

TOLUENE-2,4-DIISOCYANATE

GHS SAFETY DATA SHEET

Version No:2.0
Page 1 of 19

Section 1 - CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

PRODUCT NAME

TOLUENE-2,4-DIISOCYANATE

OTHER NAMES

C₉H₆N₂O₂, CH₃C₆H₃(NCO)₂, TDI, "toluene diisocyanate", 4-methyl-m-phenylenediisocyanate, "isocyanic acid, methylphenylene ester", "2, 4-diisocyanato-1-methylbenzene", "1, 3-diisocyanato-4-methylbenzene", "2, 4-tolylene diisocyanate", di-iso-cyanatoluene, "isocyanic acid, 4-methyl-m-phenylene ester"

PROPER SHIPPING NAME

TOLUENE DIISOCYANATE

PRODUCT USE

The material when ready for use, i.e. with 2 parts mixed together, CONTAINS free organic isocyanate. Application requires control measures, special precautions and use of personal protective gear. [APMF].

CAUTION: isocyanates are strong respiratory sensitisers and skin sensitisers. Sensitised people can react to very low levels of airborne isocyanates and should not be required to work with these materials.

In the manufacture of polyurethane foams, elastomers and coatings; a cross-linking agent for nylon-6.

SUPPLIER

Company: S D FINE- CHEM LIMITED

Address:

315- 317, T.V. INDUSTRIAL ESTATE,

248, WORLI,

MUMBAI- 400030.INDIA.

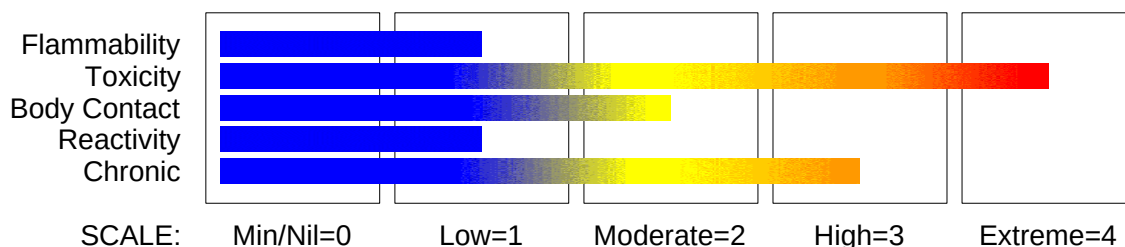
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HAZARD RATINGS



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Section 2 - HAZARDS IDENTIFICATION

GHS Classification

Acute Toxicity (Inhalation) Category 1
Acute Toxicity (Oral) Category 3
Carcinogen Category 2
Chronic Aquatic Hazard Category 3
Eye Irritation Category 2A
Respiratory Irritation Category 3
Respiratory Sensitizer Category 1
Skin Corrosion/Irritation Category 2
Skin Sensitizer Category 1



EMERGENCY OVERVIEW

HAZARD

DANGER
Determined by using GHS criteria:
H335 H330 H301 H315 H319 H334 H317 H351 H412
May cause respiratory irritation
Fatal if inhaled
Toxic if swallowed
Causes skin irritation
Causes serious eye irritation
May cause allergic or asthmatic symptoms or breathing difficulties if inhaled
May cause allergic skin reaction
Suspected of causing cancer
Harmful to aquatic life with long lasting effects

PRECAUTIONARY STATEMENTS

Prevention

Avoid breathing dust/fume/gas/mist/vapours/spray.
Contaminated clothing should not be allowed out of the workplace.
Wash thoroughly after handling.
In case of inadequate ventilation wear respiratory protection.
Wear respiratory protection.
Use only outdoors or in a well ventilated area.
Do not breathe dust/fume/gas/mist/vapours/spray.
Use personal protective equipment as required.
Wash hands thoroughly after handling.
Do not eat, drink or smoke when using this product.
Obtain special instructions before use.
Do not handle until all safety precautions have been read and understood.

Response

If skin irritation occurs, seek medical advice/attention.
Wear eye/face protection.

TOLUENE-2,4-DIISOCYANATE

If eye irritation persists, get medical advice/attention.
If skin irritation or rash occurs, seek medical advice/attention.
If exposed or concerned: Get medical attention advice.
IF INHALED: If breathing is difficult, remove to fresh air and keep at rest in a position comfortable for breathing.
If experiencing respiratory symptoms call a POISON CENTER or doctor/physician.
IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing.
Remove/Take off immediately all contaminated clothing
Wash/Decontaminate removed clothing before reuse.
IF SWALLOWED: Immediately call a POISON CENTER or doctor/physician.
Specific treatment: refer to Label or MSDS.
IF ON SKIN: Gently wash with plenty of soap and water.
Keep container tightly closed.
Wash contaminated clothing before reuse.
Immediately call a POISON CENTER or doctor/physician.
IF INHALED: Remove to fresh air and keep at rest in a position comfortable for breathing.

Storage

Store locked up.

Disposal

Dispose of contents and container in accordance with relevant legislation.

Section 3 - COMPOSITION / INFORMATION ON INGREDIENTS

NAME	CAS RN	%
toluene- 2, 4- diisocyanate	584-84-9	>98
(*) Note: toluene- 2, 6- diisocyanate can be an impurity; its effects are similar.		

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:
- Immediately hold eyelids apart and flush the eye continuously with running water.

TOLUENE-2,4-DIISOCYANATE

- 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.
- Continue flushing until advised to stop by the Poisons Information Centre or a doctor, or for at least 15 minutes.
- Transport to hospital or doctor without delay.
- 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 sub-chronic and chronic exposures to isocyanates:

- This material may be a potent pulmonary sensitiser which causes bronchospasm even in patients without prior airway hyperreactivity.
- Clinical symptoms of exposure involve mucosal irritation of respiratory and gastrointestinal tracts.
- Conjunctival irritation, skin inflammation (erythema, pain vesiculation) and gastrointestinal disturbances occur soon after exposure.
- Pulmonary symptoms include cough, burning, substernal pain and dyspnoea.
- Some cross-sensitivity occurs between different isocyanates.
- Noncardiogenic pulmonary edema and bronchospasm are the most serious consequences of exposure. Markedly symptomatic patients should receive oxygen, ventilatory support and an intravenous line.
- Treatment for asthma includes inhaled sympathomimetics (epinephrine [adrenalin], terbutaline) and steroids.
- Activated charcoal (1 g/kg) and a cathartic (sorbitol, magnesium citrate) may be useful for ingestion.
- Mydriatics, systemic analgesics and topical antibiotics (Sulamyd) may be used for corneal abrasions.
- There is no effective therapy for sensitised workers.

[Ellenhorn and Barceloux; Medical Toxicology]

NOTE: Isocyanates cause airway restriction in naive individuals with the degree of response dependant on the concentration and duration of exposure. They induce smooth muscle contraction which leads to bronchoconstrictive episodes. Acute changes in lung function, such as decreased FEV1, may not represent sensitivity.

[Karol & Jin, Frontiers in Molecular Toxicology, pp 56-61, 1992].

In normal commercial preparations of toluene diisocyanate, the 2,4-isomer dominates in the ratio 4:1. However it is also hydrolysed, in air, more rapidly than the 2,6-isomer. Airway sensitivities may result from the appearance of immunoglobulins in the blood. Frequent inability to detect antibodies to TDI in clinical cases may result from the routine use of diagnostic antigens containing predominantly 2,4-TDI, whereas individuals may have been exposed to atmospheres in which 2,6-TDI was the predominant isomer. [Karol&Jin, Frontiers of Molecular Toxicology, pp 55-61, 1992]

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 full body protective clothing with breathing apparatus.
- Prevent, by any means available, spillage from entering drains or water course.
- 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.
 - Moderate fire hazard when exposed to heat or flame.
 - When heated to high temperatures decomposes rapidly generating vapour which pressures and may then rupture containers with release of flammable and highly toxic isocyanate vapour.
 - Burns with acrid black smoke and poisonous fumes.
 - Combustion yields traces of highly toxic hydrogen cyanide HCN, plus toxic nitrogen oxides NO_x and carbon monoxide.
 - Small quantities of water in contact with hot liquid may react violently with generation of a large volume of rapidly expanding hot sticky semi-solid foam.
 - Presents additional hazard when fire fighting in a confined space.
 - Cooling with flooding quantities of water reduces this risk.
- Combustion products include: carbon dioxide (CO₂), isocyanates, and minor amounts of, hydrogen cyanide, nitrogen oxides (NO_x), 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

Gas tight chemical resistant suit.

Section 6 - ACCIDENTAL RELEASE MEASURES

EMERGENCY PROCEDURES

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.

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TOLUENE-2,4-DIISOCYANATE

- Place in a suitable labelled container for waste disposal.

MAJOR SPILLS

Treat isocyanate spills with sufficient amounts of isocyanate decontaminant preparation. Typically, such a preparation may consist of: sawdust: 20 parts by weight Kieselguhr 40 parts by weight plus a mixture of {ammonia (s.g. 0.880) 8% v/v non-ionic surfactant 2% v/v water 90% v/v}. Let stand for 24 hours.

- Clear area of personnel and move upwind.
 - Alert Fire Brigade and tell them location and nature of hazard.
 - Wear full body protective clothing with breathing apparatus.
 - Prevent, by all means available, spillage from entering drains or water courses.
 - Consider evacuation (or protect in place).
 - 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.
- Chemical Class: cyanates and isocyanates

For release onto land: recommended sorbents listed in order of priority.

SORBENT TYPE	RANK	APPLICATION	COLLECTION	LIMITATIONS
LAND SPILL - SMALL				
cross- linked polymer - particulate	1	shovel	shovel	R, W, SS
wood fiber - particulate	1	throw	pitchfork	R, P, DGC, RT
cross- linked polymer - pillow	1	throw	pitchfork	R, DGC, RT
sorbent clay - particulate	2	shovel	shovel	R, I, P
foamed glass - pillow	2	throw	pitchfork	R, P, DGC, RT
wood fiber - particulate	3	shovel	shovel	R, W, P, DGC
LAND SPILL - MEDIUM				
cross- linked polymer - particulate	1	blower	skiploader	R, W, SS
cross- linked polymer - pillow	1	throw	skiploader	R, DGC, RT
polypropylene - particulate	2	blower	skiploader	R, SS, DGC
expanded mineral - particulate	3	blower	skiploader	R, I, W, P, DGC
wood fiber -	3	blower	skiploader	R, W, P, DGC

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TOLUENE-2,4-DIISOCYANATE

particulate polypropylene - mat	3	throw	skiploader	DGC, RT
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Legend

DGC: Not effective where ground cover is dense

R; Not reusable

I: Not incinerable

P: Effectiveness reduced when rainy

RT: Not effective where terrain is rugged

SS: Not for use within environmentally sensitive sites

W: Effectiveness reduced when windy

Reference: Sorbents for Liquid Hazardous Substance Cleanup and Control;

R.W Melvold et al: Pollution Technology Review No. 150: Noyes Data Corporation 1988.

EMERGENCY RESPONSE PLANNING GUIDELINES (ERPG)

The maximum airborne concentration below which it is believed that nearly all individuals could be exposed for up to one hour WITHOUT experiencing or developing

life-threatening health effects is:

toluene-2,4-diisocyanate	0.6 ppm
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irreversible or other serious effects or symptoms which could impair an individual's ability to take protective action is:

toluene-2,4-diisocyanate	0.15 ppm
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other than mild, transient adverse effects without perceiving a clearly defined odour is:

toluene-2,4-diisocyanate	0.01 ppm
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The threshold concentration below which most people will experience no appreciable risk of health effects:

toluene-2,4-diisocyanate	0.005 ppm
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American Industrial Hygiene Association (AIHA)

Ingredients considered according to the following cutoffs

Very Toxic (T+)	$\geq 0.1\%$	Toxic (T)	$\geq 3.0\%$
R50	$\geq 0.25\%$	Corrosive (C)	$\geq 5.0\%$
R51	$\geq 2.5\%$		
else	$\geq 10\%$		

where percentage is percentage of ingredient found in the mixture

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.

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TOLUENE-2,4-DIISOCYANATE

- 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

- 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 *.

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

All inner and sole packagings for substances that have been assigned to Packaging Groups I or II on the basis of inhalation toxicity criteria, must be hermetically sealed.

STORAGE INCOMPATIBILITY

A range of exothermic decomposition energies for isocyanates is given as 20-30 kJ/mol. The relationship between energy of decomposition and processing hazards has been the subject of discussion; it is suggested that values of energy released per unit of mass, rather than on a molar basis (J/g) be used in the assessment. For example, in "open vessel processes" (with man-hole size openings, in an industrial setting), substances with exothermic decomposition energies below 500 J/g are unlikely to present a danger, whilst those in "closed vessel processes" (opening is a safety valve or bursting disk) present some danger where the decomposition energy exceeds 150 J/g.

BREThERICK: Handbook of Reactive Chemical Hazards, 4th Edition.

Avoid reaction with water, alcohols, strong bases, alkalis, metal compounds and detergent solutions. Reacts with water, may generate a large volume of foam, carbon dioxide gas (CO₂) and heat. Foaming in confined space may produce pressure. Isocyanates will attack and embrittle some plastics and rubbers.

- Reactions of isocyanates with amines, aldehydes, alcohols, alkali metals, ketones, mercaptans, strong oxidisers, hydrides, phenols, and peroxides can cause vigorous release of heat.
- Acids and bases initiate polymerisation reactions with isocyanates.
- Avoid contamination with water, alkalies and detergent solutions.
- Material reacts with water and generates gas, pressurises containers with even drum rupture resulting.

TOLUENE-2,4-DIISOCYANATE

- DO NOT reseal container if contamination is suspected.
 - Open all containers with care.
- Avoid reaction with oxidising agents.
- Avoid reaction with compounds containing active hydrogen (such as water, ammonia, amines, alcohols, acids, etc.) - the reaction may be violent, the rate being dependent upon the active hydrogen compound and the presence of catalysts.

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.
- Bulk storage should be blanketed with nitrogen and equipped with absorptive type breather valve (to prevent vapour emissions).
- DO NOT store in pits, depressions, basements or areas where vapours may be trapped.

SAFE STORAGE WITH OTHER CLASSIFIED CHEMICALS



- +: May be stored together
O: May be stored together with specific precautions
X: Must not be stored together

Section 8 - EXPOSURE CONTROLS / PERSONAL PROTECTION

EXPOSURE CONTROLS

ODOUR SAFETY FACTOR (OSF)

OSF=0.029 ("2,4-TOLUENEDIISOCYANATE")

Exposed individuals are NOT reasonably expected to be warned, by smell, that the Exposure Standard is being exceeded.

Odour Safety Factor (OSF) is determined to fall into either Class C, D or E.

The Odour Safety Factor (OSF) is defined as:

OSF= Exposure Standard (TWA) ppm/ Odour Threshold Value (OTV) ppm

Classification into classes follows:

Class	OSF	Description
A	550	Over 90% of exposed individuals are aware by smell that the Exposure Standard (TLV- TWA for example) is being reached, even when distracted by working activities
B	26- 550	As " A" for 50- 90% of persons being distracted
C	1- 26	As " A" for less than 50% of

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TOLUENE-2,4-DIISOCYANATE

D	0.18- 1	persons being distracted 10- 50% of persons aware of being tested perceive by smell that the Exposure Standard is being reached
E	<0.18	As " D" for less than 10% of persons aware of being tested

MATERIAL DATA

Sensory irritants are chemicals that produce temporary and undesirable side-effects on the eyes, nose or throat. Historically occupational exposure standards for these irritants have been based on observation of workers' responses to various airborne concentrations. Present day expectations require that nearly every individual should be protected against even minor sensory irritation and exposure standards are established using uncertainty factors or safety factors of 5 to 10 or more. On occasion animal no-observable-effect-levels (NOEL) are used to determine these limits where human results are unavailable. An additional approach, typically used by the TLV committee (USA) in determining respiratory standards for this group of chemicals, has been to assign ceiling values (TLV C) to rapidly acting irritants and to assign short-term exposure limits (TLV STELs) when the weight of evidence from irritation, bioaccumulation and other endpoints combine to warrant such a limit. In contrast the MAK Commission (Germany) uses a five-category system based on intensive odour, local irritation, and elimination half-life. However this system is being replaced to be consistent with the European Union (EU) Scientific Committee for Occupational Exposure Limits (SCOEL); this is more closely allied to that of the USA.

OSHA (USA) concluded that exposure to sensory irritants can:

- cause inflammation
- cause increased susceptibility to other irritants and infectious agents
- lead to permanent injury or dysfunction
- permit greater absorption of hazardous substances and
- acclimate the worker to the irritant warning properties of these substances thus increasing the risk of overexposure.

Some jurisdictions require that health surveillance be conducted on occupationally exposed workers. This should emphasise:

- demography, occupational and medical history and health advice
- completion of a standardised respiratory questionnaire
- physical examination of the respiratory system and skin
- standardised respiratory function tests such as FEV1, FVC and FEV1/FVC.

NOTE: Detector tubes for toluene diisocyanate, measuring in excess of 0.02 ppm, are commercially available.

The odour recognition threshold, 0.05-0.4 ppm in air, is not reliable and being above exposure standard, gives no warning of exposure.

A substantial proportion of the working population (4.3% to 25%) can be sensitised to TDI at the ES-TWA. Such sensitisation was not limited to highly susceptible individuals and workers often developed symptoms early. Preplacement exams have been unsuccessful in identifying those who may develop sensitisation. Allergy, bronchial asthma and chronic bronchitis sufferers should be excluded from exposure to TDI. Chronic low level exposures below 0.02 ppm have been reported to cause sensitisation. Workers complained of cough, phlegm production, breathlessness and wheezing 2 to 17 years after the last exposure and it is reported that several workers developed chronic bronchitis 40 months after removal from exposure. Effects of TDI appear to be dose-related and there is a threshold (0.005 ppm) below which no respiratory effects are produced by at least the isomer 2,4-TDI. It should be noted that some polyurethane production facilities also emit amines which are the most important cause of respiratory symptoms and occupational asthma.

TOLUENE-2,4-DIISOCYANATE

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

Suitability and durability of glove type is dependent on usage. Factors such as:

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

are important in the selection of gloves.

Wear chemical protective gloves, eg. PVC.

Wear safety footwear or safety gumboots, eg. Rubber.

NOTE: The material may produce skin sensitisation in predisposed individuals. Care must be taken, when removing gloves and other protective equipment, to avoid all possible skin contact.

Note: Natural rubber, neoprene, PVC can be affected by TDI.

Note: Organic vapour respirators are not protection for sensitised workers.

OTHER

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

RESPIRATOR

Selection of the Class and Type of respirator will depend upon the level of breathing zone contaminant and the chemical nature of the contaminant. Protection Factors (defined as the ratio of contaminant outside and inside the mask) may also be important.

Breathing Zone Level ppm (volume)	Maximum Protection Factor	Half- face Respirator	Full- Face Respirator
1000	10	AB- AUS P	-
1000	50	-	AB- AUS P
5000	50	Airline *	-
5000	100	-	AB- 2 P
10000	100	-	AB- 3 P

continued...

TOLUENE-2,4-DIISOCYANATE

100+

Airline**

* - Continuous Flow

** - Continuous-flow or positive pressure demand.

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

- Employees exposed to confirmed human carcinogens should be authorized to do so by the employer, and work in a regulated area.
 - Work should be undertaken in an isolated system such as a "glove-box" . Employees should wash their hands and arms upon completion of the assigned task and before engaging in other activities not associated with the isolated system.
 - Within regulated areas, the carcinogen should be stored in sealed containers, or enclosed in a closed system, including piping systems, with any sample ports or openings closed while the carcinogens are contained within.
 - Open-vessel systems are prohibited.
 - Each operation should be provided with continuous local exhaust ventilation so that air movement is always from ordinary work areas to the operation.
 - Exhaust air should not be discharged to regulated areas, non-regulated areas or the external environment unless decontaminated. Clean make-up air should be introduced in sufficient volume to maintain correct operation of the local exhaust system.
 - For maintenance and decontamination activities, authorized employees entering the area should be provided with and required to wear clean, impervious garments, including gloves , boots and continuous-air supplied hood. Prior to removing protective garments the employee should undergo decontamination and be required to shower upon removal of the garments and hood.
 - Except for outdoor systems, regulated areas should be maintained under negative pressure (with respect to non-regulated areas).
 - Local exhaust ventilation requires make-up air be supplied in equal volumes to replaced air.
 - Laboratory hoods must be designed and maintained so as to draw air inward at an average linear face velocity of 150 feet/ min. with a minimum of 125 feet/ min. Design and construction of the fume hood requires that insertion of any portion of the employees body, other than hands and arms, be disallowed.
- Spraying of material or material in admixture with other components must be carried out in conditions conforming to local state regulations. Local exhaust ventilation with full face air supplied breathing apparatus (hood or helmet type) is normally required. Unprotected personnel must vacate spraying area.
- NOTE: Isocyanate vapours will not be adequately absorbed by organic vapour respirators. Air contaminants generated in the workplace possess varying "escape" velocities which, in turn, determine the "capture velocities" of fresh circulating air required to effectively remove the contaminant.

Type of Contaminant:
direct spray, spray painting in shallow booths,
drum filling, conveyer loading, crusher dusts,
gas discharge (active generation into zone of
rapid air motion)

Air Speed:
1- 2.5 m/s (200- 500 f/min.)

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

Upper end of the range

1: Disturbing room air currents

2: Contaminants of high toxicity

continued...

TOLUENE-2,4-DIISOCYANATE

Section 8 - EXPOSURE CONTROLS / PERSONAL PROTECTION

value only

3: Intermittent, low production.

4: Large hood or large air mass in motion

3: High production, heavy use

4: Small hood- local control only

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 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 4-10 m/s (800-2000 f/min.) for extraction of solvents generated by spraying at a point 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

Clear, off-white to pale yellow liquid with a sharp, pungent odour that causes tear formation. The odour recognition threshold (100% of test panel) is 2.14 ppm in air. Darkens on exposure to sunlight. Miscible with alcohol (decomposition), diglycol monomethyl ether, ether, acetone, carbon tetrachloride, benzene, chlorobenzene, kerosene, and olive oil. Reacts with water to produce carbon dioxide.

PHYSICAL PROPERTIES

Liquid.

Does not mix with water.

Sinks in water.

Toxic or noxious vapours/gas.

Molecular Weight: 174.16

Melting Range (°C): 19.5 - 21.5

Solubility in water (g/L): Immiscible

pH (1% solution): Not applicable

Volatile Component (%vol): Not applicable.

Relative Vapour Density (air=1): 6.0

Lower Explosive Limit (%): 0.9

Autoignition Temp (°C): Not available.

State: Liquid

Boiling Range (°C): 251

Specific Gravity (water=1): 1.21

pH (as supplied): Not applicable

Vapour Pressure (kPa): 0.013 @ 20 C

Evaporation Rate: Not available

Flash Point (°C): 121- 132

Upper Explosive Limit (%): 9.5

Decomposition Temp (°C): Not Available

Viscosity: Not Available

Section 10 - CHEMICAL STABILITY AND REACTIVITY INFORMATION

CONDITIONS CONTRIBUTING TO INSTABILITY

- Presence of incompatible materials.
- Product is considered stable.
- Hazardous polymerisation will occur.

Section 11 - TOXICOLOGICAL INFORMATION

POTENTIAL HEALTH EFFECTS

ACUTE HEALTH EFFECTS

SWALLOWED

Accidental ingestion of the material may be seriously damaging to the health of the individual; animal experiments indicate that ingestion of less than 40 gram may be fatal.

EYE

Irritation of the eyes may produce a heavy secretion of tears (lachrymation). Evidence exists, or practical experience predicts, that the material may cause severe eye irritation in a substantial number of individuals and/or may produce significant ocular lesions which are present twenty-four hours or more after instillation into the eye(s) of experimental animals. Eye contact may cause significant inflammation with pain. Corneal injury may occur; permanent impairment of vision may result unless treatment is prompt and adequate. Repeated or prolonged exposure to irritants may cause inflammation characterised by a temporary redness (similar to windburn) of the conjunctiva (conjunctivitis); temporary impairment of vision and/or other transient eye damage/ulceration may occur.

SKIN

Skin contact with the material may damage the health of the individual; systemic effects may result following absorption.

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.

The material produces severe skin irritation; evidence exists, or practical experience predicts, that the material either:

- produces severe inflammation of the skin in a substantial number of individuals following direct contact, and/or
- produces significant and severe inflammation when applied to the healthy intact skin of animals (for up to four hours), such inflammation being present twenty-four hours or more after the end of the exposure period.
- Skin irritation may also be present after prolonged or repeated exposure; this may result in a form of contact dermatitis (nonallergic). The dermatitis is often characterised by skin redness (erythema) and swelling (oedema) which may progress to blistering (vesiculation), scaling and thickening of the epidermis. At the microscopic level there may be intercellular oedema of the spongy layer of the skin (spongiosis) and intracellular oedema of the epidermis.

NOTE: Prolonged contact is unlikely, given the severity of response, but repeated exposures may produce severe ulceration.

INHALED

The vapour/mist may be highly irritating to the upper respiratory tract and lungs; the response may be severe enough to produce bronchitis and pulmonary oedema. Possible neurological symptoms arising from isocyanate exposure include headache, insomnia, euphoria, ataxia, anxiety neurosis, depression and paranoia. Gastrointestinal disturbances are characterised by nausea and vomiting. Pulmonary sensitisation may produce asthmatic reactions ranging from minor breathing difficulties to severe allergic attacks; this may occur following a single acute exposure or may develop without warning for several hours after exposure. Sensitized people can react to very low doses, and should not be allowed to work in situations allowing exposure to this material. Continued exposure of sensitised persons may lead to possible long term respiratory impairment. Inhalation hazard is increased at higher temperatures.

In addition to producing pulmonary sensitisation, toluene diisocyanate (TDI) is active in contracting smooth muscle such as that found in the airway. So-called bronchoconstriction is often mistaken for sensitisation and lung function tests, including measurement of forced expiratory volume (FEV1) and forced vital capacity (FCV) may distinguish acute reaction. Severe irritation is produced by inhalation of low vapour concentrations. At 0.02 ppm, TDI does not produce immediate irritation but this may become apparent after an extended period of exposure. Symptoms may include a burning sensation, coughing, wheezing

continued...

, laryngitis, shortness of breath, headache, nausea and vomiting. Overexposure or repeated exposure may produce bronchial spasm and asthma which may not appear for several hours. Symptoms may persist for several weeks. Most individuals recover completely. Both allergy-prone and non allergy-prone individuals may become sensitised. Cross-sensitisation to other isocyanates may occur.

Evidence shows, or practical experience predicts, that the material produces irritation of the respiratory system, in a substantial number of individuals, following inhalation. In contrast to most organs, the lung is able to respond to a chemical insult by first removing or neutralising the irritant and then repairing the damage. The repair process, which initially evolved to protect mammalian lungs from foreign matter and antigens, may however, produce further lung damage resulting in the impairment of gas exchange, the primary function of the lungs. Respiratory tract irritation often results in an inflammatory response involving the recruitment and activation of many cell types, mainly derived from the vascular system.

CHRONIC HEALTH EFFECTS

On the basis, primarily, of animal experiments, concern has been expressed that the material may produce carcinogenic or mutagenic effects; in respect of the available information, however, there presently exists inadequate data for making a satisfactory assessment.

Persons with a history of asthma or other respiratory problems or are known to be sensitised, should not be engaged in any work involving the handling of isocyanates. [CCTRADE-Bayer, APMF].

Limited evidence suggests that repeated or long-term occupational exposure may produce cumulative health effects involving organs or biochemical systems.

With most allergens, removal of the offending agent results in the individual becoming asymptomatic. Toluene diisocyanate (TDI)-induced asthma may continue for months or even years after exposure ceases. This may be due to a non-allergenic condition known as reactive airway dysfunction syndrome (RADS) which can occur following exposure to high levels of highly irritating compound. Evidence of carcinogenic potential of commercial grade TDI in female mice included induction of haemangiomas in the spleen and subcutaneous tissues, hepatocellular adenomas, and haemangiosarcomas in the liver, ovary and peritoneum. Ingestion of commercial grade TDI produced subcutaneous fibromas, pancreatic acinar cell adenomas, mammary gland fibroadenomas and subcutaneous fibromas and fibrosarcomas in female rats. No treatment related tumours were induced in male mice. Long-term exposure to respiratory irritants may result in disease of the airways involving difficult breathing and related systemic problems.

Practical evidence shows that inhalation of the material is capable of inducing a sensitisation reaction in a substantial number of individuals at a greater frequency than would be expected from the response of a normal population.

Pulmonary sensitisation, resulting in hyperactive airway dysfunction and pulmonary allergy may be accompanied by fatigue, malaise and aching. Significant symptoms of exposure may persist for extended periods, even after exposure ceases. Symptoms can be activated by a variety of nonspecific environmental stimuli such as automobile exhaust, perfumes and passive smoking.

Practical experience shows that skin contact with the material is capable either of inducing a sensitisation reaction in a substantial number of individuals, and/or of producing a positive response in experimental animals.

On the basis, primarily, of animal experiments, the material may be regarded as carcinogenic to humans. There is sufficient evidence to provide a strong presumption that human exposure to the material may result in cancer on the basis of:

- appropriate long-term animal studies
- other relevant information.

Isocyanate vapours/mists are irritating to the upper respiratory tract and lungs; the response may be severe enough to produce bronchitis with wheezing, gasping and severe distress, even sudden loss of consciousness, and pulmonary oedema. Possible neurological symptoms arising from isocyanate exposure include headache, insomnia, euphoria, ataxia, anxiety neurosis, depression and paranoia. Gastrointestinal disturbances are characterised by nausea and vomiting. Pulmonary sensitisation may produce asthmatic

reactions ranging from minor breathing difficulties to severe allergic attacks; this may occur following a single acute exposure or may develop without warning after a period of tolerance. A respiratory response may occur following minor skin contact. Skin sensitisation is possible and may result in allergic dermatitis responses including rash, itching, hives and swelling of extremities.

Isocyanate-containing vapours/ mists may cause inflammation of eyes and nasal passages. Onset of symptoms may be immediate or delayed for several hours after exposure. Sensitised people can react to very low levels of airborne isocyanates. Unprotected or sensitised persons should not be allowed to work in situations allowing exposure to this material.

TOXICITY AND IRRITATION

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

TOXICITY

Inhalation (human) TCLO: 20 ppb/2 yr
Inhalation (human) TCLO: 80 ppb
Inhalation (human) TCLO: 500 ppb
Oral (rat) LD50: 5800 mg/kg
Inhalation (rat) LC50: 14 ppm/14 hr
Inhalation (rat) LC50: 600 ppm/6 hr

IRRITATION

Skin (rabbit): 500 mg(open)- SEVERE
Skin (rabbit):500 mg/24hr- Moderate
Eye (rabbit): 100 mg - SEVERE

Contact allergies quickly manifest themselves as contact eczema, more rarely as urticaria or Quincke's oedema. The pathogenesis of contact eczema involves a cell-mediated (T lymphocytes) immune reaction of the delayed type. Other allergic skin reactions, e.g. contact urticaria, involve antibody-mediated immune reactions. The significance of the contact allergen is not simply determined by its sensitisation potential: the distribution of the substance and the opportunities for contact with it are equally important. A weakly sensitising substance which is widely distributed can be a more important allergen than one with stronger sensitising potential with which few individuals come into contact. From a clinical point of view, substances are noteworthy if they produce an allergic test reaction in more than 1% of the persons tested. The material may produce severe irritation to the eye causing pronounced inflammation. Repeated or prolonged exposure to irritants may produce conjunctivitis. The material may produce severe skin irritation after prolonged or repeated exposure, and may produce a contact dermatitis (nonallergic). This form of dermatitis is often characterised by skin redness (erythema) thickening of the epidermis.

Histologically there may be intercellular oedema of the spongy layer (spongiosis) and intracellular oedema of the epidermis. Prolonged contact is unlikely, given the severity of response, but repeated exposures may produce severe ulceration. 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 dyspnea, cough and mucus production. Allergic reactions which develop in the respiratory passages as bronchial asthma or rhinoconjunctivitis, are mostly the result of reactions of the allergen with specific antibodies of the IgE class and belong in their reaction rates to the manifestation of the immediate type. In addition to the allergen-specific potential for causing

TOLUENE-2,4-DIISOCYANATE

Section 11 - TOXICOLOGICAL INFORMATION

respiratory sensitisation, the amount of the allergen, the exposure period and the genetically determined disposition of the exposed person are likely to be decisive. Factors which increase the sensitivity of the mucosa may play a role in predisposing a person to allergy. They may be genetically determined or acquired, for example, during infections or exposure to irritant substances. Immunologically the low molecular weight substances become complete allergens in the organism either by binding to peptides or proteins (haptens) or after metabolism (prohaptens).

Particular attention is drawn to so-called atopic diathesis which is characterised by an increased susceptibility to allergic rhinitis, allergic bronchial asthma and atopic eczema (neurodermatitis) which is associated with increased IgE synthesis.

Exogenous allergic alveolitis is induced essentially by allergen specific immune-complexes of the IgG type; cell-mediated reactions (T lymphocytes) may be involved. Such allergy is of the delayed type with onset up to four hours following exposure.

WARNING: This substance has been classified by the IARC as Group 2B: Possibly Carcinogenic to Humans.

Tenth Annual Report on Carcinogens: Substance anticipated to be Carcinogen [National Toxicology Program: U.S. Dep. of Health & Human Services 2002].

Section 12 - ECOLOGICAL INFORMATION

Hazardous Air Pollutant: Yes

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.

DO NOT discharge into sewer or waterways.

Half-life (hr) air: 3.3

Toxicity Fish: LC50(96)0.0045-57.68mg/L

Toxicity invertebrate: cell mult. inhib.26-456mg/L

Bioaccumulation: low-moderate

Nitrif. inhib.: inhib at 350mg/L

Effects on algae and plankton: cell mult. inhib. algae 105->400mg/L

Degradation Biological: sig

processes Abiotic: nophotol&hydrol,sig oxid,RxnOH*

Section 13 - DISPOSAL CONSIDERATIONS

- DO NOT recycle spilled material.
- Consult State Land Waste Management Authority for disposal.
- Neutralise spill material carefully and decontaminate empty containers and spill residues with 10% ammonia solution plus detergent or a proprietary decontaminant prior to disposal.
- DO NOT seal or stopper drums being decontaminated as CO2 gas is generated and may pressurise containers.
- Puncture containers to prevent re-use.
- Bury or incinerate residues at an approved site.
- 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.

TOLUENE-2,4-DIISOCYANATE

Page 18 of 19

Section 14 - TRANSPORTATION INFORMATION



Labels Required: TOXIC
HAZCHEM: 2XE

UNDG:

Dangerous Goods Class: 6.1
UN Number: 2078
Shipping Name: TOLUENE DIISOCYANATE

Subrisk: None
Packing Group: II

Air Transport IATA:

ICAO/IATA Class: 6.1
UN/ID Number: 2078
Special provisions: A113
Shipping Name: TOLUENE DIISOCYANATE

ICAO/IATA Subrisk: None
Packing Group: II

Maritime Transport IMDG:

IMDG Class: 6.1
UN Number: 2078
EMS Number: F- A, S- A
Shipping Name: TOLUENE DIISOCYANATE

IMDG Subrisk: None
Packing Group: II
Special provisions: 279

Section 15 - REGULATORY INFORMATION

REGULATIONS

toluene-2,4-diisocyanate (CAS: 584-84-9) is found on the following regulatory lists;
International Council of Chemical Associations (ICCA) - High Production Volume List
OECD Representative List of High Production Volume (HPV) Chemicals

Section 16 - OTHER INFORMATION

MSDS SECTION CHANGES

The following table displays the version number of and date on which each section was last changed.

Section Name	Version	Date	Section Name	Version	Date	Section Name	Version	Date
Ingredients	4	3- Nov- 2005	Storage (storage requirement)	5	30- Apr- 2007	Acute Health (eye)	5	30- Apr- 2007
Advice to Doctor	4	3- Nov- 2005	Storage (suitable container)	5	30- Apr- 2007	Acute Health (inhaled)	5	30- Apr- 2007
First Aid (skin)	5	30- Apr- 2007	Engineering Control	5	30- Apr- 2007	Acute Health (skin)	5	30- Apr- 2007
First Aid (swallowed)	5	30- Apr- 2007	Exposure Standard	5	30- Apr- 2007	Acute Health (swallowed)	5	30- Apr- 2007
Fire Fighter (extinguishing media)	5	30- Apr- 2007	Personal Protection (eye)	5	30- Apr- 2007	Chronic Health	5	30- Apr- 2007
Fire Fighter (fire fighting)	5	30- Apr- 2007	Personal Protection (hands/feet)	5	30- Apr- 2007	Toxicity and Irritation (Irritation)	4	3- Nov- 2005
Fire Fighter	5	30- Apr- 2007	Personal	5	30- Apr- 2007	Toxicity and	5	30- Apr- 2007

continued...

TOLUENE-2,4-DIISOCYANATE

Page 19 of 19
Section 16 - OTHER INFORMATION

(fire/explosion hazard)			Protection (other)			Irritation (Other)		
Spills (major)	5	30- Apr- 2007	Appearance	4	3- Nov- 2005	Toxicity and Irritation (Toxicity Figure)	4	3- Nov- 2005
Spills (minor)	5	30- Apr- 2007	Physical Properties	5	30- Apr- 2007	Environmental	5	30- Apr- 2007
Handling Procedure	5	30- Apr- 2007	Instability	4	3- Nov- 2005	Disposal	5	30- Apr- 2007
Storage (storage incompatibility)	5	30- Apr- 2007	Condition					

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.

Issue Date: 30-Apr-2018