

1,2,4-TRICHLOROBENZENE

GHS Safety Data Sheet

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Section 1 - CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

PRODUCT NAME

1,2,4-TRICHLOROBENZENE

OTHER NAMES

C6-H3-Cl3, "benzene, 1, 2, 4-trichloro-", "benzene, 1, 2, 4-trichloro-", unsym-trichlorobenzene, "Hostetex L-Pec", "Hostetex L-Pec", "1, 2, 5-trichlorobenzene", "1, 2, 5-trichlorobenzene", "1, 3, 4-trichlorobenzene", "1, 3, 4-trichlorobenzene", "1, 2, 4-trichlorobenzol", "1, 2, 4-trichlorobenzol"

PROPER SHIPPING NAME

TRICHLOROBENZENES, LIQUID

PRODUCT USE

Solvent in chemical manufacture, dyes and intermediates, dielectric fluid, synthetic transformer oils, lubricants, heat-transfer medium, insecticides.

Drier

SUPPLIER

Company: S D FINE- CHEM LIMITED

Address:

315- 317, T.V. IND. ESTATE

248, WORLI ROAD,

MUMBAI- 400 030, INDIA

technical@sdfine.com

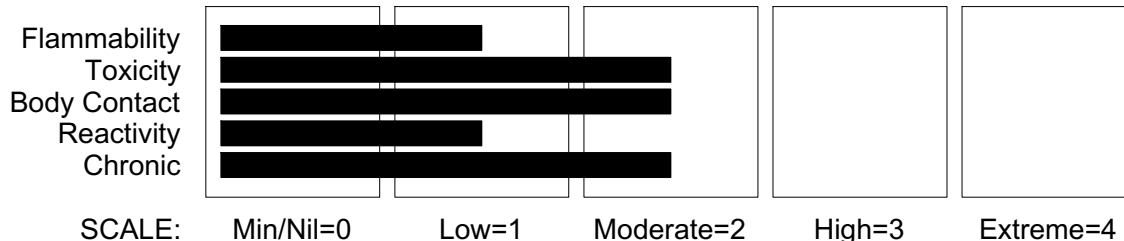
Telephone: 91- 22 2495 9898

Telephone: 91- 22 2495 9899

Fax: 91- 22 24937232

Section 2 - HAZARDS IDENTIFICATION

HAZARD RATINGS



GHS Classification

Acute Aquatic Hazard Category 1

Acute Toxicity (Oral) Category 3

Chronic Aquatic Hazard Category 1

Eye Irritation Category 2A

continued...

1,2,4-TRICHLOROBENZENE

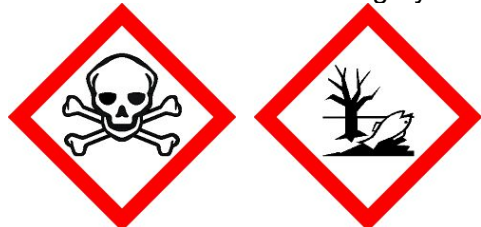
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Section 2 - HAZARDS IDENTIFICATION

Respiratory Effects Category 3
Respiratory Irritation Category 3
Skin Corrosion/Irritation Category 2



EMERGENCY OVERVIEW

HAZARD

DANGER

Determined by using GHS criteria:

H335 H336 H301 H315 H319 H400 H410

May cause respiratory irritation

May cause drowsiness or dizziness

Toxic if swallowed

Causes skin irritation

Causes serious eye irritation

Very toxic to aquatic life

Very toxic to aquatic life with long lasting effects

PRECAUTIONARY STATEMENTS

Prevention

Avoid breathing dust/fume/gas/mist/vapours/spray.

Wash thoroughly after handling.

Do not eat, drink or smoke when using this product.

Use only outdoors or in a well-ventilated area.

Avoid release to the environment.

Wear protective gloves/protective clothing/eye protection/face protection.

Response

IF SWALLOWED: Immediately call a POISON CENTER or doctor/physician.

IF INHALED: Remove to fresh air and keep at rest in a position comfortable for breathing.

IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing.

Call a POISON CENTER or doctor/physician if you feel unwell.

Rinse mouth.

If eye irritation persists: Get medical advice/attention.

Collect spillage.

Storage

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

Store locked up.

Section 3 - COMPOSITION / INFORMATION ON INGREDIENTS

NAME	CAS RN	%
1, 2, 4- trichlorobenzene	120-82-1	>98

continued...

1,2,4-TRICHLOROBENZENE

Section 4 - FIRST AID MEASURES

SWALLOWED

- IF SWALLOWED, REFER FOR MEDICAL ATTENTION, WHERE POSSIBLE, WITHOUT DELAY.
 - For advice, contact a Poisons Information Centre or a doctor.
 - Urgent hospital treatment is likely to be needed.
 - In the mean time, qualified first-aid personnel should treat the patient following observation and employing supportive measures as indicated by the patient's condition.
 - If the services of a medical officer or medical doctor are readily available, the patient should be placed in his/her care and a copy of the MSDS should be provided. Further action will be the responsibility of the medical specialist.
 - If medical attention is not available on the worksite or surroundings send the patient to a hospital together with a copy of the MSDS.
 - Where medical attention is not immediately available or where the patient is more than 15 minutes from a hospital or unless instructed otherwise:
 - INDUCE vomiting with fingers down the back of the throat, ONLY IF CONSCIOUS. Lean patient forward or place on left side (head-down position, if possible) to maintain open airway and prevent aspiration.
- NOTE: Wear a protective glove when inducing vomiting by mechanical means.

EYE

- If this product comes in contact with the eyes:
- Wash out immediately with fresh running water.
- Ensure complete irrigation of the eye by keeping eyelids apart and away from eye and moving the eyelids by occasionally lifting the upper and lower lids.
- Seek medical attention without delay; if pain persists or recurs seek medical attention.
- Removal of contact lenses after an eye injury should only be undertaken by skilled personnel.

SKIN

- If skin contact occurs:
- Immediately remove all contaminated clothing, including footwear.
- Flush skin and hair with running water (and soap if available).
- Seek medical attention in event of irritation.

INHALED

- If fumes or combustion products are inhaled remove from contaminated area.
- Lay patient down. Keep warm and rested.
- Prostheses such as false teeth, which may block airway, should be removed, where possible, prior to initiating first aid procedures.
- Apply artificial respiration if not breathing, preferably with a demand valve resuscitator, bag-valve mask device, or pocket mask as trained. Perform CPR if necessary.
- Transport to hospital, or doctor, without delay.

NOTES TO PHYSICIAN

- for poisons (where specific treatment regime is absent):

BASIC TREATMENT

- Establish a patent airway with suction where necessary.
- Watch for signs of respiratory insufficiency and assist ventilation as necessary.
- Administer oxygen by non-rebreather mask at 10 to 15 L/min.
- Monitor and treat, where necessary, for pulmonary oedema .
- Monitor and treat, where necessary, for shock.
- Anticipate seizures .
- DO NOT use emetics. Where ingestion is suspected rinse mouth and give up to 200 ml water (5 ml/kg recommended) for dilution where patient is able to swallow, has a strong gag reflex and does not drool.

ADVANCED TREATMENT

1,2,4-TRICHLOROBENZENE

Section 4 - FIRST AID MEASURES

- Consider orotracheal or nasotracheal intubation for airway control in unconscious patient or where respiratory arrest has occurred.
- Positive-pressure ventilation using a bag-valve mask might be of use.
- Monitor and treat, where necessary, for arrhythmias.
- Start an IV D5W TKO. If signs of hypovolaemia are present use lactated Ringers solution. Fluid overload might create complications.
- Drug therapy should be considered for pulmonary oedema.
- Hypotension with signs of hypovolaemia requires the cautious administration of fluids. Fluid overload might create complications.
- Treat seizures with diazepam.
- Proparacaine hydrochloride should be used to assist eye irrigation.

BRONSTEIN, A.C. and CURRANCE, P.L.

EMERGENCY CARE FOR HAZARDOUS MATERIALS EXPOSURE: 2nd Ed. 1994.

Chlorobenzenes are readily adsorbed from the gastrointestinal tract; they are distributed into highly perfused tissues and accumulate in lipid tissues. Lipid accumulation is greatest for the more highly chlorinated chlorobenzene compounds. Chlorobenzenes are metabolised by microsomal oxidation to form arene oxide intermediates and then further to their corresponding chlorophenols which are excreted in the urine as mercapturic acids after conjugation with glutathione or as glucuronic acid or sulfate conjugates. A small percentage are eliminated unchanged in expired air or faeces.

Section 5 - FIRE FIGHTING MEASURES

EXTINGUISHING MEDIA

- Foam.
- Dry chemical powder.
- BCF (where regulations permit).
- Carbon dioxide.
- Water spray or fog - Large fires only.

FIRE FIGHTING

- Alert Fire Brigade and tell them location and nature of hazard.
- Wear breathing apparatus plus protective gloves.
- Prevent, by any means available, spillage from entering drains or water courses.
- Use fire fighting procedures suitable for surrounding area.
- DO NOT approach containers suspected to be hot.
- Cool fire exposed containers with water spray from a protected location.
- If safe to do so, remove containers from path of fire.
- Equipment should be thoroughly decontaminated after use.

FIRE/EXPLOSION HAZARD

- Combustible.
 - Slight fire hazard when exposed to heat or flame.
 - Heating may cause expansion or decomposition leading to violent rupture of containers.
 - On combustion, may emit toxic fumes of carbon monoxide (CO).
 - May emit acrid smoke.
 - Mists containing combustible materials may be explosive.
- Combustion products include: carbon dioxide (CO₂), hydrogen chloride, phosgene, other pyrolysis products typical of burning organic material.
- May emit poisonous fumes.

FIRE INCOMPATIBILITY

- Avoid contamination with oxidising agents i.e. nitrates, oxidising acids, chlorine bleaches, pool chlorine etc. as ignition may result.

Personal Protective Equipment

Breathing apparatus.

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Section 6 - ACCIDENTAL RELEASE MEASURES

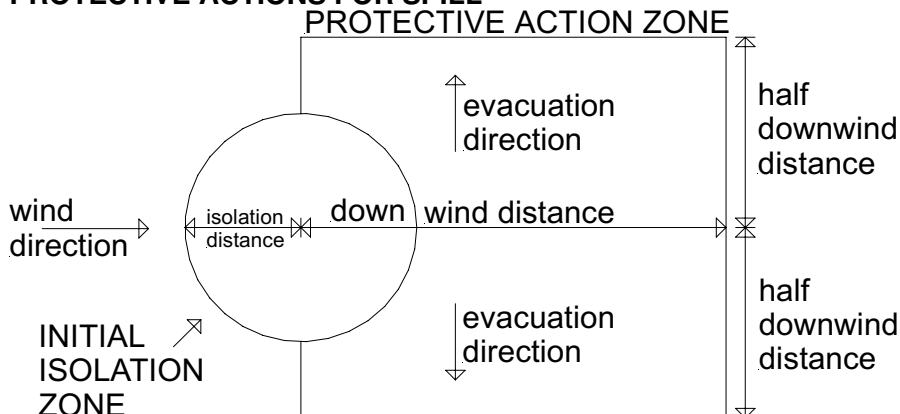
MINOR SPILLS

- Remove all ignition sources.
- Clean up all spills immediately.
- Avoid breathing vapours and contact with skin and eyes.
- Control personal contact by using protective equipment.
- Contain and absorb spill with sand, earth, inert material or vermiculite.
- Wipe up.
- Place in a suitable, labelled container for waste disposal.

MAJOR SPILLS

- Clear area of personnel and move upwind.
- Alert Fire Brigade and tell them location and nature of hazard.
- Wear breathing apparatus plus protective gloves.
- Prevent, by any means available, spillage from entering drains or water courses.
- No smoking, naked lights or ignition sources.
- Increase ventilation.
- Stop leak if safe to do so.
- Water spray or fog may be used to disperse / absorb vapour.
- Contain or absorb spill with sand, earth or vermiculite.
- Collect recoverable product into labelled containers for recycling.
- Collect solid residues and seal in labelled drums for disposal.
- Wash area and prevent runoff into drains.
- After clean up operations, decontaminate and launder all protective clothing and equipment before storing and re-using.
- If contamination of drains or waterways occurs, advise emergency services.

PROTECTIVE ACTIONS FOR SPILL



From IERG (Canada/Australia)

Isolation Distance	25 metres
Downwind Protection Distance	250 metres
IERG Number	36

FOOTNOTES

1 PROTECTIVE ACTION ZONE is defined as the area in which people are at risk of harmful exposure. This zone assumes that random changes in wind direction confines the vapour plume to an area within 30 degrees on either side of the predominant wind direction, resulting in a crosswind protective action distance equal to the downwind protective action distance.

2 PROTECTIVE ACTIONS should be initiated to the extent possible, beginning with those closest to the spill and working away from the site in the downwind direction. Within the protective action zone a level of vapour concentration may exist resulting in nearly all unprotected persons becoming incapacitated and unable to take protective action and/or incurring serious or irreversible health effects.

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Section 6 - ACCIDENTAL RELEASE MEASURES

3 INITIAL ISOLATION ZONE is determined as an area, including upwind of the incident, within which a high probability of localised wind reversal may expose nearly all persons without appropriate protection to life-threatening concentrations of the material.

4 SMALL SPILLS involve a leaking package of 200 litres (55 US gallons) or less, such as a drum (jerrican or box with inner containers). Larger packages leaking less than 200 litres and compressed gas leaking from a small cylinder are also considered "small spills".

LARGE SPILLS involve many small leaking packages or a leaking package of greater than 200 litres, such as a cargo tank, portable tank or a "one-tonne" compressed gas cylinder.

5 Guide 153 is taken from the US DOT emergency response guide book.

6 IERG information is derived from CANUTEC - Transport Canada.

Personal Protective Equipment advice is contained in Section 8 of the MSDS.

Section 7 - HANDLING AND STORAGE

PROCEDURE FOR HANDLING

- DO NOT allow clothing wet with material to stay in contact with skin.
- Avoid all personal contact, including inhalation.
- Wear protective clothing when risk of exposure occurs.
- Use in a well-ventilated area.
- Prevent concentration in hollows and sumps.
- DO NOT enter confined spaces until atmosphere has been checked.
- DO NOT allow material to contact humans, exposed food or food utensils.
- Avoid contact with incompatible materials.
- When handling, DO NOT eat, drink or smoke.
- Keep containers securely sealed when not in use.
- Avoid physical damage to containers.
- Always wash hands with soap and water after handling.
- Work clothes should be laundered separately. Launder contaminated clothing before re-use.
- Use good occupational work practice.
- Observe manufacturer's storing and handling recommendations.
- Atmosphere should be regularly checked against established exposure standards to ensure safe working conditions are maintained.

SUITABLE CONTAINER

- Avoid contact with aluminium and its alloys (including storage containers). Formation of aluminium chloride may catalyse further self-accelerating attack on the metal (Friedel-Crafts reaction) leading to violent explosion.
- Lined metal can, lined metal pail/ can.
- Plastic pail.
- Polyliner drum.
- Packing as recommended by manufacturer.
- Check all containers are clearly labelled and free from leaks.

For low viscosity materials

- Drums and jerricans must be of the non-removable head type.
- Where a can is to be used as an inner package, the can must have a screwed enclosure.

For materials with a viscosity of at least 2680 cSt. (23 deg. C) and solids (between 15 C deg. and 40 deg C.):

- Removable head packaging;
 - Cans with friction closures and
 - low pressure tubes and cartridges
- may be used.

-

Where combination packages are used, and the inner packages are of glass, there must be sufficient inert cushioning material in contact with inner and outer packages *.

-

In addition, where inner packagings are glass and contain liquids of packing group I and II there must be sufficient inert absorbent to absorb any spillage *.

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Section 7 - HANDLING AND STORAGE

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* unless the outer packaging is a close fitting moulded plastic box and the substances are not incompatible with the plastic.

STORAGE INCOMPATIBILITY

- Haloaryl compounds, though normally not very reactive, may be sufficiently activated by other substituents or by a few specific reaction conditions, to undergo violent reactions.
BREITHERICK L.: Handbook of Reactive Chemical Hazards.
- Avoid contact with aluminium and its alloys (including storage containers). Formation of aluminium chloride may catalyse further self-accelerating attack on the metal (Friedel-Crafts reaction) leading to violent explosion.
- Avoid reaction with oxidising agents.

STORAGE REQUIREMENTS

- Store in original containers.
- Keep containers securely sealed.
- Store in a cool, dry, well-ventilated area.
- Store away from incompatible materials and foodstuff containers.
- Protect containers against physical damage and check regularly for leaks.
- Observe manufacturer's storing and handling recommendations.

SAFE STORAGE WITH OTHER CLASSIFIED CHEMICALS



+: May be stored together

O: May be stored together with specific preventions

X: Must not be stored together

Section 8 - EXPOSURE CONTROLS / PERSONAL PROTECTION

EXPOSURE CONTROLS

The following materials had no OELs on our records

- 1, 2, 4- trichlorobenzene:

CAS:120- 82- 1

MATERIAL DATA

1,2,4-TRICHLOROBENZENE:

■ Odour thresholds of 10, 5-30 and 50 ug/litre have been reported for 1,2,3-TCB, 1,2,4-TCB and 1,3,5-TCB, respectively. A taste and odour threshold concentration of 30 ug/litre has been reported for 1,2,4-TCB. The potential exists for trichlorobenzene-induced hepatic toxicity at higher exposures and data needed to base a TLV upon is limited; accordingly the ceiling value has been chosen to minimise the potential for ocular and upper respiratory tract irritation.
Odour Threshold is approximately 3 ppm and minimal throat and eye irritation occur at 3 to 5 ppm.

PERSONAL PROTECTION

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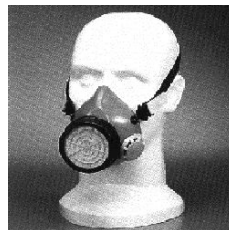
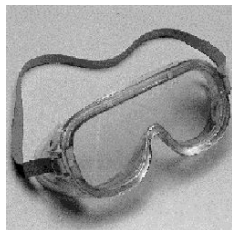
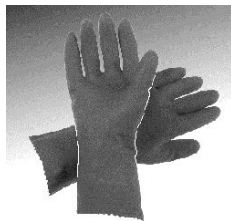
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Section 8 - EXPOSURE CONTROLS / PERSONAL PROTECTION



EYE

- Safety glasses with side shields.
- Chemical goggles.
- Contact lenses may pose a special hazard; soft contact lenses may absorb and concentrate irritants. A written policy document, describing the wearing of lens or restrictions on use, should be created for each workplace or task. This should include a review of lens absorption and adsorption for the class of chemicals in use and an account of injury experience. Medical and first-aid personnel should be trained in their removal and suitable equipment should be readily available. In the event of chemical exposure, begin eye irrigation immediately and remove contact lens as soon as practicable. Lens should be removed at the first signs of eye redness or irritation - lens should be removed in a clean environment only after workers have washed hands thoroughly. [CDC NIOSH Current Intelligence Bulletin 59].

HANDS/FEET

- Wear chemical protective gloves, eg. PVC.
- Wear safety footwear or safety gumboots, eg. Rubber.

Suitability and durability of glove type is dependent on usage. Important factors in the selection of gloves include: such as:

- frequency and duration of contact,
- chemical resistance of glove material,
- glove thickness and
- dexterity

Select gloves tested to a relevant standard (e.g. Europe EN 374, US F739).

- When prolonged or frequently repeated contact may occur, a glove with a protection class of 5 or higher (breakthrough time greater than 240 minutes according to EN 374) is recommended.
- When only brief contact is expected, a glove with a protection class of 3 or higher (breakthrough time greater than 60 minutes according to EN 374) is recommended.
- Contaminated gloves should be replaced.

Gloves must only be worn on clean hands. After using gloves, hands should be washed and dried thoroughly. Application of a non-perfumed moisturiser is recommended.

- Neoprene gloves.

OTHER

- Overalls.
- Eyewash unit.
- Barrier cream.
- Skin cleansing cream.

The local concentration of material, quantity and conditions of use determine the type of personal protective equipment required. For further information consult your Occupational Health and Safety Advisor.

ENGINEERING CONTROLS

■ Local exhaust ventilation usually required. If risk of overexposure exists, wear approved respirator. Correct fit is essential to obtain adequate protection. Supplied-air type respirator may be required in special circumstances. Correct fit is essential to ensure adequate protection.

An approved self contained breathing apparatus (SCBA) may be required in some situations.

Provide adequate ventilation in warehouse or closed storage area. Air contaminants generated in the workplace

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Section 8 - EXPOSURE CONTROLS / PERSONAL PROTECTION

possess varying "escape" velocities which, in turn, determine the "capture velocities" of fresh circulating air required to effectively remove the contaminant.

Type of Contaminant: solvent, vapours, degreasing etc., evaporating from tank (in still air). aerosols, fumes from pouring operations, intermittent container filling, low speed conveyer transfers, welding, spray drift, plating acid fumes, pickling (released at low velocity into zone of active generation) direct spray, spray painting in shallow booths, drum filling, conveyer loading, crusher dusts, gas discharge (active generation into zone of rapid air motion) grinding, abrasive blasting, tumbling, high speed wheel generated dusts (released at high initial velocity into zone of very high rapid air motion).	Air Speed: 0.25- 0.5 m/s (50- 100 f/min.) 0.5- 1 m/s (100- 200 f/min.) 1- 2.5 m/s (200- 500 f/min.) 2.5- 10 m/s (500- 2000 f/min.)
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Within each range the appropriate value depends on:

Lower end of the range 1: Room air currents minimal or favourable to capture 2: Contaminants of low toxicity or of nuisance value only. 3: Intermittent, low production. 4: Large hood or large air mass in motion	Upper end of the range 1: Disturbing room air currents 2: Contaminants of high toxicity 3: High production, heavy use 4: Small hood- local control only
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Simple theory shows that air velocity falls rapidly with distance away from the opening of a simple extraction pipe. Velocity generally decreases with the square of distance from the extraction point (in simple cases). Therefore the air speed at the extraction point should be adjusted, accordingly, after reference to distance from the contaminating source. The air velocity at the extraction fan, for example, should be a minimum of 1-2 m/s (200-400 f/min) for extraction of solvents generated in a tank 2 meters distant from the extraction point. Other mechanical considerations, producing performance deficits within the extraction apparatus, make it essential that theoretical air velocities are multiplied by factors of 10 or more when extraction systems are installed or used.

Section 9 - PHYSICAL AND CHEMICAL PROPERTIES

APPEARANCE

Colourless liquid with odour resembling that of o-dichlorobenzene; does not mix with water (19 mg/l). Miscible with ether, benzene, petroleum ether, carbon disulfide. Volatile with steam.

PHYSICAL PROPERTIES

Liquid.
Does not mix with water.
Sinks in water.

State	Liquid	Molecular Weight	181.44
Melting Range (°C)	17	Viscosity	Not Available

continued...

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Section 9 - PHYSICAL AND CHEMICAL PROPERTIES

Boiling Range (°C)	213	Solubility in water (g/L)	Immiscible
Flash Point (°C)	>110	pH (1% solution)	Not applicable
Decomposition Temp (°C)	Not Available	pH (as supplied)	Not applicable
Autoignition Temp (°C)	570	Vapour Pressure (kPa)	0.1 @ 40C
Upper Explosive Limit (%)	6.6 @ 150C	Specific Gravity (water=1)	1.46
Lower Explosive Limit (%)	2.5	Relative Vapour Density (air=1)	>6
Volatile Component (%vol)	Not available	Evaporation Rate	Not available
Gas group	IIA		

Section 10 - CHEMICAL STABILITY AND REACTIVITY INFORMATION

CONDITIONS CONTRIBUTING TO INSTABILITY

- Presence of incompatible materials.
- Product is considered stable.
- Hazardous polymerisation will not occur.

For incompatible materials - refer to Section 7 - Handling and Storage.

Section 11 - TOXICOLOGICAL INFORMATION

POTENTIAL HEALTH EFFECTS

ACUTE HEALTH EFFECTS

SWALLOWED

- Accidental ingestion of the material may be harmful; animal experiments indicate that ingestion of less than 150 gram may be fatal or may produce serious damage to the health of the individual.
- At sufficiently high doses the material may be hepatotoxic(i.e. poisonous to the liver).
- At sufficiently high doses the material may be nephrotoxic(i.e. poisonous to the kidney).

EYE

- This material can cause eye irritation and damage in some persons.

SKIN

- The material may cause moderate inflammation of the skin either following direct contact or after a delay of some time. Repeated exposure can cause contact dermatitis which is characterised by redness, swelling and blistering.
- Open cuts, abraded or irritated skin should not be exposed to this material.
- Repeated topical applications of trichlorobenzene (TCB) to rabbit ear failed to elicit chloracne or acneform dermatitis; local dermal irritation is attributed to defatting.
- Entry into the blood-stream, through, for example, cuts, abrasions or lesions, may produce systemic injury with harmful effects. Examine the skin prior to the use of the material and ensure that any external damage is suitably protected.

INHALED

- The material can cause respiratory irritation in some persons. The body's response to such irritation can cause further lung damage.
- Inhalation of vapours may cause drowsiness and dizziness. This may be accompanied by sleepiness, reduced alertness, loss of reflexes, lack of co-ordination, and vertigo.
- Inhalation of aerosols (mists, fumes), generated by the material during the course of normal handling, may be damaging to the health of the individual.
- Inhalation hazard is increased at higher temperatures.
- Inhalation of high concentrations of gas/vapour causes lung irritation with coughing and nausea, central nervous depression with headache and dizziness, slowing of reflexes, fatigue and inco-ordination.
- Target organs from non-lethal exposures to trichlorobenzenes (TCBs) by cats, dogs, rats, rabbits and guinea

continued...

1,2,4-TRICHLOROBENZENE

Section 11 - TOXICOLOGICAL INFORMATION

pig include liver, kidney and ganglion cells of the brain. Local pulmonary irritation of the lungs and dyspnoea were recorded in animals which later died after inhaling 1,2,4-TCB. Sublethal doses cause liver damage in guinea pigs and lethargy and weight gain in other animals.

CHRONIC HEALTH EFFECTS

■ Long-term exposure to respiratory irritants may result in disease of the airways involving difficult breathing and related systemic problems.

Substance accumulation, in the human body, may occur and may cause some concern following repeated or long-term occupational exposure.

TOXICITY AND IRRITATION

■ unless otherwise specified data extracted from RTECS - Register of Toxic Effects of Chemical Substances.

TOXICITY

Oral (rat) TDLo: 1800 mg/kg

Oral (rat) LD50: 756 mg/kg - Moderate

Intraperitoneal (mouse) LD50: 1223 mg/kg

■ Asthma-like symptoms may continue for months or even years after exposure to the material ceases. This may be due to a non-allergenic condition known as reactive airways dysfunction syndrome (RADS) which can occur following exposure to high levels of highly irritating compound. Key criteria for the diagnosis of RADS include the absence of preceding respiratory disease, in a non-atopic individual, with abrupt onset of persistent asthma-like symptoms within minutes to hours of a documented exposure to the irritant. A reversible airflow pattern, on spirometry, with the presence of moderate to severe bronchial hyperreactivity on methacholine challenge testing and the lack of minimal lymphocytic inflammation, without eosinophilia, have also been included in the criteria for diagnosis of RADS. RADS (or asthma) following an irritating inhalation is an infrequent disorder with rates related to the concentration of and duration of exposure to the irritating substance. Industrial bronchitis, on the other hand, is a disorder that occurs as result of exposure due to high concentrations of irritating substance (often particulate in nature) and is completely reversible after exposure ceases. The disorder is characterised by dyspnoea, cough and mucus production. Trichlorobenzenes (TCBs) are moderately toxic when ingested or inhaled. They produce irritation of the skin, eyes and respiratory tract. There has been one report of aplastic anaemia in a woman chronically exposed to 1,2,4-TCB from washing work clothes.

After short-term oral exposure, all three isomers show similar toxic effects, predominantly on the liver. Long-term toxicity and carcinogenicity studies via the oral route have not been carried out, but the data available suggest that all three isomers are non-genotoxic.

All three TCB isomers were readily absorbed following oral administration in rats. High concentrations of the parent compound were found in fat, skin and liver, whereas high levels of metabolites were found in kidney and muscle. The major metabolic products are trichlorophenols. Species differences appear to exist in the metabolism of TCBs. Rats and rhesus monkeys given 1,2,4-TCB orally and intravenously excreted different urinary metabolites. Excretion was more rapid in rats than in monkeys; after 24 h, rats had excreted 84% of the oral dose in the urine and 11% in the faeces, compared with 40% and <1%, respectively, in monkeys. There is also evidence that the TCBs are broad inducers of metabolising enzymes.

In a 13-week study, weanling Sprague-Dawley rats were fed diets containing TCB isomers at 1, 10, 100 or 1000 mg/kg. All three isomers at 1000 mg/kg caused increased relative liver and kidney weights and histological changes in the liver and thyroid of male rats.

In a 2-year dermal study, mice administered 0.03 ml of a 30% or 60% solution of 1,2,4-TCB twice a week showed signs of clinical toxicity, decreased survival and keratinization of the epidermis. The main causes of death were respiratory infection, amyloidosis and tumours.

No evidence of teratogenic effects was reported when Sprague-Dawley rats were given oral doses of 75, 150 or 300 mg of 1,2,4-TCB per kg of body weight per day or 150, 300 or 600 mg of 1,2,3-TCB or 1,3,5-TCB per kg of body weight per day on days 6-15 of gestation. Rats exposed to 0, 25, 100 or 400 mg of 1,2,4-TCB per litre in their drinking-water from the birth of the F0 generation to the weaning of the F2 generation did not show any effects on fertility.

None of the isomers of TCB was mutagenic in *Salmonella typhimurium* strains TA98, TA100, TA1535 or TA1537, with or without metabolic activation (22,23). All three caused dose-related increases in the formation of micronucleated polychromatic erythrocytes in mice injected with TCBs in corn oil at doses up to 70% of the LD50. It was considered that the effects were due to the clastogenic activity of the TCBs; however, these results have not been confirmed by other workers.

During the manufacture and use of chlorobenzenes, clinical symptoms and signs of excessive exposure include:

continued...

1,2,4-TRICHLOROBENZENE

central nervous system effects and irritation of the eyes and upper respiratory tract (MCB); haematological disorders (1,2-DCB); and central nervous system effects, hardening of the skin, and haematological disorders including anaemia (1,4-DCB).

All chlorobenzenes appear to be absorbed readily from the gastrointestinal and respiratory tracts in humans and experimental animals, with absorption influenced by the position of the chlorine in different isomers of the same congener. The chlorobenzenes are less readily absorbed through the skin. After rapid distribution to highly perfused organs in experimental animals, absorbed chlorobenzenes accumulate primarily in the fatty tissue, with smaller amounts in the liver and other organs. Chlorobenzenes have been shown to cross the placenta, and have been found in the foetal brain. In general, accumulation is greater for the more highly chlorinated congeners. There is considerable variation, however, in the accumulation of different isomers of the same congener. In both humans and experimental animals, the metabolism of chlorobenzenes proceeds via microsomal oxidation to the corresponding chlorophenol. These chlorophenols can be excreted in the urine as mercapturic acids, or as glucuronic acid or sulfate conjugates. Tetrachlorobenzenes (TeCB) and pentachlorobenzene (PeCB) are metabolized at a slower rate and remain in the tissues for longer periods than the monochloro- to trichloro- congeners. Some of the chlorobenzenes induce a wide range of enzyme systems including those involved in oxidative, reductive, conjugation, and hydrolytic pathways. In general, elimination of the higher chlorinated benzenes is slower than that of the MCB and DCB congeners, and a greater proportion of the tri- to penta- congeners are eliminated unchanged in the faeces.

With few exceptions, the chlorobenzenes are only moderately toxic for experimental animals, on an acute basis, and, generally, have oral LD50s greater than 1000 mg/kg body weight; from the limited data available, dermal LD50s are higher. The ingestion of a lethal dose leads to respiratory paralysis, while the inhalation of high doses causes local irritation and depression of the central nervous system. Acute exposures to non-lethal doses of chlorobenzenes induce toxic effects on the liver, kidneys, adrenal glands, mucous membranes, and brain, and effects on metabolizing enzymes. Studies on skin and eye irritation caused by chlorobenzenes have been restricted to 1,2,4-TCB and 1,2-DCB. Both produce severe discomfort, but no permanent damage was noted after direct application to the rabbit eye. 1,2,4-TCB is mildly irritating to the skin and may lead to dermatitis after repeated or prolonged contact. No evidence of sensitization was found. Short-term exposures (5-21 days) of rats and mice to MCB and DCBs at hundreds of mg/kg body weight resulted in liver damage and haematological changes indicative of bone marrow damage. Liver damage was also the major adverse effect noted after the short-term exposure of rats or rabbits to other chlorobenzenes (TCB-PeCB), at doses slightly lower than those for MCB and DCBs. Several of the chlorobenzene isomers studied induced porphyria, the isomers with para chlorine atoms being the most active (i.e., 1,4-DCB, 1,2,4-TCB, 1,2,3,4-TeCB, and PeCB). The general order of toxicity noted for TeCBs and PeCB after short-term exposure was: 1,2,4,5-TeCB > PeCB > 1,2,3,4- and 1,2,3,5-TeCB, which correlated well with the levels found in fat and liver.

Long-term exposure studies (up to 6 months) on several species of experimental animals indicated a trend for the toxicity of chlorobenzenes to increase with increased ring chlorination. However, there was considerable variation in the long-term toxicities of different isomers of the same congener. For example, 1,4-DCB appeared to be much less toxic than 1,2-DCB. There was a good correlation between toxicity and the degree of accumulation of the compound in the body tissues, female animals being less sensitive than males. Major target organs were the liver and kidney; at higher doses, effects on the haematopoietic system were reported and thyroid toxicity was noted in studies on 1,2,4,5-TeCB and PeCB.

There has been no evidence that chlorobenzenes are teratogenic in rats and rabbits. High doses produce embryotoxic and fetotoxic effects. However, such doses were clearly toxic to the mother. Although there is some evidence that TCBs, TeCBs, and PeCB are embryotoxic and fetotoxic at doses that are not toxic for the mother, available data are inconsistent.

The material may cause skin irritation after prolonged or repeated exposure and may produce on contact skin redness, swelling, the production of vesicles, scaling and thickening of the skin.

Bacterial mutagen

Altered sleep times, somnolence, convulsions, ataxia, maternal effects, effects on embryo, foetotoxicity, foetolethality recorded.

1,2,4-TRICHLOROBENZENE

Section 12 - ECOLOGICAL INFORMATION

Refer to data for ingredients, which follows:

1,2,4-TRICHLOROBENZENE:

Marine Pollutant:	Yes
■ Hazardous Air Pollutant:	Yes
■ log Kow (Sangster 1997):	4.02
■ Half- life Soil - High (hours):	4320
■ Half- life Soil - Low (hours):	672
■ Half- life Air - High (hours):	1284
■ Half- life Air - Low (hours):	128.4
■ Half- life Surface water - High (hours):	4320
■ Half- life Surface water - Low (hours):	672
■ Half- life Ground water - High (hours):	8640
■ Half- life Ground water - Low (hours):	1344
■ Aqueous biodegradation - Aerobic - High (hours):	4320
■ Aqueous biodegradation - Aerobic - Low (hours):	672
■ Aqueous biodegradation - Anaerobic - High (hours):	17280
■ Aqueous biodegradation - Anaerobic - Low (hours):	2688
■ Photolysis maximum light absorption - High (nano- m):	286
■ Photolysis maximum light absorption - Low (nano- m):	278
■ Photooxidation half- life air - High (hours):	1284
■ Photooxidation half- life air - Low (hours):	128.4
■ First order hydrolysis half- life (hours):	29784

■ Very toxic to aquatic organisms, may cause long-term adverse effects in the aquatic environment.

■ Do NOT allow product to come in contact with surface waters or to intertidal areas below the mean high water mark. Do not contaminate water when cleaning equipment or disposing of equipment wash-waters. Wastes resulting from use of the product must be disposed of on site or at approved waste sites.

■ Chlorobenzenes are removed from the environment principally by biological, and, to a lesser extent, by non-biological mechanisms; however, they are considered moderately persistent in water, air, and sediments. Residence times in water of 1 day in rivers and over 100 days in ground water have been reported. In air, chemical and photolytic reactions are presumed to be the predominant pathways for chlorobenzene degradation, with residence times in the range of 13-116 days. Many microorganisms from sediments and sewage sludge have been shown to degrade chlorobenzenes. It would appear that the higher chlorinated compounds are less readily degraded, and such degradation occurs only under aerobic conditions. Under anaerobic conditions in soil and ground water, dichlorobenzenes (DCB), trichlorobenzenes (TCBs), and pentachlorobenzenes (PeCBs) are usually resistant to microbial degradation. The major mechanism of aerobic degradation is via oxidative dechlorination, usually initiated by dioxygenative hydroxylation, leading to the formation of hydroxylated aromatic compounds (mainly catechols), which undergo ring fission and subsequent mineralisation to carbon dioxide and water.

Chlorobenzenes as a family can persist in soil for several months, in air for 3.5 days and in water for 1 day or less. Chlorobenzenes released into water environments will evaporate from water to the atmosphere. Henry's Law constant, the soil sorption constant, and the octanol-water (Kow) constant predict movement and fate in the environment. The distribution from water to air will decrease with increasing chlorination of the compound. Ninety-six percent of monochlorobenzene (MCB) is released to the atmosphere from aquatic environments. In other studies 99% of MCB, 1,2-dichlorobenzene (DCB) and 1,2,4-trichlorobenzene (TCB) evaporated from water solutions within 4 hours.

Chlorobenzenes released into the aquatic environment will be redistributed preferentially to the air and to sediment (particularly organically rich sediments). Limited information has shown that levels 1000 times those found in water have been detected in sediments, particularly in highly industrialised regions. Retention of chlorobenzenes in soil increases with the organic content of the soil; there is a positive correlation between the degree of chlorination of the compound and its adsorption on organic matter. Limited evidence is available showing that sediment-bound residues are bioavailable to organisms; i.e., aquatic invertebrates can take up residues from sediment, and plants, from soil.

There is some indication that concentrations of chlorobenzenes in freshwater fish increase with increasing degree of chlorination of the compound. The few studies available indicate levels of 1,4-DCB in some marine

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1,2,4-TRICHLOROBENZENE

fish of 0.05 mg/kg (wet weight). In the available studies on chlorobenzene levels in meat and milk, limited primarily to samples from contaminated areas, concentrations of 0.02-5 ug/kg have been reported. Available information on the effects of chlorobenzenes on the environment is mainly focused on acute effects on aquatic organisms. In general, toxicity increases with the degree of chlorination of the benzene ring. While MCB, 1,2-DCB, 1,3-DCB, 1,2,4-TCB, 1,3,5-TCB, and 1,2,4,5-TeCB all exhibit a low toxicity for microorganisms, the toxicity of the TCBs and TeCBs is, with the exception of 1,2,4,5-TeCB, slightly higher than that of the other compounds; in unicellular aquatic algae, EC50 values for 96-h cell growth or chlorophyll a production ranged from over 300 mg/litre for MCB to approximately 1 mg/litre for 1,2,3,5-TeCB. Some aquatic invertebrates appear more sensitive to chlorobenzenes, but levels required for 48- or 96-h lethality are still near, or well above, 1 mg/litre (e.g., *Daphnia magna* at 2.4 mg/litre for 1,2-DCB, and up to 530 mg/litre for 1,2,4,5-TeCB). The 96-h LC50 for bluegill sunfish ranged between 0.3 mg/litre for PeCB and 24 mg/litre for MCB. In embryo-larval assays, the chronic toxicity limits for DCBs varied between 0.76 and 2.0 mg/litre for the fathead minnow; in the estuarine sheepshead minnow, the chronic toxicity limits for 1,2,4-TCB and 1,2,4,5-TeCB were 0.22 and 0.13 mg/litre, respectively. Newly-hatched goldfish and large-mouth bass were the most susceptible life-stage with LC50s (96-h) of 1 and 0.05 mg/litre, respectively, for MCB.

The bioaccumulation of chlorobenzenes by aquatic organisms is determined by their relative water and lipid solubility (thus reflecting the octanol/water partition coefficients) and the number of chlorine substitutions. Uptake from water increases with increasing chlorination. The rate of elimination of chlorobenzenes decreases with increasing chlorination. BCFs ranging from 270 for 1,2-DCB to 20 000 for PeCB were reported for laboratory studies on rainbow trout (*Oncorhynchus mykiss*). BCFs for a variety of fish species ranged from 7000 to 24000 (lipid weight) for 1,2,4-TCB, with a positive correlation between bioaccumulation and lipid content.

However, the prediction of BCFs is more difficult for terrestrial plants than for aquatic organisms because of the complex nature of the root soil interface combined with gaseous uptake by aerial parts.

A negative correlation was demonstrated between the BCF and the soil adsorption coefficient (based on soil organic matter content) for the uptake into the roots of barley. The adsorption of chlorobenzenes onto soil organic matter increased with increasing chlorination. However, expression of uptake in barley roots in relation to the soil interstitial water concentration of the chlorobenzenes produced a positive correlation between the BCF and the octanol/water partition coefficients. Higher chlorinated chlorobenzenes, therefore, are most readily taken up by the plant roots when they are available in soil interstitial water. This will occur particularly in sandy soils with low organic matter content.

Reduction of the widespread use and disposal of chlorobenzenes should, however, be considered because:

- Chlorobenzenes may act as precursors for the formation of polychlorinated dibenzodioxins/polychlorinated dibenzofurans (PCDDs/PCDFs), e.g., in incineration processes.
- These chemicals can lead to taste and odour problems in drinking-water and fish.
- Residues persist in organically-rich anaerobic sediments and soils, and ground water.
- The trichlorobenzenes (TCBs) are expected to be adsorbed onto soils of high organic content, but not to leach appreciably into groundwater. They are not hydrolysed and are unlikely to biodegrade significantly. Some evaporation may occur from soil surfaces. In water, TCBs are likely to be adsorbed onto sediments and to bioconcentrate in aquatic organisms. Evaporation from water may be a significant removal process. TCBs tend to accumulate in biological materials rich in lipids, such as fatty tissue and milk; residues at levels of 0.1-4 mg/kg on a fat basis were found in the liver of cod from areas polluted by industrial effluents. Mean levels reported in human milk were 1, 1 and 5 ug/kg for 1,3,5-TCB, 1,2,4-TCB and 1,2,3-TCB, respectively.

General population exposure will occur mainly through the inhalation of contaminated air in areas where TCBs are manufactured and from the ingestion of contaminated food, especially fish.

■ Substance has been evaluated and categorised as persistent, bioaccumulative and toxic (PBT) PBT Substances pose a particular challenge to the chemicals safety management. For these substances a "safe" concentration in the environment cannot be established with sufficient reliability. The concerns, which may not be adequately addressed by the traditional risk assessment methodologies, can be summarised as:

- the concern that hazardous substances may accumulate in parts of the environment whereas the effects of such accumulation are unpredictable in the long term and that such accumulation would be difficult to reverse;
- the concern that remote areas should remain untouched by hazardous substances and that the intrinsic value of pristine environments should be protected.
- DO NOT discharge into sewer or waterways.
- The material is classified as an ecotoxin* because it is NOT readily biodegradable, the log octanol/ water partition coefficient (log Kow) is greater than or equal to 3.5 and for which the Fish LC50 (96 hours) is less than or equal to 10 mg/l.

1,2,4-TRICHLOROBENZENE

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Section 12 - ECOLOGICAL INFORMATION

Substances are considered to be readily biodegradable if the following levels of degradation are achieved in 28 days:

- In tests based on dissolved organic carbon: 70%
- In tests based on oxygen depletion or carbon dioxide generation: 60% of the theoretical maxima
- These levels of biodegradation must be achieved within 10 days of the start of biodegradation, which point is taken as the time when 10% of the substance has been degraded.

* Classification of Substances as Ecotoxic (Dangerous to the Environment)

Appendix 8, Table 1

Compiler's Guide for the Preparation of International Chemical Safety Cards: 1993 Commission of the European Communities.

It is concluded that the substance based on existing data should be regarded as a substance fulfilling the PBT-criteria and controlled as such. The substance is considered to fulfil the P criteria, but most probably not the vP-criteria. It is recognised, that 1,2,4-trichlorobenzene is a borderline case with regard to the B criterion and that it does not meet the T-criterion, although some aquatic toxicity data are not very far from the cut-off value, and some uncertainty still remains regarding mammalian toxicity. The overall conclusion (PBT) is however drawn taking supporting evidence into account relating to the very high long-range environmental transport potential of this substance.

02.03.2008

Ecotoxicity:

Fish toxicity: LC50 on *Poecilia reticulata*: approx. 2,4 mg/l. Duration of test: 14 d (Verschuieren, K. Handb. of Environm. Data on Org. Chem., 2 ed., 1983); LC50 on *Lepomis macrochirus*: approx. 3,4 mg/l (Buccafusco, R.J. et al. Bull. Environm. Toxicol. 26, 446-452, 1981).

Environmental Fate: According to WORNE biological degradation with complete ring cleavage occurs within 46 hours at 30 deg.C in the presence of *Pseudomonas* sp. The test was conducted with adapted bacteria (Worne, H.E. Magazine from BECEWA, Liege, Belgium 22, 1972, 61-71).

log Koc: 3.09-4.7

Koc: 670-5000

log Kom: 2.7-2.97

Half-life (hr) air: 128.4-1284

Half-life (hr) H₂O surface water: 4.2-4320

Half-life (hr) H₂O ground: 1344-8640

Half-life (hr) soil: 672-4320

Henry's Pa m³ /mol: 122-435

Henry's atm m³ /mol: 1.42E-03

BCF: 89-5200

Log BCF: 2.61-4.23

Toxicity Fish: LC50(336)2.4ppm

Toxicity invertebrate: LC50(48)2.72-3.1mg/L

Bioaccumulation: sig

Effects on algae and plankton: 50% growth inhib(96) 0.9mg/L

Ecotoxicity

Ingredient	Persistence: Water/Soil	Persistence: Air	Bioaccumulation	Mobility
1, 2, 4- trichlorobenzene	HIGH	HIGH	MED	MED

GESAMP/EHS COMPOSITE LIST - GESAMP Hazard Profiles

Name / Cas No / RTECS No	EHS	TRN	A1a	A1b	A1	A2	B1	B2	C1	C2	C3	D1	D2	D3	E1	E2	E3
- CAS:120- 82- 1 / DC2100000	132	7	4	5	5	NR	4	1	1	0	(2)	2	2	M		S	3

Legend:

continued...

1,2,4-TRICHLORO BENZENE

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Section 12 - ECOLOGICAL INFORMATION

EHS=EHS Number (EHS=GESAMP Working Group on the Evaluation of the Hazards of Harmful Substances Carried by Ships) NRT=Net Register Tonnage, A1a=Bioaccumulation log Pow, A1b=Bioaccumulation BCF, A1=Bioaccumulation, A2=Biodegradation, B1=Acute aquatic toxicity LC/EC50 (mg/l), B2=Chronic aquatic toxicity NOEC (mg/l), C1=Acute mammalian oral toxicity LD50 (mg/kg), C2=Acute mammalian dermal toxicity LD50 (mg/kg), C3=Acute mammalian inhalation toxicity LC50 (mg/kg), D1=Skin irritation & corrosion, D2=Eye irritation & corrosion, D3=Long-term health effects, E1=Tainting, E2=Physical effects on wildlife & benthic habitats, E3=Interference with coastal amenities,

For column A2: R=Readily biodegradable, NR=Not readily biodegradable.

For column D3: C=Carcinogen, M=Mutagenic, R=Reprotoxic, S=Sensitising, A=Aspiration hazard, T=Target organ systemic toxicity, L=Lung injury, N=Neurotoxic, I=Immunotoxic.

For column E1: NT=Not tainting (tested), T=Tainting test positive.

For column E2: Fp=Persistent floater, F=Floater, S=Sinking substances.

The numerical scales start from 0 (no hazard), while higher numbers reflect increasing hazard.

(GESAMP/EHS Composite List of Hazard Profiles - Hazard evaluation of substances transported by ships)

Section 13 - DISPOSAL CONSIDERATIONS

- Containers may still present a chemical hazard/ danger when empty.

- Return to supplier for reuse/ recycling if possible.

Otherwise:

- If container can not be cleaned sufficiently well to ensure that residuals do not remain or if the container cannot be used to store the same product, then puncture containers, to prevent re-use, and bury at an authorised landfill.

- Where possible retain label warnings and MSDS and observe all notices pertaining to the product.

Legislation addressing waste disposal requirements may differ by country, state and/ or territory. Each user must refer to laws operating in their area. In some areas, certain wastes must be tracked.

A Hierarchy of Controls seems to be common - the user should investigate:

- Reduction,
- Reuse
- Recycling
- Disposal (if all else fails)

This material may be recycled if unused, or if it has not been contaminated so as to make it unsuitable for its intended use. If it has been contaminated, it may be possible to reclaim the product by filtration, distillation or some other means. Shelf life considerations should also be applied in making decisions of this type. Note that properties of a material may change in use, and recycling or reuse may not always be appropriate.

- DO NOT allow wash water from cleaning or process equipment to enter drains.

- It may be necessary to collect all wash water for treatment before disposal.

- In all cases disposal to sewer may be subject to local laws and regulations and these should be considered first.

- Where in doubt contact the responsible authority.

- Recycle wherever possible or consult manufacturer for recycling options.

- Consult State Land Waste Authority for disposal.

- Bury or incinerate residue at an approved site.

- Recycle containers if possible, or dispose of in an authorised landfill.

Section 14 - TRANSPORTATION INFORMATION



continued...

1,2,4-TRICHLOROBENZENE

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Section 14 - TRANSPORTATION INFORMATION

Labels Required: TOXIC

HAZCHEM:

☐ 2X

Land Transport UNDG:

Class or division:	6.1	Subsidiary risk:	None
UN No.:	2321	UN packing group:	III
Shipping Name:TRICHLOROBENZENES, LIQUID			

Air Transport IATA:

ICAO/IATA Class:	6.1	ICAO/IATA Subrisk:	None
UN/ID Number:	2321	Packing Group:	III
Special provisions:	None		
Shipping Name: TRICHLOROBENZENES, LIQUID			

Maritime Transport IMDG:

IMDG Class:	6.1	IMDG Subrisk:	None
UN Number:	2321	Packing Group:	III
EMS Number:	F- A, S- A	Special provisions:	None
Limited Quantities:	5 L	Marine Pollutant:	Yes
Shipping Name: TRICHLOROBENZENES, LIQUID			

GESAMP hazard profiles for this material can be found in section 12 of the MSDS.

Section 15 - REGULATORY INFORMATION

REGULATIONS

1,2,4-trichlorobenzene (CAS: 120-82-1) is found on the following regulatory lists;

"GESAMP/EHS Composite List - GESAMP Hazard Profiles","IMO IBC Code Chapter 17: Summary of minimum requirements","IMO MARPOL 73/78 (Annex II) - List of Noxious Liquid Substances Carried in Bulk","International Chemical Secretariat (ChemSec) REACH SIN* List (*Substitute It Now!) 1.0","OECD Representative List of High Production Volume (HPV) Chemicals","OSPAR List of Chemicals for Priority Action","OSPAR List of Substances of Possible Concern"

Section 16 - OTHER INFORMATION

■ The (M)SDS is a Hazard Communication tool and should be used to assist in the Risk Assessment. Many factors determine whether the reported Hazards are Risks in the workplace or other settings. Risks may be determined by reference to Exposures Scenarios. Scale of use, frequency of use and current or available engineering controls must be considered.

The above information is believed to be accurate and represent the best information currently available to us, but does not represent any warranty expressed or implied of the properties of the product. User should make their own investigation to determine the suitability of the information for their particular purpose.

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