rigolets did not contain benzene(1).

Average Daily Intake:

The average amount of the compound taken into the body through eating, drinking, or breathing.

>> Two studies of benzene levels in foods have confirmed the conclusion that ingesting food and beverages are an unimportant pathway for benzene exposure. In a study of more than 50 foods, most contained benzene below 2 ng/g ppbw. A Canadian review of benzene exposures concluded that food and drinking water each contributed only about 0.02 ug/kg benzene per day compared to a total intake of 2.4 ug/kg per day from airborne exposures (3.3 ug/kg/day if exposed to cigarette smoke). In a 1980's study of non-occupational benzene exposure, it was found that more than 99% of the total personal exposure was through air and that a global average personal exposure for benzene was about 15 ug/cu m. Roughly half the total benzene exposure in the United States was borne by smokers. For non-smokers, most benzene exposure ultimately was derived from auto exhaust or gasoline vapor emissions. A series of experiments were conducted in a 290 sq m single-family residence from June 11-13, 1991 to ascertain the human exposure to benzene from a contaminated groundwater source. It involved an individual taking a 20 min shower with the bathroom door closed, followed by five minutes for drying and dressing, and then opening the bathroom door and allowing the individual to leave and have his blood, breath and urine sampled. Whole air samples were collected from the bathroom, shower and living room. The inhalation exposure to benzene of an individual in the living room averaged 72 ug for the three days. The individual taking the shower had an average inhalation dose of 113 ug and an average dermal dose of 168

ug (exposure = 40% inhalation, 60% dermal). There may be a large number of cases where well water is contaminated by benzene at low concentrations. A number of studies have reported finding benzene at levels on the order of 5 ng/L in surface and well waters. However, these levels correspond to a daily intake of <10 ng benzene, assuming 2 liters of water drunk daily. This amount is only 0.5% of the average daily intake for nonsmokers of 200 ng from air. Thus, it is concluded that the effect of contaminated water on total benzene intake is negligible(1).

13. Disposal Considerations

Spillage Disposal

>> Remove all ignition sources. Evacuate danger area! Consult an expert! Personal protection: complete protective clothing including self-contained breathing apparatus. Do NOT wash away into sewer. Do NOT let this chemical enter the environment. Collect leaking and spilled liquid in sealable containers as far as possible. Absorb remaining liquid in sand or inert absorbent. Then store and dispose of according to local regulations.

Disposal Methods

>> Generators of waste (equal to or greater than 100 kg/mo) containing this contaminant, EPA hazardous waste number F005, U019, D018, must conform with USEPA regulations in storage, transportation, treatment and disposal of waste.

>> SRP: Wastewater from contaminant suppression, cleaning of protective clothing/equipment, or contaminated sites should be contained and evaluated for subject chemical or decomposition product concentrations. Concentrations shall be lower than applicable environmental discharge or disposal criteria. Alternatively, pretreatment and/or discharge to a permitted wastewater treatment facility is acceptable only after review by the governing authority and assurance that "pass through" violations will not occur. Due consideration shall be given to remediation worker exposure (inhalation, dermal and ingestion) as well as fate during treatment, transfer and disposal. If it is not practicable to manage the chemical in this fashion, it must be evaluated in accordance with EPA 40 CFR Part 261, specifically Subpart B, in order to determine the appropriate local, state and federal requirements for disposal.

>> Biodegradation, incineration: Benzene is biodegradable. Diluted aqueous soln, therefore, are drained into sewage treatment plants and decomposed there by anaerobic bacteria. Solvent mixtures and sludges of higher concn are burnt in special waste incinerators if a recovery process is uneconomical.

>> This flammable liquid burns with a very smoky flame. Dilution with alcohol or acetone is suggested to minimize smoke. Recommendable methods: Use as boiler fuel, incineration. Not recommendable: Landfill, discharge to sewer.

>> For more Disposal Methods (Complete) data for BENZENE (31 total), please visit the HSDB record page.

14. Transport Information

DOT

Benzene a
3
UN Pack Group: II
Reportable Quantity of 10 lb or 4

IATA

Benzene a
3,
UN Pack Group: II

15. Regulatory Information

Federal Drinking Water Standards:

Federal drinking water standards (e.g. maximum containment level (MCL)) for this chemical. These standards are legally enforceable.

>> Maximum contaminant levels (MCL) for organic contaminants apply to community and non-transient, non-community water systems: Benzene, MCL 0.005 mg/L.

State Drinking Water Standards:

State drinking water standards (e.g. maximum containment level (MCL)) for this chemical. These standards are legally enforceable.

>> (CA) CALIFORNIA 1 ug/L

Clean Water Act Requirements:

The Clean Water Act (CWA) of 1972 establishes the basic structure for regulating discharges of pollutants into the waters of the United States and regulating quality standards for surface waters. Under CWA, the U.S. Environmental Protection Agency (EPA) developed the Toxic Pollutant List (40 CFR Part 401.15) and the Priority Pollutant List (40 CFR Part 423, Appendix A). These lists are to be used by EPA and States to develop the Effluent Guidelines regulations and ensure water quality criteria and standards.

>> Toxic pollutant designated pursuant to section 307(a)(1) of the Federal Water Pollution Control Act and is subject to effluent limitations.

Regulatory Information

The Australian Inventory of Industrial Chemicals

>> Chemical: Benzene

>> Specific Information Requirement: Obligations to provide information apply. You must tell us within 28 days if the circumstances of your importation or manufacture (introduction) are different to those in our assessment.

REACH Registered Substance

>> Status: Active Update: 02-03-2023 https://echa.europa.eu/registration-dossier/-/registered-dossier/16102

>> Status: Active Update: 09-12-2011 https://echa.europa.eu/registration-dossier/-/registered-dossier/1466

REACH Restricted Substance

>> Restricted substance: Benzene

>> EC: 200-753-7

New Zealand EPA Inventory of Chemical Status

>> Benzene: HSNO Approval: HSR001038 Approved with controls

16. Other Information

Other Safety Information

Chemical Assessment

>> PEC / SN / Other assessments - Benzene: Health and Environment

Methods of Dissemination

>> Indoor Air: Benzene can be released into indoor air as a liquid spray (aerosol), mist, or vapor.

>> Water: Benzene can be used to contaminate water.

>> Food: Benzene can be used to contaminate food.

>> Outdoor Air: Benzene can be released into outdoor air as a liquid spray (aerosol), mist, or vapor.

>> Agricultural: If benzene is released into the air as a mist, it has the potential to contaminate agricultural products.