SECTION 1 IDENTIFICATION OF THE SUBSTANCE / MIXTURE AND OF THE COMPANY / UNDERTAKING

**Product Identifier**

<table>
<thead>
<tr>
<th>Product name</th>
<th>WANNATE® HDI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chemical Name</td>
<td>hexamethylene diisocyanate</td>
</tr>
<tr>
<td>Chemical English Name</td>
<td>hexamethylene diisocyanate</td>
</tr>
<tr>
<td>Synonyms</td>
<td>HEXAMETHYLENE DIISOCYANATE</td>
</tr>
<tr>
<td>Proper shipping name</td>
<td>HEXAMETHYLENE DIISOCYANATE</td>
</tr>
<tr>
<td>Other means of identification</td>
<td>Not Available</td>
</tr>
</tbody>
</table>

**Relevant identified uses of the substance or mixture and uses advised against**

Relevant identified uses: Binding agents, intermediates; isocyanate component for polyurethanes. The highly reactive diisocyanates are important materials used in production of PUR products. Their reaction with various polyols and auxiliary materials is utilized to obtain miscellaneous material structures like foams, coatings or adhesives.

**Details of the supplier of the safety data sheet**

- **Registered company name**: WANHUA CHEMICAL GROUP Co., LTD.
- **Address**: No.17 Tianshan Road, Yantai, Shandong.
- **Telephone**: 0535-3031150
- **Fax**: 0535-358222-1150
- **Website**: https://www.whchem.com
- **Email**: whsds@whchem.com

**Emergency telephone number**

- **Association / Organisation**: Not Available
- **Emergency telephone numbers**: +86 532-8389090
- **Other emergency telephone numbers**: +86 535-8203123

SECTION 2 HAZARDS IDENTIFICATION

**Classification of the substance or mixture**

<table>
<thead>
<tr>
<th>SUMMARY OF HAZARD IN AN EMERGENCY SITUATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Liquid Combustible.</td>
</tr>
<tr>
<td>Toxic by inhalation.</td>
</tr>
<tr>
<td>Irritating to eyes.</td>
</tr>
<tr>
<td>Irritating to respiratory system.</td>
</tr>
<tr>
<td>Irritating to skin.</td>
</tr>
<tr>
<td>May cause SENSITISATION by inhalation.</td>
</tr>
<tr>
<td>May cause SENSITISATION by skin contact.</td>
</tr>
</tbody>
</table>

| Classification [1] | Skin Corrosion/Irritation Category 2, Skin Sensitizer Category 1, Eye Irritation Category 2, Respiratory Sensitizer Category 1, Acute Toxicity (Inhalation) Category 3, Specific target organ toxicity - single exposure Category 3 (respiratory tract irritation) |

<table>
<thead>
<tr>
<th>Legend:</th>
</tr>
</thead>
</table>

**Label elements**

Hazard pictogram(s)
Hazard statement(s)

<table>
<thead>
<tr>
<th>Hazard Statement</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>H315</td>
<td>Causes skin irritation.</td>
</tr>
<tr>
<td>H317</td>
<td>May cause an allergic skin reaction.</td>
</tr>
<tr>
<td>H319</td>
<td>Causes serious eye irritation.</td>
</tr>
<tr>
<td>H331</td>
<td>Toxic if inhaled.</td>
</tr>
<tr>
<td>H334</td>
<td>May cause allergy or asthma symptoms or breathing difficulties if inhaled.</td>
</tr>
<tr>
<td>H335</td>
<td>Toxic if inhaled.</td>
</tr>
<tr>
<td>H336</td>
<td>May cause respiratory irritation.</td>
</tr>
</tbody>
</table>

Precautionary statement(s) Prevention

<table>
<thead>
<tr>
<th>Precautionary Statement</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>P261</td>
<td>Avoid breathing mist/vapours/spray.</td>
</tr>
<tr>
<td>P272</td>
<td>Contaminated work clothing should not be allowed out of the workplace.</td>
</tr>
<tr>
<td>P280</td>
<td>Wear protective gloves/protective clothing/eye protection/face protection.</td>
</tr>
<tr>
<td>P281</td>
<td>Use only outdoors or in a well-ventilated area.</td>
</tr>
<tr>
<td>P284</td>
<td>If in case of inadequate ventilation wear respiratory protection.</td>
</tr>
<tr>
<td>P302+P352</td>
<td>Store in a well-ventilated place. Keep container tightly closed.</td>
</tr>
<tr>
<td>P337+P313</td>
<td>Take off contaminated clothing and wash it before reuse.</td>
</tr>
<tr>
<td>P333+P313</td>
<td>If skin irritation or rash occurs: Get medical advice/attention.</td>
</tr>
<tr>
<td>P362+P364</td>
<td>If eye irritation persists: Get medical advice/attention.</td>
</tr>
<tr>
<td>P362+P313</td>
<td>If experiencing respiratory symptoms: Call a POISON CENTER/doctor/physician/first aider.</td>
</tr>
</tbody>
</table>

Precautionary statement(s) Response

<table>
<thead>
<tr>
<th>Precautionary Statement</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>P304+P340</td>
<td>IF INHALED: Remove person to fresh air and keep comfortable for breathing.</td>
</tr>
<tr>
<td>P342+P311</td>
<td>IF experiencing respiratory symptoms: Call a POISON CENTER/doctor/physician/first aider.</td>
</tr>
<tr>
<td>P302+P352</td>
<td>IF ON SKIN: Wash with plenty of water and soap.</td>
</tr>
<tr>
<td>P305+P351+P328</td>
<td>IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing.</td>
</tr>
<tr>
<td>P333+P313</td>
<td>If skin irritation or rash occurs: Get medical advice/attention.</td>
</tr>
<tr>
<td>P337+P313</td>
<td>If eye irritation persists: Get medical advice/attention.</td>
</tr>
</tbody>
</table>

Precautionary statement(s) Storage

<table>
<thead>
<tr>
<th>Precautionary Statement</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>P402+P233</td>
<td>Store in a well-ventilated place. Keep container tightly closed.</td>
</tr>
<tr>
<td>P405</td>
<td>Store locked up.</td>
</tr>
</tbody>
</table>

Precautionary statement(s) Disposal

<table>
<thead>
<tr>
<th>Precautionary Statement</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>P501</td>
<td>Dispose of contents/container in accordance with local regulations.</td>
</tr>
</tbody>
</table>

Physical and Chemical Hazard

In case of fire and/or explosion, DO NOT BREATHE FUMES.

Health Hazards

Inhaled

Evidence exists, or practical experience predicts, that the material produces irritation of the respiratory system to 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.

Ingestion

The material is not thought to produce adverse health effects following ingestion (as classified by EC Directives using animal models). Nevertheless, adverse systemic effects have been produced following exposure of animals by at least one other route and good hygiene practice requires that exposure be kept to a minimum.

Skin Contact

Evidence exists, or practical experience predicts, that the material either produces inflammation of the skin in a substantial number of individuals following direct contact, and/or produces significant 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. The material may accentuate any pre-existing dermatitis condition.

Open cuts, abraded or irritated skin should not be exposed to this material.

Entry into the blood-stream through, for example, cuts, abrasions, puncture wounds 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.

Eye

Evidence exists, or practical experience predicts, that the material may cause 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.

Repeated or prolonged eye contact may cause inflammation characterised by temporary redness (similar to windburn) of the conjunctiva (conjunctivitis); temporary impairment of vision and/or other transient eye damage/irritation may occur.

Chronic

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 factors.
immediately give a glass of water.

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. 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.

Environmental Hazards
See Section 12

Other hazards
Ingestion may produce serious health damage*. Ingestion may produce serious health damage*. 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.

SECTION 3 COMPOSITION / INFORMATION ON INGREDIENTS

Substances
See section below for composition of mixtures

Mixtures

<table>
<thead>
<tr>
<th>CAS No</th>
<th>% [weight]</th>
<th>Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>822-06-0</td>
<td>≥99.5</td>
<td>hexamethylene diisocyanate</td>
</tr>
</tbody>
</table>

SECTION 4 FIRST AID MEASURES

Description of first aid measures

Eye Contact
If this product comes in contact with the eyes:
- Immediately hold eyelids apart and flush the eye continuously with 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.
- 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 Contact
If skin contact occurs:
- Immediately remove all contaminated clothing, including footwear.
- Wash skin and hair with running water (and soap if available).
- Seek medical attention in event of irritation.

Inhalation
If fumes or combustion products are inhaled remove from contaminated area.
- Lay patient down. Keep warm and rested.
- Posttachy 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.
- Following uptake by inhalation, move person to an area free from risk of further exposure. Oxygen or artificial respiration should be administered as needed. Asthmatic-type symptoms may develop and may be immediate or delayed up to several hours. Treatment is essentially symptomatic. A physician should be consulted.

Ingestion
- Immediately give a glass of water.
- First aid is generally not required. If in doubt, contact a Poisons Information Centre or a doctor.

Advise for rescue team (PPE requirement for rescue personnel)

Indication of any immediate medical attention and special treatment needed

For sub-chronic and chronic exposures to isocyanates:
- This 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 oedema 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]

Personnel who work with isocyanates, isocyanate prepolymers or polyisocyanates should have a pre-placement medical examination and periodic examinations thereafter, including a pulmonary

Continued...
function test. Anyone with a medical history of chronic respiratory disease, asthmatic or bronchial attacks, indications of allergic responses, recurrent eczema or sensitisation conditions of the skin should not handle or work with isocyanates. Anyone who develops chronic respiratory distress when working with isocyanates should be removed from exposure and examined by a physician. Further exposure must be avoided if a sensitivity to isocyanates or polyisocyanates has developed.

SECTION 5 FIREFIGHTING MEASURES

Extinguishing media

- 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.
- Water spray or fog may cause frothing and should be used in large quantities.
- Foam.
- Dry chemical powder.
- BCF (where regulations permit).
- Carbon dioxide.
- Water spray or fog - Large fires only.

Special hazards arising from the substrate or mixture

<table>
<thead>
<tr>
<th>Fire Incompatibility</th>
</tr>
</thead>
<tbody>
<tr>
<td>Avoid contamination with oxidising agents i.e. nitrates, oxidising acids, chlorine bleaches, pool chlorine etc. as ignition may result</td>
</tr>
</tbody>
</table>

Advice for firefighters

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

<table>
<thead>
<tr>
<th>Fire/Explosion Hazard</th>
</tr>
</thead>
<tbody>
<tr>
<td>Combustible.</td>
</tr>
<tr>
<td>Moderate fire hazard when exposed to heat or flame.</td>
</tr>
<tr>
<td>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.</td>
</tr>
<tr>
<td>Burns with acid black smoke and poisonous fumes.</td>
</tr>
<tr>
<td>Combustion yields traces of highly toxic hydrogen cyanide HCN, plus toxic nitrogen oxides NOx and carbon monoxide.</td>
</tr>
</tbody>
</table>

Combustion products include:
- carbon dioxide (CO2)
- hydrogen cyanide
- isocyanates
- and minor amounts of nitrogen oxides (NOx)
- other pyrolysis products typical of burning organic material.

When heated at high temperatures many isocyanates decompose rapidly generating a vapour which pressures containers, possibly to the point of rupture. Release of toxic and/or flammable isocyanate vapours may then occur.

SECTION 6 ACCIDENTAL RELEASE MEASURES

Personal precautions, protective equipment and emergency procedures

See section 8

Measures for Preventing Secondary Contamination

Refer to section above

Environmental precautions

See section 12

Methods and material for containment and cleaning up

<table>
<thead>
<tr>
<th>Minor Spills</th>
</tr>
</thead>
<tbody>
<tr>
<td>Remove all ignition sources.</td>
</tr>
<tr>
<td>Clean up all spills immediately.</td>
</tr>
<tr>
<td>Avoid breathing vapours and contact with skin and eyes.</td>
</tr>
<tr>
<td>Control personal contact with the substance, by using protective equipment.</td>
</tr>
<tr>
<td>Contain and absorb spill with sand, earth, inert material or vermiculite.</td>
</tr>
<tr>
<td>Wipe up.</td>
</tr>
<tr>
<td>Place in a suitable, labelled container for waste disposal.</td>
</tr>
</tbody>
</table>

<p>| Chemical Class: cyanates and isocyanates For release onto land: recommended sorbents listed in order of priority. |</p>
<table>
<thead>
<tr>
<th>SORBENT TYPE</th>
<th>RANK</th>
<th>APPLICATION</th>
<th>COLLECTION</th>
<th>LIMITATIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>LAND SPILL - SMALL</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>cross-linked polymer - particulate</td>
<td>1</td>
<td>shovel</td>
<td>shovel</td>
<td>R, W, SS</td>
</tr>
<tr>
<td>wood fiber - particulate</td>
<td>1</td>
<td>throw</td>
<td>pitchfork</td>
<td>R, P, DGC, RT</td>
</tr>
<tr>
<td>cross-linked polymer - pillow</td>
<td>1</td>
<td>throw</td>
<td>pitchfork</td>
<td>R, DGC, RT</td>
</tr>
<tr>
<td>sorbent clay - particulate</td>
<td>2</td>
<td>shovel</td>
<td>shovel</td>
<td>R, I, P</td>
</tr>
</tbody>
</table>

Continued...
**LAND SPILL - MEDIUM**

<table>
<thead>
<tr>
<th>Material</th>
<th>Quantity</th>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>cross-linked polymer - particulate</td>
<td>1</td>
<td>blower</td>
<td>skiploader</td>
</tr>
<tr>
<td>cross-linked polymer - pillow</td>
<td>1</td>
<td>throw</td>
<td>skiploader</td>
</tr>
<tr>
<td>polypropylene - particulate</td>
<td>2</td>
<td>blow</td>
<td>skiploader</td>
</tr>
<tr>
<td>expanded mineral - particulate</td>
<td>3</td>
<td>blow</td>
<td>skiploader</td>
</tr>
<tr>
<td>wood fiber - particulate</td>
<td>3</td>
<td>blow</td>
<td>skiploader</td>
</tr>
<tr>
<td>polypropylene - mat</td>
<td>3</td>
<td>throw</td>
<td>skiploader</td>
</tr>
</tbody>
</table>

**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

- Liquid isocyanates and high isocyanate vapour concentrations will penetrate seals on self contained breathing apparatus - SCBA should be used inside encapsulating suit where this exposure may occur.
- Evacuate area from everybody not dealing with the emergency, keep them upwind and prevent further access, remove ignition sources and, if inside building, ventilate area as well as possible.
- Notify supervision and others as necessary.
- Put on personal protective equipment (suitable respiratory protection, face and eye protection, protective suit, gloves and impermeable boots).
- Control source of leakage (where applicable).
- Dive the spill to prevent spreading and to contain additions of decontaminating solution.
- Prevent the material from entering drains.
- Estimate spill pool volume or area.
- Absorb and decontaminate. - Completely cover the spill with wet sand, wet earth, vermiculite or other similar absorbent. - Add neutraliser (for suitable formulations: see below) to the absorbent materials (equal to that of estimated spill pool volume). Intensify contact between spill, absorbent and neutraliser by carefully mixing with a rake and allow to react for 15 minutes.
- Shovel absorbent/decontaminant solution mixture into a steel drum.
- Decontaminate surface. - Pour an equal amount of neutraliser solution over contaminated surface. - Scrub area with a stiff bristle brush, using moderate pressure. - Completely cover decontaminant with vermiculite or other similar absorbent. - After 5 minutes, shovel absorbent/decontaminant solution mixture into the same steel drum used above.
- Monitor for residual isocyanate. If surface is decontaminated, proceed to next step. If contamination persists, repeat decontamination procedure immediately above.
- Place loosely covered drum (release of carbon dioxide) outside for at least 72 hours. Label waste-containing drum appropriately. Remove waste materials for incineration.
- Decontaminate and remove personal protective equipment.
- Return to normal operation.
- Conduct accident investigation and consider measures to prevent reoccurrence.

**Decontamination:**

Treat isocyanate spills with sufficient amounts of isocyanate decontaminant preparation (“neutralising fluid”). Isocyanates and polyisocyanates are generally not miscible with water. Liquid surfactants are necessary to allow better dispersion of isocyanate and neutralising fluids/ preparations. Alkaline neutralisers react faster than water/surfactant mixtures alone.

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.
- Three commonly used neutralising fluids each exhibit advantages in different situations.

**Formulation A:**

<table>
<thead>
<tr>
<th>Component</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>liquid surfactant</td>
<td>0.2-2%</td>
</tr>
<tr>
<td>sodium carbonate</td>
<td>5-10%</td>
</tr>
<tr>
<td>water</td>
<td>100%</td>
</tr>
</tbody>
</table>

**Formulation B:**

<table>
<thead>
<tr>
<th>Component</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>liquid surfactant</td>
<td>0.2-2%</td>
</tr>
<tr>
<td>concentrated ammonia</td>
<td>3-6%</td>
</tr>
<tr>
<td>water</td>
<td>100%</td>
</tr>
</tbody>
</table>

**Formulation C:**

<table>
<thead>
<tr>
<th>Component</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>ethanol, isopropanol or butanol</td>
<td>50%</td>
</tr>
<tr>
<td>concentrated ammonia</td>
<td>5%</td>
</tr>
<tr>
<td>water</td>
<td>100%</td>
</tr>
</tbody>
</table>

After application of any of these formulae, let stand for 24 hours.

Formulation B reacts faster than Formulation A. However, ammonia-based neutralisers should be used only under well-ventilated conditions to avoid overexposure to ammonia or if members of the emergency team wear suitable respiratory protection. Formulation C is especially suitable for cleaning of equipment from unreacted isocyanate and neutralising under freezing conditions. Regard has to be taken to the flammability of the alcoholic solution.

- Avoid contamination with water, alkalies and detergent solutions.
- Material reacts with water and generates gas, pressureises containers with even drum rupture resulting.
- **DO NOT** reseal container if contamination is suspected.
- Open all containers with care.
- **DO NOT** touch the spill material.

Personal Protective Equipment advice is contained in Section 8 of the SDS.
Precautions for safe handling

- 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 come into contact with 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 storage and handling recommendations contained within this SDS.
- Atmosphere should be regularly checked against established exposure standards to ensure safe working conditions are maintained.
- **DO NOT** allow clothing wet with material to stay in contact with skin.

Other information

For commercial quantities of isocyanates:
- Isocyanates should be stored in adequately bunded areas. Nothing else should be kept within the same bunding. Pre-polymer need not be segregated.
- Drums of isocyanates should be stored under cover, out of direct sunlight, protected from rain, protected from physical damage and well away from moisture, acids and alkalis.
- Where isocyanates are stored at elevated temperatures to prevent solidifying, adequate controls should be installed to prevent the high temperatures and precautions against fire should be taken.
- Where stored in tanks, the more reactive isocyanates should be blanketed with a non-reactive gas such as nitrogen and equipped with absorptive type breather valve (to prevent vapour escape).
- Transfer systems for isocyanates in bulk storage should be fully enclosed and use pump or vacuum systems. Warning signs, in appropriate languages, should be posted where necessary.
- Areas in which polyurethane foam products are stored should be supplied with good general ventilation. Residual amounts of unreacted isocyanate may be present in the finished foam, resulting in hazardous atmospheric concentrations.
- Store in original containers.
- Keep containers securely sealed.
- Store in a cool, dry, well-ventilated area.
- Store away from incompatible materials and foodstuffs containers.
- Protect containers against physical damage and check regularly for leaks.
- Observe manufacturer's storage and handling recommendations contained within this SDS.

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

- Avoid cross contamination between the two liquid parts of product (kit).
- If two part products are mixed or allowed to mix in proportions other than manufacturer's recommendation, polymerisation with gelation and evolution of heat (exotherm) may occur.
- This excess heat may generate toxic vapours.
- Avoid reaction with water, alcohols and detergent solutions.
- Isocyanates and thiisocyanates are incompatible with many classes of compounds, reacting exothermically to release toxic gases. Reactions with amines, strong bases, aldehydes, alcohols, alkali metals, ketones, mercaptans, strong oxidisers, hydrides, phenols, and peroxides can cause vigorous releases of heat. Acids and bases initiate polymerisation reactions in these materials.
- Isocyanates easily form adducts with carbodiimides, isocyanurates, ketenes, or with substrates containing activated CC or CN bonds.
- Some isocyanates react with water to form amines and halogenated carbon dioxide. This reaction may also generate large volumes of foam and heat. Foaming in confined spaces may produce pressure in confined spaces or containers. Gas generation may pressurise drums to the point of rupture.
- **DO NOT reseal container if contamination is expected**
- Open all containers with care.
- Base-catalysed reactions of isocyanates with alcohols should be carried out in inert solvents. Such reactions in the absence of solvents often occur with explosive violence.
- Isocyanates will attack and embrittle some plastics and rubbers.
- 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
SECTION 8 EXPOSURE CONTROLS / PERSONAL PROTECTION

Control parameters

### OCCUPATIONAL EXPOSURE LIMITS (OEL)

<table>
<thead>
<tr>
<th>Source</th>
<th>Ingredient</th>
<th>Material name</th>
<th>TWA</th>
<th>STEL</th>
<th>Peak</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>China Occupational Exposure Limits for Hazardous Agents in the Workplace</td>
<td>hexamethylene diisocyanate</td>
<td>Hexamethylene diisocyanate</td>
<td>0.03 mg/m³</td>
<td>Not Available</td>
<td>Not Available</td>
<td>Not Available</td>
</tr>
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</table>

#### EMERGENCY LIMITS

<table>
<thead>
<tr>
<th>Ingredient</th>
<th>Material name</th>
</tr>
</thead>
<tbody>
<tr>
<td>hexamethylene diisocyanate</td>
<td>Hexamethylene diisocyanate; (1,6-Diisocyanatohexane)</td>
</tr>
<tr>
<td></td>
<td>0.018 ppm</td>
</tr>
<tr>
<td></td>
<td>0.2 ppm</td>
</tr>
<tr>
<td></td>
<td>3 ppm</td>
</tr>
</tbody>
</table>

### MATERIAL DATA

For 1,6-hexamethylene diisocyanate (HDI):
The toxicological action of HDI is similar to that of toluene diisocyanate and and the TLV-TWA is analogous. In light of reported asthmatic/ respiratory sensitisation like responses in HDI exposed workers, individuals who may be hypersusceptible or otherwise unusually responsive may not be adequately protected at this limit.

Exposure controls

Engineering controls are used to remove a hazard or place a barrier between the worker and the hazard. Well-designed engineering controls can be highly effective in protecting workers and will typically be independent of worker interactions to provide this high level of protection.

The basic types of engineering controls are:

- Process controls which involve changing the way a job activity or process is done to reduce the risk.
- Enclosure and/or isolation of emission source which keeps a selected hazard “physically” away from the worker and ventilation that strategically “adds” and “removes” air in the work environment. Ventilation can remove or dilute an air contaminant if designed properly. The design of a ventilation system must match the particular process and chemical or contaminant in use.
- Effective in protecting workers and will typically be independent of worker interactions to provide this high level of protection.

Enclosure and/or isolation of emission source which keeps a selected hazard “physically” away from the worker and ventilation that strategically “adds” and “removes” air in the work environment. Ventilation can remove or dilute an air contaminant if designed properly. The design of a ventilation system must match the particular process and chemical or contaminant in use.

Employees may need to use multiple types of controls to prevent employee overexposure.

- Spraying of material or material in admixture with other components must be carried out in conditions conforming to local state regulations (AS/NZS 4114, UNI EN 12215:2010, ANSI/AIHA Z9.3-2007 or national equivalent).
- Local exhaust ventilation with full face positive-pressure air supplied breathing apparatus (hood or helmet type) is required.
- Spraying should be performed in a spray booth fitted with an effective exhaust system which complies with local environmental legislation.
- The spray booth area must be isolated from unprotected personnel whilst spraying is in progress and until all spraying mist has cleared.

**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.

**Appropriate engineering controls**

- Direct spray, spray painting in shallow booths, drum filling, conveyor loading, crusher dusts, gas discharge (active generation into zone of rapid air motion) 1-2.5 m/s (200-500 f/min.)

Within each range the appropriate value depends on:

<table>
<thead>
<tr>
<th>Type of Contaminant</th>
<th>Air Speed:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Room air currents minimal or favourable to capture</td>
<td>1.25 m/s (200-500 f/min.)</td>
</tr>
<tr>
<td>Disturbing room air currents</td>
<td></td>
</tr>
</tbody>
</table>

**Personal protection**

- 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 lenses or restrictions on use, should be created for each workplace or task. This should include a review of lens absorption and adhesion 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. Lenses 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), (AS/NZS 1336 or national equivalent)

**Eye and face protection**

See Hand protection below

**Hands/feet protection**

- Contaminated leather items, such as shoes, belts and watch-bands should be removed and destroyed.

**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.

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Continued...
The selection of suitable gloves does not only depend on the material, but also on further marks of quality which vary from manufacturer to manufacturer. Where the chemical is a preparation of several substances, the resistance of the glove material can not be calculated in advance and has therefore to be checked prior to the application. The exact break through time for substances has to be obtained from the manufacturer of the protective gloves and has to be observed when making a final choice. Personal hygiene is a key element of effective hand care. Gloves must only be worn on clean hands. After using gloves, hands should be washed and dried thoroughly. Application of a non-perfumed moisturizer is recommended

Suitability and durability of glove type is dependent on usage. Important factors in the selection of gloves include:
- 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, AS/NZS 2161.1 or national equivalent).
- 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, AS/NZS 2161.10.1 or national equivalent) 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, AS/NZS 2161.10.1 or national equivalent) is recommended.
- Some glove polymer types are less affected by movement and this should be taken into account when considering gloves for long-term use.

For general applications, gloves with a thickness typically greater than 0.35 mm, are recommended. It should be emphasised that glove thickness is not necessarily a good predictor of glove resistance to a specific chemical, as the permeation efficiency of the glove will be dependent on the exact composition of the glove material. Therefore, glove selection should also be based on consideration of the task requirements and knowledge of breakthrough times.

Glove thickness may also vary depending on the glove manufacturer, the glove type and the glove model. Therefore, the manufacturers’ technical data should always be taken into account to ensure selection of the most appropriate glove for the task.

Note: Depending on the activity being conducted, gloves of varying thickness may be required for specific tasks. For example:
- Thinner gloves (down to 0.1 mm or less) may be required where a high degree of manual dexterity is needed. However, these gloves are only likely to give short duration protection and would normally be just for single use applications, then disposed of.
- Thicker gloves (up to 3 mm or more) may be required where there is a mechanical (as well as a chemical) risk i.e. where there is abrasion or puncture potential

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

Isocyanate resistant materials include Teflon, Viton, nitrite rubber and some PVA gloves.
- Protective gloves and overalls should be worn as specified in the appropriate national standard.
- Contaminated garments should be removed promptly and should not be re-used until they have been decontaminated.

NOTE: Natural rubber, neoprene, PVC can be affected by isocyanates

Body protection
See Other protection below

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

Thermal hazards
Not Available

Recommended material(s)

GLOVE SELECTION INDEX
Glove selection is based on a modified presentation of the: "Forsberg Clothing Performance Index".
The effect(s) of the following substance(s) are taken into account in the computer-generated selection:
WANNATE® HDI

<table>
<thead>
<tr>
<th>Material</th>
<th>CPI</th>
</tr>
</thead>
<tbody>
<tr>
<td>SARANEX-23</td>
<td>A</td>
</tr>
</tbody>
</table>

* CPI: Chemwatch Performance Index
A: Best Selection
B: Satisfactory; may degrade after 4 hours continuous immersion
C: Poor to Dangerous Choice for other than short term immersion

NOTE: As a series of factors will influence the actual performance of the glove, a final selection must be based on detailed observation.

* Where the glove is to be used on a short term, casual or infrequent basis, factors such as "feel" or convenience (e.g. disposability), may dictate a choice of gloves which might otherwise be unsuitable following long-term or frequent use. A qualified practitioner should be consulted.

Respiratory protection
Cartridge respirators should never be used for emergency ingress or in areas of unknown vapour concentrations or oxygen content. The wearer must be warned to leave the contaminated area immediately on detecting any odours through the respirator. The odour may indicate that the mask is not functioning properly, that the vapour concentration is too high, or that the mask is not properly fitted. Because of these limitations, only restricted use of cartridge respirators is considered appropriate.
- In certain circumstances, personal protection of the individual employee is necessary. Personal protective devices should be regarded as being supplementary to substitution and engineering control and should not be used in preference to them as they do nothing to eliminate the hazard.
- However, in some situations, minimising exposure to isocyanates by enclosure and ventilation is not possible, and occupational exposure standards may be exceeded, particularly during on-site mixing of paints, spray-painting, foaming and maintenance of machine and ventilation systems. In these situations, air-line respirators or self-contained breathing apparatus complying with the appropriate national standard must be used.
- Organic vapour respirators with particulate pre-filters and powered, air-purifying respirators are NOT suitable.
- Personal protective equipment must be appropriately selected, individually fitted and workers trained in their correct use and maintenance. Personal protective equipment must be regularly checked and maintained to ensure that the worker is being protected.
- Air-line respirators or self-contained breathing apparatus complying with the appropriate national standard should be used during the clean-up of spills and the repair or clean-up of contaminated equipment and similar situations which cause emergency exposures to hazardous atmospheric concentrations of isocyanate.

SECTION 9 PHYSICAL AND CHEMICAL PROPERTIES

Information on basic physical and chemical properties

<table>
<thead>
<tr>
<th>Appearance</th>
<th>Colorless clear liquid</th>
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</thead>
<tbody>
<tr>
<td>Physical state</td>
<td>Liquid</td>
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<tr>
<td>Odour</td>
<td>Pungent smell</td>
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<td>Odour threshold</td>
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<tr>
<td>Relative density</td>
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</tr>
<tr>
<td>Partition coefficient</td>
<td>n-octanol / water</td>
</tr>
<tr>
<td>Auto-ignition temperature °C</td>
<td>454</td>
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</table>

Continued...
## SECTION 10 STABILITY AND REACTIVITY

<table>
<thead>
<tr>
<th>Reactivity</th>
<th>See section 7</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chemical stability</td>
<td></td>
</tr>
<tr>
<td>◦ Presence of heat source and ignition source</td>
<td></td>
</tr>
<tr>
<td>◦ Unstable in the presence of incompatible materials.</td>
<td></td>
</tr>
<tr>
<td>◦ Product is considered stable.</td>
<td></td>
</tr>
<tr>
<td>◦ Hazardous polymerisation will not occur.</td>
<td></td>
</tr>
<tr>
<td>Possibility of hazardous reactions</td>
<td>See section 7</td>
</tr>
<tr>
<td>Conditions to avoid</td>
<td>See section 7</td>
</tr>
<tr>
<td>Incompatible materials</td>
<td>See section 7</td>
</tr>
<tr>
<td>Hazardous decomposition products</td>
<td>See section 5</td>
</tr>
</tbody>
</table>

## SECTION 11 TOXICOLOGICAL INFORMATION

<table>
<thead>
<tr>
<th><strong>WANNATE® HDI</strong></th>
<th><strong>TOXICITY</strong></th>
<th><strong>IRRITATION</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Not Available</td>
<td>Not Available</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>hexamethylene disocyanate</strong></th>
<th><strong>TOXICITY</strong></th>
<th><strong>IRRITATION</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Dermal (rabbit) LD50: 570 mg/kg[^1]</td>
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</tr>
<tr>
<td></td>
<td>Inhalation (rat) LC50: 6.5 mg/L[^2]</td>
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</tr>
<tr>
<td></td>
<td>Oral (rat) LD50: 738 mg/kg[^2]</td>
<td>Not Available</td>
</tr>
</tbody>
</table>

**Legend:**
1. Value obtained from Europe ECHA Registered Substances - Acute toxicity 2.
2. Value obtained from manufacturer’s SDS. Unless otherwise specified data extracted from RTECS - Register of Toxic Effect of chemical Substances

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**HEXAMETHYLENE DISOCYANATE**

The following information refers to contact allergens as a group and may not be specific to this product. 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.

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 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.

Exposures to HDI are often associated with exposures to its prepolymers, especially to a trimeric biuretic prepolymer of HDI (HDI-BT), which is widely used as
a hardener in automobile and airplane paints, and which typically contains 0.5-1% unreacted HDI. There is evidence that diisocyanate prepolymers may induce asthma at the same or greater frequency as the monomers; therefore, there is a need to assess the potential for human exposure to prepolymeric HDI as well as monomeric HDI.

1.6-Hexamethylene diisocyanate is corrosive to the skin and the eye. 1.6-Hexamethylene diisocyanate was found to induce dermal and respiratory sensitization in animals and humans. There is no threshold known for this effect. Inhalation studies with repeated exposures to 1,6-hexamethylene diisocyanate vapor show that the respiratory tract is the target with 1,6-hexamethylene diisocyanate showing primarily upper respiratory tract lesions (nasal cavity). 1,6-Hexamethylene diisocyanate did not show a neurotoxic effect in a combined reproduction/developmental/neurotoxicity study. Life-time inhalation exposure to rats revealed a progression of non-necrotic respiratory tract lesions, primarily to the nasal cavity, and represented the sequelae of non-specific irritation. Based on the presence of only reversible tissue responses to irritation at the low concentration of 0.005 ppm, this concentration was a NOAEL. No carcinogenic potential in rats was observed after life-time inhalation.

1.6-Hexamethylene diisocyanate showed no mutagenic activity in vivo in bacterial and in mammalian cell tests systems. 1.6-Hexamethylene diisocyanate has no effect on fertility and post-natal viability through post-natal day 4 in the rat after inhalation up to 0.299 ppm. The overall NOEL was 0.005 ppm.

Inhalation of 1,6-hexamethylene diisocyanate during the pregnancy of rats produced maternal effects (nasal turbinate histopathology) at concentrations ≥ 0.052 ppm. No developmental toxicity was observed up to 0.006 ppm. 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 symptoms 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.

If 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

<table>
<thead>
<tr>
<th>ENDPOINT</th>
<th>TEST DURATION (HR)</th>
<th>SPECIES</th>
<th>VALUE</th>
<th>SOURCE</th>
</tr>
</thead>
<tbody>
<tr>
<td>LC50</td>
<td>96</td>
<td>Fish</td>
<td>22mg/L</td>
<td>1</td>
</tr>
<tr>
<td>EC50</td>
<td>72</td>
<td>Algae or other aquatic plants</td>
<td>&gt;77.4mg/L</td>
<td>2</td>
</tr>
<tr>
<td>ECO</td>
<td>24</td>
<td>Crustacea</td>
<td>&lt;0.33mg/L</td>
<td>1</td>
</tr>
<tr>
<td>NOEC</td>
<td>72</td>
<td>Algae or other aquatic plants</td>
<td>11.7mg/L</td>
<td>2</td>
</tr>
</tbody>
</table>

Legend:
- Data available but does not fill the criteria for classification
- Data available to make classification
- Data Not Available to make classification

Hydrolysis would represent the primary fate mechanism for the majority of the commercial isocyanate monomers, but is tempered somewhat by the lack of water solubility. In the absence of hydrolysis, sorption to solids (e.g., sludge and sediments) will be the primary mechanism of removal. Biodegradation is minimal for most compounds and volatilisation is negligible. Atmospheric degradation is not expected with removal from air occurring by washout or dry deposition. Volatilisation from surface waters (e.g., lakes and rivers) is expected to take years. In wastewater treatment this process is not expected to be significant.

Review of the estimated properties of the isocyanates suggest that sorption is the primary removal mechanism in the ambient environment and in wastewater treatment in the absence of significant hydrolysis. Sorption to solids in wastewater treatment is considered strong to very strong for most compounds. Sorption to sediments and soils in the ambient environment is very strong in most instances. Migration to groundwater and surface waters is not expected due to sorption or hydrolysis. Hydrolysis of the N=C=O will occur in less than hours in most instances and within minutes for more than 90% of the commercial isocyanates. However, the low to very low solubility of these substances will generally lessen the effectiveness of hydrolysis as a fate pathway. But hydrolysis should be considered one of the two major fate processes for the isocyanates.

Aerobic and/or anaerobic biodegradation of the isocyanates is not expected to occur at significant levels. Most of the substances take several months to degrade. Degradation of the hydrolysis products will occur at varying rates depending on the moiety formed.

### Carcinogenicity

- Data available but does not fill the criteria for classification
- Data available to make classification
- Data Not Available to make classification

Hydrolysis of 1,6-hexamethylene diisocyanate would occur in less than hours in most instances and within minutes for more than 90% of the commercial isocyanates. However, the low to very low solubility of these substances will generally lessen the effectiveness of hydrolysis as a fate pathway. But hydrolysis should be considered one of the two major fate processes for the isocyanates. Aerobic and/or anaerobic biodegradation of the isocyanates is not expected to occur at significant levels. Most of the substances take several months to degrade.

Degradation of the hydrolysis products will occur at varying rates depending on the moiety formed.

### Reproductivity

- Data available but does not fill the criteria for classification
- Data available to make classification
- Data Not Available to make classification

Hydrolysis of 1,6-hexamethylene diisocyanate would occur in less than hours in most instances and within minutes for more than 90% of the commercial isocyanates. However, the low to very low solubility of these substances will generally lessen the effectiveness of hydrolysis as a fate pathway. But hydrolysis should be considered one of the two major fate processes for the isocyanates. Aerobic and/or anaerobic biodegradation of the isocyanates is not expected to occur at significant levels. Most of the substances take several months to degrade.

Degradation of the hydrolysis products will occur at varying rates depending on the moiety formed.

### Aspiration Hazard

- Data available but does not fill the criteria for classification
- Data available to make classification
- Data Not Available to make classification

Hydrolysis of 1,6-hexamethylene diisocyanate would occur in less than hours in most instances and within minutes for more than 90% of the commercial isocyanates. However, the low to very low solubility of these substances will generally lessen the effectiveness of hydrolysis as a fate pathway. But hydrolysis should be considered one of the two major fate processes for the isocyanates. Aerobic and/or anaerobic biodegradation of the isocyanates is not expected to occur at significant levels. Most of the substances take several months to degrade.

Degradation of the hydrolysis products will occur at varying rates depending on the moiety formed.
Hydrolysation of HDI was 90% after a reaction period of 30 min in water at 20°C. Hydrolysis products are principally HDA and polyurea. Biodegradation tests on hexamethylene diamine (HAD) show the substance to be inherently biodegradable. Polyureas are more or less inert and, because of their molecular size, not bioavailable. The favourite compartment for HDA is water as suggested by the high water solubility. Mackay level 1 distribution for HDA is not applicable as this substance is protonated under environmental pH conditions. Due to the high solubility in water of HDA (800 g/l at 15.6°C) and its log Kg of 0.02, no bioaccumulation is expected.

Because of the rapid hydrolysis of HDI in water and the ease with which this substance is metabolised in higher trophic animals, it is not expected that HDI will bioconcentrate in aquatic organisms or bioaccumulate in the food chain. HDI would also not be expected to partition onto suspended solids and sediment in water. Henry's law constant (H) for HDI has been estimated to be 4.80 x 10^-5 atm-m^3/mol, which indicates a relatively slow rate of volatilisation from water.

Ecotoxicity:
As the inherent property of HDI is to hydrolyse rapidly in an aquatic environment the ecotoxicological tests were conducted with the hydrolysis product(s) under defined conditions.
Fish LC50 (96 h): Brachydanio rerio >=82.8 mg/l
Daphnia magna EC0 (48 h): >=89.1 mg/l
Algal EC50 (72 h): Scenedesmus subspicatus >77.4 mg/l; NOEC 1.7 mg/l

Do not discharge into sewer or waterways.

### Section 13 Disposal Considerations

#### Waste Treatment Methods
- 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 SDS 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.
- 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 store 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.

#### Contaminated Packing Materials:
Refer to section above

#### Precautions for Transport:
Refer to section above

### Section 14 Transport Information

#### Labels Required

Marine Pollutant: NO
### Land transport (UN)

<table>
<thead>
<tr>
<th>UN number</th>
<th>2281</th>
</tr>
</thead>
<tbody>
<tr>
<td>UN proper shipping name</td>
<td>HEXAMETHYLENE DIISOCYANATE</td>
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<td>Transport hazard class(es)</td>
<td>Class 6.1</td>
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<td></td>
<td>Subrisk Not Applicable</td>
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<tr>
<td>Packing group</td>
<td>II</td>
</tr>
<tr>
<td>Environmental hazard</td>
<td>Not Applicable</td>
</tr>
<tr>
<td>Special precautions for user</td>
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</tr>
<tr>
<td>Special provisions</td>
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<tr>
<td>Limited quantity</td>
<td>100 ml</td>
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</table>

### Air transport (ICAO-IATA / DGR)

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<th>UN number</th>
<th>2281</th>
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<tbody>
<tr>
<td>UN proper shipping name</td>
<td>Hexamethylene diisocyanate</td>
</tr>
<tr>
<td>Transport hazard class(es)</td>
<td>ICAO/IATA Class 6.1</td>
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<tr>
<td></td>
<td>ICAO / IATA Subrisk Not Applicable</td>
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<tr>
<td>ERG Code</td>
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<tr>
<td>Packing group</td>
<td>II</td>
</tr>
<tr>
<td>Environmental hazard</td>
<td>Not Applicable</td>
</tr>
<tr>
<td>Special precautions for user</td>
<td></td>
</tr>
<tr>
<td>Cargo Only Packing Instructions</td>
<td>662</td>
</tr>
<tr>
<td>Cargo Only Maximum Qty / Pack</td>
<td>60 L</td>
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<tr>
<td>Passenger and Cargo Packing Instructions</td>
<td>654</td>
</tr>
<tr>
<td>Passenger and Cargo Maximum Qty / Pack</td>
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<tr>
<td>Passenger and Cargo Limited Quantity Packing Instructions</td>
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<tr>
<td>Passenger and Cargo Limited Maximum Qty / Pack</td>
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### Sea transport (IMDG-Code / GGVSee)

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<th>UN number</th>
<th>2281</th>
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</thead>
<tbody>
<tr>
<td>UN proper shipping name</td>
<td>HEXAMETHYLENE DIISOCYANATE</td>
</tr>
<tr>
<td>Transport hazard class(es)</td>
<td>IMDG Class 6.1</td>
</tr>
<tr>
<td></td>
<td>IMDG Subrisk Not Applicable</td>
</tr>
<tr>
<td>Packing group</td>
<td>II</td>
</tr>
<tr>
<td>Environmental hazard</td>
<td>Not Applicable</td>
</tr>
<tr>
<td>Special precautions for user</td>
<td></td>
</tr>
<tr>
<td>EMS Number</td>
<td>F-A, S-A</td>
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<tr>
<td>Special provisions</td>
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<tr>
<td>Limited Quantities</td>
<td>100 mL</td>
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</tbody>
</table>

### Transport in bulk according to Annex II of MARPOL and the IBC code

<table>
<thead>
<tr>
<th>Source</th>
<th>Product name</th>
<th>Pollution Category</th>
<th>Ship Type</th>
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<tbody>
<tr>
<td>IMO MARPOL (Annex II) - List of Noxious Liquid Substances Carried in Bulk</td>
<td>Hexamethylene diisocyanate</td>
<td>Y</td>
<td>2</td>
</tr>
</tbody>
</table>

### Precautions for Transport

Transportation precautions:
- Documentation covering all dangerous goods carried on the vehicle
- The transport unit must be placarded and marked in accordance with relevant transporting requirements.
- Personal protective equipment must be in sufficient quantities and suitable for use by the driver of the vehicle and where required for escape purposes, any other persons travelling in the vehicle.
- Toxic substances can have subsidiary risks of Class 3, 4, 5 or 8, and dangerous goods of Classes 1, 3, 4, 5, and 8 can have a subsidiary risk of Class 6.1. The hazards associated with subsidiary risks must be taken into account.
- Likely to be incompatible however refer to SDS for further details:
  - Class 2.1, 3, 4.1, 4.2, 4.3
  - Incompatible for transport with foodstuffs (including stock feed).
  - If applicable, use appropriate types of segregation devices to isolate incompatible dangerous goods:
  - Routes for road vehicles should avoid heavily populated or environmentally sensitive areas, congested crossings or a concentration of people
- Vehicle exhaust or hot engine components must be shielded to ensure cargo temperatures cannot be raised.

**Suitable Containers**
See section 7

### SECTION 15 REGULATORY INFORMATION

**Safety, health and environmental regulations / legislation specific for the substance or mixture**

<table>
<thead>
<tr>
<th>HEXAMETHYLENE DIISOCYANATE (822-06-0) IS FOUND ON THE FOLLOWING REGULATORY LISTS</th>
<th>China Inventory of Existing Chemical Substances</th>
<th>China Inventory of Hazardous Chemicals (Chinese)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>National Inventory</strong></td>
<td><strong>Status</strong></td>
<td></td>
</tr>
<tr>
<td>Australia - AICS</td>
<td>Y</td>
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</tr>
<tr>
<td>Canada - DSL</td>
<td>Y</td>
<td></td>
</tr>
<tr>
<td>Canada - NDSL</td>
<td>N (hexamethylene diisocyanate)</td>
<td></td>
</tr>
<tr>
<td>China - IECSC</td>
<td>Y</td>
<td></td>
</tr>
<tr>
<td>Europe - EINEC / ELINCS / NLP</td>
<td>Y</td>
<td></td>
</tr>
<tr>
<td>Japan - ENCS</td>
<td>Y</td>
<td></td>
</tr>
<tr>
<td>Korea - KECS</td>
<td>Y</td>
<td></td>
</tr>
<tr>
<td>New Zealand - NZIoC</td>
<td>Y</td>
<td></td>
</tr>
<tr>
<td>Philippines - PICCS</td>
<td>Y</td>
<td></td>
</tr>
<tr>
<td>USA - TSCA</td>
<td>Y</td>
<td></td>
</tr>
</tbody>
</table>

**Legend:**
- Y = All ingredients are on the inventory
- N = Not determined or one or more ingredients are not on the inventory and are not exempt from listing (see specific ingredients in brackets)

### SECTION 16 OTHER INFORMATION

**Other information**

Classification of the preparation and its individual components has drawn on official and authoritative sources as well as independent review by the Chemwatch Classification committee using available literature references.

The 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.

**Definitions and abbreviations**

- PC – TWA: Permissible Concentration-Time Weighted Average
- PC – STEL: Permissible Concentration-Short Term Exposure Limit
- IARC: International Agency for Research on Cancer
- ACGIH: American Conference of Governmental Industrial Hygienists
- STEL: Short Term Exposure Limit
- TEEL: Temporary Emergency Exposure Limit
- IDLH: Immediately Dangerous to Life or Health Concentrations
- OSF: Odour Safety Factor
- NOAEL: No Observed Adverse Effect Level
- LOAEL: Lowest Observed Adverse Effect Level
- TLV: Threshold Limit Value
- LOD: Limit Of Detection
- OTV: Odour Threshold Value
- BCF: BioConcentration Factors
- BEI: Biological Exposure Index

**Disclaimer**

The information in the SDS applies only for the specified product and does not include mixtures of this product with other substances and mixtures. The SDS provides product safety information for personnel trained to use this product only.