



SAFETY DATA SHEET (SDS) BENZENE

1. Identification

SDS Record Number	:	PCS 95004
Date of SDS	:	11 February 2015
Identity of the substance	:	Benzene
Product Description	:	Aromatic hydrocarbon.
Other names/synonyms	:	Benzol, Phenyl hydride, Benzene and mixtures having 10% benzene or more (IBC code)
Name of the supplier	:	Petrochemical Corporation of Singapore (Private) Limited
Recommended uses	:	Chemical feedstock.
Contact detail of the supplier	:	100 Ayer Merbau Road, Singapore 628277
	:	+65 68672102
24-Hour Emergency contact	:	Asia Pacific +65 3158 1074 (Singapore)
	:	China +86 10 5100 3039 (Beijing)
	:	Europe, Israel & Americas +44 (0) 1235 239 670 (UK)
	:	Middle East & Africa +44 (0) 1235 239 671 (UK)

2. Hazards Identification

GHS Classification

<u>Hazard Class</u>	<u>Hazard Category</u>
• Flammable Liquid	2
• Acute Toxicity (Oral)	4
• Skin Corrosion/Irritation	2
• Serious Eye Damage/ Irritation	2A
• Germ Cell Mutagenicity	2
• Toxic to reproduction	2
• Carcinogenicity	1A
• STOST (Single exposure)	1 (respiratory organs)
• STOST (Single exposure)	3 (narcotic effects)
• STOST (Repeated exposure)	1 (central nervous system, hematopoietic organs)
• Aspiration hazard	1
• Acute hazards to the aquatic environment	2

Pictograms



Signal Word: Danger

Hazard Statements

- Highly Flammable liquid and vapour
- Harmful if swallowed
- Causes skin irritation
- Causes serious eye irritation
- Suspected of causing genetic defects



- Suspected of damaging fertility or the unborn child
- May cause cancer
- Causes damage to organs
- May cause drowsiness or dizziness
- Causes damage to organs through prolonged or repeated exposure May be fatal if swallowed and enters airways
- Toxic to aquatic life

Precautionary Statements

Prevention

- Keep container tightly closed.
- Keep away from heat/sparks/open flames/hot surfaces. – No smoking.
- Wear protective gloves/protective clothing/eye protection/face protection
- Ground/Bond container and receiving equipment
- Use explosion-proof electrical/ventilating/lighting equipment.
- Take precautionary measures against static discharge.
- Use only non-sparking tools.
- Wash thoroughly after handling.
- Obtain special instructions before use.
- Do not handle until all safety precautions have been read and understood.
- Use personal protective equipment as required.
- Do not eat, drink or smoke when using this product.
- Avoid breathing dust/fume/gas/mist/vapours/spray.
- Avoid release to the environment
- Use only outdoors or in well-ventilated area.

Response

- IF ON SKIN (or hair): Remove/take off immediately all contaminated clothing. Rinse skin with water/ shower.
- IF exposed: Call a POISON CENTER/doctor/physician.
- In case of fire: Use appropriate media for extinction.
- IF ON SKIN: Wash with plenty of soap and water. Take off contaminated clothing and wash before re-use. If skin irritation occurs, seek medical advice/attention.
- Take of contaminated clothing and wash before re-use.
- IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing. If eye irritation persists, get medical advice/attention.
- IF SWALLOWED: Immediately call a POISON CENTER or doctor/physician. Rinse mouth. Do NOT induce vomiting.
- IF exposed or concerned: Get medical attention/advice.
- IF INHALED: Remove victim to fresh air and keep at rest in a position comfortable for breathing. Call a POISON CENTER/doctor/physician. if you feel unwell.

Storage

- Store in a well-ventilated place. Keep cool.
- Store locked up.
- Store container in a well-ventilated place. Keep container tightly closed.

Disposal

- Dispose of the contents/container in accordance to the local mandatory rules and regulations



3. Composition/Information On Ingredients

Chemical identification	:	C ₆ H ₆
Common name(s) / synonym(s)	:	Benzene, Bicarburet of hydrogen, carbon oil, coal naphtha, cyclohexatriene, mineral naphtha, phenyl hydride, pyrobenzol
CAS number / EC number	:	71-43-2 /601-020-00-8

4. First-Aid Measures

Eye:

Irrigate immediately. If this chemical contacts the eyes, immediately wash (irrigate) the eyes with large amounts of water, occasionally lifting the lower and upper lids. Get medical attention immediately.

Skin:

Soap wash immediately. If this chemical contacts the skin, immediately wash the contaminated skin with soap and water. If this chemical penetrates the clothing, immediately remove the clothing, wash the skin with soap and water, and get medical attention promptly.

Breathing:

Respiratory support. If a person breathes large amounts of this chemical, move the exposed person to fresh air at once. If breathing has stopped, perform artificial resuscitation. Keep the affected person warm and at rest. Get medical attention as soon as possible.

Swallow:

Medical attention immediately. If this chemical has been swallowed, get medical attention immediately. **Do not** induce vomiting. Keep at rest.

5. Fire-Fighting Measures

Extinguishing media: Water spray, foam or dry chemical based on situation.

Small Fires

- Dry chemical, CO₂, water spray or regular foam.

Large Fires

- Water spray, fog or regular foam.
- Do not use straight streams.
- Move containers from fire area if you can do it without risk.

Fire involving Tanks or Car/Trailer Loads

- Fight fire from maximum distance or use unmanned hose holders 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 engulfed in fire.
- For massive fire, use unmanned hose holders or monitor nozzles; if impossible, withdraw from area and let fire burn.

Specific hazards arising from the chemical:

- This is a Flammable Liquid and may release vapours that form flammable mixtures at or above the flash point.

**Special protective equipment and precautions for fire fighters:**

- Use water spray to cool fire exposed surfaces and to protect personnel.
- Shut off fuel to fire if possible to do so without hazard.
- If a leak or spill has not ignited use water spray to disperse the vapours.
- Either allow fire to burn out under controlled conditions or extinguish with foam or dry chemical.
- Try to cover liquid spills with foam.
- A self-contained breathing apparatus (SCBA) is recommended for indoor fires and any significant outdoor fires.
- For small outdoor fires, which may easily be extinguished with a portable fire extinguisher, use of an SCBA is optional.

Caution: All these products have a very low flash point: Use of water spray when fighting fire may be inefficient.

6. Accidental Release Measures

Call Emergency Response Telephone Number on Shipping Paper first. If Shipping Paper not available or no answer, refer to appropriate telephone number.

- As an immediate precautionary measure, isolate spill or leak area for at least 50 meters (150 feet) in all directions.
- Keep unauthorized personnel away.
- Stay upwind.
- Keep out of low areas.
- Ventilate closed spaces before entering.
- Remove all ignition sources.
- Dike far ahead of liquid spill for later disposal.
- Water spray may reduce vapor; but may not prevent ignition in closed spaces.
- Warn occupants and shipping in downwind areas of fire and explosion hazard and request all to stay clear.
- Collect leaking and spilled liquid in sealable containers as far as possible.
- Prevent additional discharge of material, if possible to do so without hazard.
- Absorb remaining liquid in sand or inert absorbent and remove to safe place.
- Recover by pumping (use an explosion proof motor or hand pump), or by using a suitable absorbent.
- Do not use combustible materials such as sawdust.
- **Do not** wash away into sewer. Do NOT let this chemical enter the environment.
- Notify the appropriate authorities immediately.
- Ensure disposal in compliance with government requirements and ensure conformity to local disposal regulations.
- Personal protection: Wear complete protective clothing including self-contained breathing apparatus.

Evacuation

Large Spill

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

Fire

- If tank, rail car or tank truck 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.



7. Handling And Storage

- Keep container closed. Use with adequate ventilation. Handle and open containers with care.
- Store in a cool, well-ventilated place away from incompatible materials.
- **Do not** handle or store near an open flame, heat, or other sources of ignition.
- Protect material from direct sunlight.
- Material will accumulate static charges, which may cause an electrical spark (ignition source). Use proper grounding procedures.
- **Do not** pressurize, cut, heat, or weld containers. Empty product containers may contain product residue.
- **Do not** reuse empty containers without commercial cleaning or reconditioning.
- Wash thoroughly after handling. Remove contaminated clothing and wash before reuse.
- Avoid contact with eyes, skin, and clothing.
- Keep away from sources of ignition. Store in a tightly closed container. Keep from contact with oxidizing materials.

8. Exposure Controls/Personal Protection

Appropriate Engineering Controls: The use of local exhaust ventilation is recommended to control emissions near the source. Laboratory samples should be handled in a fume hood. Provide mechanical ventilation of confined spaces. Use explosion-proof ventilation equipment.

Personal Protective Equipment (PPE)

- The selection of personal protective equipment varies depending upon conditions of use. Where prolonged and/or repeated skin and eye contact is likely to occur, wear chemical resistant gloves, rubber boots a chemical jacket, and a face shield. Where skin and eye contact is unlikely, but may occur as a result of short and/or periodic exposures, wear long sleeves, chemical resistant gloves, and a face shield.
- **Skin:** Prevent skin contact. Wear appropriate personal protective clothing to prevent skin contact.
- **Eyes:** Prevent eye contact. Wear appropriate eye protection to prevent eye contact.
- **Wash skin:** When contaminated the worker should immediately wash the skin when it becomes contaminated.
- **Remove:** When wet (flammable). Work clothing that becomes wet should be immediately removed due to its flammability hazard (i.e., for liquids with a flash point <100°F).
- **Change:** No recommendation. No recommendation is made specifying the need for the worker to change clothing after the work shift.
- **Provide Eyewash:** Quick drench Facilities for quickly drenching the body should be provided within the immediate work area for emergency use where there is a possibility of exposure. [Note: It is intended that these facilities provide a sufficient quantity or flow of water to quickly remove the substance from any body areas likely to be exposed. The actual determination of what constitutes an adequate quick drench facility depends on the specific circumstances. In certain instances, a deluge shower should be readily available, whereas in others, the availability of water from a sink or hose could be considered adequate.]

Respirator Recommendations (NIOSH)

Airborne Concentration or Condition of Use

< or = 10 ppm (parts per million)

< or = 50 ppm

Required Respirator

Half-mask air-purifying respirator with organic vapor cartridge.

(1) Full-facepiece respirator with organic vapor cartridges; or



< or = 100 ppm	2) Full-facepiece gas mask with chin-style canisters*. Full-facepiece powered air-purifying respirator with organic vapor canister*.
< or = 1,000 ppm	Supplied-air respirator with full facepiece in positive-pressure mode.
> 1,000 ppm or unknown concentration	(1) Self-contained breathing apparatus with full facepiece in positive-pressure mode; or (2) Full-facepiece positive-pressure supplied-air respirator with auxiliary self-contained air supply.
Escape	(1) Any organic vapor gas mask; or (2) Any self-contained breathing apparatus with full facepiece.
Firefighting	Full-facepiece self-contained breathing apparatus in positive-pressure mode.

* Canisters must have a minimum service life of four (4) hours when tested at 150 ppm benzene, at a flow rate of 64 liters per minute (LPM), 25°C, and 85% relative humidity for non-powered air-purifying respirators. The flow rate shall be 115 LPM and 170 LPM, respectively, for tight-fitting and loose-fitting powered air-purifying respirators.

9. Physical And Chemical Properties

Property	Value, Description
Appearance (physical state, colour etc);	Liquid, Clear colorless liquid.
Odour;	Characteristic aromatic odor.
Odour threshold;	Not available
pH;	Not applicable
Melting point/freezing point;	6 deg C
Initial boiling point and boiling range;	80 deg C
Flash point;	-11 deg C ASTM D56
Evaporation rate;	5.1 (diethyl ether = 1)
Upper/lower flammability or explosive limits;	1.3 to 7.1 % by volume
Vapour pressure;	21.9 kPa at 38 deg C
Vapour density;	2.7
Relative density;	0.89 at 15.5 deg C
Solubility(ies);	0.18% at 25 deg C
Partition coefficient: n-octanol/water;	Not available
Auto-ignition temperature;	561 deg C
Decomposition temperature;	Not available
Viscosity.	0.71 cST at 16 deg C



10. Stability And Reactivity

Reactivity/Chemical stability: This product is stable under normal temperatures and pressures. Possibility of hazardous reactions: Hazardous polymerisation will not occur.

Conditions to avoid: Keep away from ignition sources (e.g. heat, sparks, and open flames).

Incompatible materials: Strong oxidising agents, fluorine, chlorine concentrated mineral acids, halogens, molten sulfur, pure oxygen
Hazardous decomposition products: carbon monoxide, carbon dioxide

11. Toxicological Information

LC50 (rat): 13,700 ppm (4 hour exposure) (26); 9,980 ppm (7 hour exposure); (13,200 ppm - equivalent 4 hour exposure) (18)

LD50 (oral, rat): 930-mg/kg (19); 5,600-mg/kg (2); 11.4 ml/kg (10,032 mg/kg) (21)

LD50 (oral, mouse): 4,700 mg/kg (11; unconfirmed)

LD50 (skin, rabbit and guinea pig): Greater than 9,400-mg/kg (20).

Eye Irritation (rabbit):

Application of 2 drops produced moderate irritation with very slight, temporary injury to the cornea. (2)
Application of 0.1 ml (88 mg) in a Standard Draize test produced moderate eye irritation. (21).

Skin Irritation (rabbit):

In a Standard Draize test, slight to moderate irritation and moderate tissue death (necrosis) was produced. (2) In an Open Draize test, 0.01 ml (8.8 mg) produced mild skin irritation. (21).

Skin Sensitization (guinea pig):

One report of skin sensitization cannot be confirmed. (4).

Effects Of Short-Term (Acute) Exposure:

The immediately noticeable effect is depression of the central nervous system (CNS) with drowsiness, incoordination and unconsciousness, eventually leading to death.(1) On autopsy, slight liver, and sometimes kidney, changes were noted. (2) In many studies, short-term exposure to very low levels by inhalation or ingestion has caused very harmful changes to the blood and immune systems. All major types of blood cells, including red blood cells, platelets and white blood cells are susceptible. Two common effects are a decreased number of lymphocytes (cells which produce antibodies) (lymphocytopenia) and a reduced number of red blood cells (anemia). Mice exposed continuously by inhalation to 21 ppm for 4 to 10 days showed significant changes in all blood parameters tested. Concentrations as low as 10 ppm have caused immunological changes in rats. Some effects may be reversible once exposure stops. (1,13)

A few studies have been reported regarding potential behavioral effects of benzene. Increased behavioral activity (sleeping, grooming, locomotion and fighting) was observed in mice following exposure to 300 or 900 PPM for 5 days. (1) The significance of these changes is not known.

Effects Of Long-Term (Chronic) Exposure:

Effects On The Blood And Blood-Forming Organs:

Extensive studies have conclusively proven that oral and inhalation exposure to benzene causes severe effects on the blood system, including damaging the bone marrow where new blood cells are



formed. Most studies report a decrease in hemoglobin, hematocrit, red and white blood cells, platelets and/or changes in the cells. Effects of varying severity have been demonstrated with both intermittent and continuous exposures to concentrations as low as 10 ppm for 24 weeks. (1,3)

Effects On The Immune System:

Studies have also conclusively shown that benzene causes harmful changes to the immune system, which protects the body from disease. Benzene has decreased the number of mature B- and T-lymphocytes (white blood cells which produce disease-fighting antibodies). Exposure of mice to 300 ppm for 6 to 23 weeks resulted in a decrease in the number of mature B- and T-lymphocytes. Rats and mice exposed orally to 25 to 200 mg/kg/day for 2 years had significantly reduced white blood cells and lymphocytes. (1)

Carcinogenicity:

The International Agency for Research on Cancer (IARC) has concluded that there is sufficient evidence for the carcinogenicity of benzene in animals. Benzene is known to be carcinogenic in humans. (12) Inhalation and ingestion studies with rats and mice have shown cancer of the lymph system (lymphoma), the blood (leukemia), and the bone marrow (myeloma), as well as tumors of the liver, zymbal gland, mammary gland, lungs, thymus, nasal and oral cavities. Inhalation exposures were in the range of 100 to 1,200 ppm while ingestion exposures were 25 to 500 mg/kg, usually for the lifetime of the animal. (1,12,13)

Teratogenicity/Embryotoxicity:

Many studies have been conducted on rats, mice and rabbits, primarily with inhalation exposures and with concentrations ranging up to 2,200 ppm. Results show that benzene is not teratogenic or embryotoxic even at levels that caused maternal toxicity. Fetal toxicity (reduced birth weight and/or minor skeletal variations) was observed at exposures above 50 ppm. In these studies, mild maternal toxicity was also seen (reduced weight gain). (1,3,22,23)

Reproductive Toxicity:

Benzene does not appear to cause reproductive toxicity. Effects on reproductive organs (testes and ovaries) have been shown at doses, which caused other significant signs of toxicity in the animals. (2.24)

Female rats were exposed to up to 300 ppm, 6 hours per day, from 10 weeks pre-mating through nursing of the offspring with no effect on female reproductive performance. (5) In another study, where female rats were exposed continuously to 210 ppm 10 to 15 days before and 3 weeks after mating, there were no litters. There are no further details available for interpretation of this study. (1)

Mutagenicity:

Benzene has been extensively examined in mutagenicity studies with rats and mice with positive results in virtually all tests reported. Analyses of bone marrow and lymphocytes of animals exposed to concentrations as low as 1 ppm have found increases in chromosomal aberrations, sister chromatic exchanges and micronuclei. Other studies have shown changes in DNA in certain cell types. (1) Recent studies have focused on mutagenesis with low-level short-term exposures. Prolonged exposure of mice to levels at or below 1 ppm (40, 100 and 1000 ppb for 22 hours per day for 6 weeks) produced an increase in mutations in lymphocytes at the two lower exposure levels. (6,7)

Inhalation:

Vapour concentrations above recommended exposure levels are irritating to the eyes and the respiratory tract, may cause headaches and dizziness, are anaesthetic and may have other central nervous system effects. This product contains benzene. High concentrations may lead to central nervous system effects (drowsiness, dizziness, nausea, headaches, convulsions, paralysis and loss of consciousness). Death due to breathing failure may occur almost immediately or may be delayed several hours to several days if the exposure is extremely high. May cause blood or blood producing system disorder and/or damage.

Eye Contact: I

rritating, but will not injure eye tissue.

Skin Contact:



Brief contact with the liquid will not result in significant irritation unless evaporation is prevented. Frequent or prolonged contact may irritate the skin and cause a skin rash (dermatitis). Evidence does not clearly indicate whether benzene can be easily absorbed through the skin; however, damaged skin may allow the absorption of benzene. Exposure under these circumstances could add to the toxic effects caused by breathing benzene vapours.

Ingestion:

Small amounts of this liquid drawn into the lungs from swallowing or vomiting may cause severe health effects (e.g. bronchopneumonia or pulmonary oedema).

Chronic:

Human health studies (epidemiological) indicate that prolonged and/or repeated overexposures of benzene may cause damage to the blood producing system (particularly the bone marrow) and serious blood disorders including leukaemia. Animal tests indicate that benzene does not cause malformations but may be toxic to the embryo/foetus. The relationship of the results to humans has not been established.

The International Agency for Research on Cancer (IARC) has evaluated benzene and found it to be a human carcinogen.

The National Toxicology Program (NTP) has evaluated benzene and found it to be a human carcinogen.

Other human data:

- It has been stated that 3,000 ppm is endurable for 0.5 to 1 hour [Flurry 1928].
- It has also been stated that exposure at 19,000 to 20,000 ppm for 5 to 10 minutes is fatal;
- Exposure at 7,500 ppm for 30 minutes is dangerous;
- Exposure at 1,500 ppm for 60 minutes induces serious symptoms;
- Exposure at 500 ppm for 60 minutes leads to symptoms of illness;
- Exposure at 50 to 150 ppm for 5 hours produces headache, lassitude, and weakness; and
- Exposure at 25 ppm for 8 hours has no effect [Gerarde 1960].

Revised IDLH: 500 ppm

Basis for revised IDLH: The revised IDLH for benzene is 500 ppm based on acute inhalation toxicity data in humans [Gerarde 1960]. [Note: NIOSH recommends as part of its carcinogen policy that the "most protective" respirators be worn for benzene at concentrations above 0.1 ppm. OSHA currently requires in 29 CFR 1919.1028 that workers be provided with and required to wear and use the "most protective" respirators in concentrations exceeding 1,000 ppm (i.e., 1,000 x the PEL).]

12. Ecological Information

Acute Toxicity

Fish: Toxic: $1 < LC/EC/IC50 \leq 10$ mg/l

Aquatic Invertebrates: Harmful: $10 < LC/EC/IC50 \leq 100$ mg/l

Algae: Harmful: $10 < LC/EC/IC50 \leq 100$ mg/l

Microorganisms: Harmful: $10 < LC/EC/IC50 \leq 100$ mg/l

Mobility: Floats on water.

Persistence/degradability: Readily biodegradable meeting the 10-day window criterion.

Bioaccumulation: Does not bioaccumulate significantly.

Other Adverse Effects: In view of the high rate of loss from solution, the product is unlikely to pose a significant hazard to aquatic life.



13. Disposal Considerations

Recover or recycle if possible. It is the responsibility of the waste generator to determine the toxicity and physical properties of the material generated to determine the proper waste classification and disposal methods in compliance with applicable regulations.

Disposal should be in accordance with applicable regional, national, and local laws and regulations.

14. Transport Information

WHMIS Information:

Class B, Division 2: Flammable Liquids

Class D, Division 2, Subdivision A: Very Toxic Material

Class D, Division 2, Subdivision B: Toxic Material

TDG Information (Rail/Road):

PIN Number: UN 1114

Shipping Name: Benzene (Benzol)

Packing Group: II

Primary TDG: Class 3

Subsidiary TDG: Class 9.2

Do not transport with food and feed stuff.

Note: E

F symbol

T symbol

R: 45-46-11-36/38-48/23/24/25-65

S: 53-45

Transport Emergency Card: TEC (R)-30S1114 / 30GF1-II

IMDG

Identification number UN 1114

Proper shipping name BENZENE

Class / Division 3

Packing group II

Marine pollutant: No

IATA (Country variations may apply)

UN No. : 1114

Proper shipping name : Benzene

Class / Division : 3

Packing group : II

Transport in Bulk (Annex II of MARPOL 73/78 and the IBC code)

Pollution Category : Y

Ship Type : 3

Product Name : Benzene and mixtures having 10% benzene or more



15. Regulatory Information

Permissible Exposure Level (Long Term) in Singapore: 1ppm (3.18mg/m³)

CAS # 71-43-2

UN # 1114

EC # 601-020-00-8

NFPA Code: H2; F3; R0

16. Other Information

Prepared By: Material Safety Committee

SDS Prepared on: 1/10/2010

Reviewed 1 on 1/10/2013

Revised 2 on 11/2/2015

Revision (2) Notes	
1	Sect. 14: Added information for Transport in Bulk according to MARPOL 73/78 Annex II

CAUTION: The information given above (“**the Information**”) relates only to the substance or mixture listed herein. The Information may not be valid when used in combination with any other substance or mixture or in any process. If the substance or mixture is to be used for a purpose other than that stated herein or under conditions other than specified herein, the Information cannot be relied upon as being complete or accurate, and the user is advised to consult the supplier before using the substance or mixture for such other purpose or under such other conditions. The Information is given based on information available at the indicated date of preparation and no representation or warranty is given that it will be correct as of any time after the indicated date of preparation.