DICYANDIAMIDE

GHS Safety Data Sheet

Section 1 - CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

PRODUCT NAME
DICYANDIAMIDE

OTHER NAMES
C2-H4-N4, H2NC(NH)(NHCN), dicyanodiamide, cyanoguanidine, 1-cyanoguanidine, 1-cyanoguanidine, 2-cyanoguanidine, 2-cyanoguanidine, "guanidine, cyano-", DICY, DCD

PRODUCT USE
Fertilizers; nitrocellulose stabiliser; organic synthesis; pharmaceutical products; dyestuffs; explosives; retarding rancidity in fats and oils; fireproofing compounds; case-hardening preparations. Also used in cleaning compounds; soldering compounds; accelerator; thinner for oil well drilling muds; stabiliser in detergent compositions; modifier for starch products; catalyst for epoxy resins.

SUPPLIER
Company: S D FINE - CHEM LIMITED
Address:
315- 317, T.V.IND.ESTATE,
248 WORLI ROAD,
MUMBAI- 400 030, INDIA
technical@sdfine.com
Telephone: 91- 22 24959898
Telephone: 91- 22 24959899
Fax: 91- 22 24937232

Section 2 - HAZARDS IDENTIFICATION

HAZARD RATINGS

GHS Classification

Acute Toxicity (Dermal) Category 4
Acute Toxicity (Inhalation) Category 4
Acute Toxicity (Oral) Category 4

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EMERGENCY OVERVIEW

HAZARD
WARNING
Determined by using GHS criteria:
H302 H312 H332
Harmful if swallowed
Harmful in contact with skin
Harmful if inhaled

PRECAUTIONARY STATEMENTS

Prevention
Avoid breathing dust/fume/gas/mist/vapours/spray.
Wash thoroughly after handling.
Do not eat, drink or smoke when using this product.
Use only outdoors or in a well-ventilated area.
Wear protective gloves/protective clothing/eye protection/face protection.

Response
IF SWALLOWED: Call a POISON CENTER or doctor/physician if you feel unwell.
IF ON SKIN: Wash with plenty of soap and water.
IF INHALED: Remove to fresh air and keep at rest in a position comfortable for breathing.
Call a POISON CENTER or doctor/physician if you feel unwell.
Rinse mouth.
Wash contaminated clothing before reuse.

Section 3 - COMPOSITION / INFORMATION ON INGREDIENTS

NAME	CAS RN	%
dicyandiamide	461-58-5	> 99
impurities include		
melamine	108-78-1	0.7
thiourea	62-56-6	200 ppm

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

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medical specialist.
• If medical attention is not available on the worksite or surroundings send the patient to a hospital together with a copy of the MSDS.
• Where medical attention is not immediately available or where the patient is more than 15 minutes from a hospital or unless instructed otherwise:
• INDUCE vomiting with fingers down the back of the throat, ONLY IF CONSCIOUS. Lean patient forward or place on left side (head-down position, if possible) to maintain open airway and prevent aspiration.
NOTE: Wear a protective glove when inducing vomiting by mechanical means.

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

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

INHALED
• If fumes or combustion products are inhaled remove from contaminated area.
• Lay patient down. Keep warm and rested.
• Prostheses such as false teeth, which may block airway, should be removed, where possible, prior to initiating first aid procedures.
• Apply artificial respiration if not breathing, preferably with a demand valve resuscitator, bag-valve mask device, or pocket mask as trained. Perform CPR if necessary.
• Transport to hospital, or doctor.

NOTES TO PHYSICIAN
■ For cyanide intoxication (and for certain nitriles which produce cyanide ion)
• Signs symptoms of acute cyanide poisoning reflect cellular hypoxia and are often non-specific.
• Cyanosis may be a late finding.
• A bradycardic, hypertensive and tachypneic patient suggests poisoning especially if CNS and cardiovascular depression subsequently occurs.
• Immediate attention should be directed towards assisted ventilation, administration of 100% oxygen, insertion of intravenous lines and institution of cardiac monitoring.
• Obtain an arterial blood gas immediately and correct any severe metabolic acidosis (pH below 7.15).
• Mildly symptomatic patients generally require supportive care alone. Nitrites should not be given indiscriminately - in all cases of moderate to severe poisoning, they should be given in conjunction with thiosulfate. As a temporizing measure supply amyl nitrite perles (0.2ml inhaled 30 seconds every minute) until intravenous lines for sodium nitrite are established. 10 ml of a 3% solution is administered over 4 minutes to produce 20% methaemoglobin in adults. Follow directly with 50 ml of 25% sodium thiosulfate, at the same rate, IV. If symptoms reappear or persist within 1/2-1 hour, repeat nitrite and thiosulfate at 50% of initial dose. As the mode of action involves the metabolic conversion of the thiosulfate to thiocyanate, renal failure may enhance thiocyanate toxicity.
• Methylene blue is not an antidote. [Ellenhorn and Barceloux: Medical Toxicology]

If amyl nitrite intervention is employed then Medical Treatment Kits should contain the following:
• One box containing one dozen amyl nitrite ampoules
• Two sterile ampoules of sodium nitrite solution (10 mL of a 3% solution in each)
• Two sterile ampoules of sodium thiosulfate solution (50 mL of a 25% solution in each)
• One 10 mL sterile syringe. One 50 mL sterile syringe. Two sterile intravenous needles. One tourniquet.
• One dozen gauze pads.
• Latex gloves
• A "Biohazard" bag for disposal of bloody/contaminated equipment.

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• A set of cyanide instructions on first aid and medical treatment.

- Notes on the use of amyl nitrite:-
• AN is highly volatile and flammable - do not smoke or use around a source of ignition.
• If treating patient in a windy or draughty area provide some shelter or protection (shirt, wall, drum, cupped hand etc.) to prevent amyl nitrite vapour from being blown away. Keep ampoule upwind from the nose, the objective is to get amyl nitrite into the patients lungs.
• Rescuers should avoid AN inhalation to avoid becoming dizzy and losing competence.
• Lay the patient down. Since AN dilates blood vessels and lowers blood pressure, lying down will help keep patient conscious.
• DO NOT overuse - excessive use might put the patient into shock. Experience at DuPont plants has not shown any serious after-effects from treatment with amyl nitrite.

ADDITIONAL NOTES:
• Major medical treatment procedures may vary e.g. US (FDA method as recommended by DuPont) uses amyl nitrite as a methaemoglobin generator, followed by treatment with sodium nitrite and then sodium thiosulfate.

MODES OF ACTION: Amyl nitrite (AN) reacts with haemoglobin (HB) to form about 5% methaemoglobin (MHB). Sodium nitrite ($NaNO_2$) reacts with haemoglobin to form approximately 20-30% methaemoglobin. Methaemoglobin attracts cyanide ions (CN) from tissue and binds with them to become cyanmethaemoglobin (CNMHB). Sodium thiosulfate ($Na_2S_2O_3$) converts cyanmethaemoglobin to thiocyanate (HSCN) which is excreted by the kidneys. i.e. AN + HB = MHB $NaNO_2$ + HB = MHB CN + MHB = CNMHB $Na_2S_2O_3$ + CNMHB + O_2 = HSCN
• The administration of the antidote salts is intravenous in normal saline, Ringers lactate or other available IV fluid.
• European practice may use 4-dimethylaminophenol (DMAP) as a methaemoglobin generator. Also hydroxycobalamin (Vitamin B12a) is used. Hydroxycobalamin works by reacting with cyanide to form cyanocobalamin (Vitamin B12) which is excreted in the urine.
• European and Australian NOHSC (ASCC) propose dicobalt edetate (Kelocyanor) as antidote. This acts by chelating cyanide to form stable cobalticyanide, which is excreted in the urine. In all cases hyperbaric therapy may increase the efficiency of a cyanide antidote kit.
Nitriles may produce metabolic cyanide.

Section 5 - FIRE FIGHTING MEASURES

EXTINGUISHING MEDIA
• Water spray or fog.
• Foam.
• Dry chemical powder.
• BCF (where regulations permit).
• Carbon dioxide.

FIRE FIGHTING
• Alert Fire Brigade and tell them location and nature of hazard.
• Wear breathing apparatus plus protective gloves.
• Prevent, by any means available, spillage from entering drains or water courses.
• Use water delivered as a fine spray to control fire and cool adjacent 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 solid which burns but propagates flame with difficulty; it is estimated that most organic dusts are combustible (circa 70%) - according to the circumstances under which the combustion process occurs, such materials may cause fires and / or dust explosions.
• Avoid generating dust, particularly clouds of dust in a confined or unventilated space as dusts may form an explosive mixture with air, and any source of ignition, i.e. flame or spark, will cause fire or explosion.

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Dust clouds generated by the fine grinding of the solid are a particular hazard; accumulations of fine dust (420 micron or less) may burn rapidly and fiercely if ignited - particles exceeding this limit will generally not form flammable dust clouds.; once initiated, however, larger particles up to 1400 microns diameter will contribute to the propagation of an explosion.
- In the same way as gases and vapours, dusts in the form of a cloud are only ignitable over a range of concentrations; in principle, the concepts of lower explosive limit (LEL) and upper explosive limit (UEL).are applicable to dust clouds but only the LEL is of practical use; - this is because of the inherent difficulty of achieving homogeneous dust clouds at high temperatures (for dusts the LEL is often called the "Minimum Explosible Concentration", MEC)
- A dust explosion may release of large quantities of gaseous products; this in turn creates a subsequent pressure rise of explosive force capable of damaging plant and buildings and injuring people.
- Usually the initial or primary explosion takes place in a confined space such as plant or machinery, and can be of sufficient force to damage or rupture the plant. If the shock wave from the primary explosion enters the surrounding area, it will disturb any settled dust layers, forming a second dust cloud, and often initiate a much larger secondary explosion. All large scale explosions have resulted from chain reactions of this type.
- Dry dust can be charged electrostatically by turbulence, pneumatic transport, pouring, in exhaust ducts and during transport.
- Build-up of electrostatic charge may be prevented by bonding and grounding.
- Powder handling equipment such as dust collectors, dryers and mills may require additional protection measures such as explosion venting.
- All movable parts coming in contact with this material should have a speed of less than 1-meter/sec
- A sudden release of statically charged materials from storage or process equipment, particularly at elevated temperatures and/ or pressure, may result in ignition especially in the absence of an apparent ignition source
- One important effect of the particulate nature of powders is that the surface are and surface structure (and often moisture content) can vary widely from sample to sample, depending of how the powder was manufactured and handled; this means that it is virtually impossible to use flammability data published in the literature for dusts (in contrast to that published for gases and vapours).
- Autoignition temperatures are often quoted for dust clouds (minimum ignition temperature (MIT)) and dust layers (layer ignition temperature (LIT)); LIT generally falls as the thickness of the layer increases.

Combustion products include: carbon monoxide (CO), carbon dioxide (CO_2), nitrogen oxides (NOx), 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 PROTECTION

Glasses:	Respirator:
Chemical goggles.	Particulate

Section 6 - ACCIDENTAL RELEASE MEASURES

MINOR SPILLS
- Environmental hazard - contain spillage.
- Remove all ignition sources.
- Clean up all spills immediately.
- Avoid contact with skin and eyes.
- Control personal contact by using protective equipment.
- Use dry clean up procedures and avoid generating dust.
- Place in a suitable, labelled container for waste disposal.

MAJOR SPILLS
- Environmental hazard - contain spillage.

Moderate hazard.

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- CAUTION: Advise personnel in area.
- Alert Emergency Services and tell them location and nature of hazard.
- Control personal contact by wearing protective clothing.
- Prevent, by any means available, spillage from entering drains or water courses.
- Recover product wherever possible.
- IF DRY: Use dry clean up procedures and avoid generating dust. Collect residues and place in sealed plastic bags or other containers for disposal. IF WET: Vacuum/shovel up and place in labelled containers for disposal.
- ALWAYS: Wash area down with large amounts of water and prevent runoff into drains.
- If contamination of drains or waterways occurs, advise Emergency Services.

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

Section 7 - HANDLING AND STORAGE

PROCEDURE FOR 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 contact humans, exposed food or food utensils.
- Avoid contact with incompatible materials.
- When handling, DO NOT eat, drink or smoke.
- Keep containers securely sealed when not in use.
- Avoid physical damage to containers.
- Always wash hands with soap and water after handling.
- Work clothes should be laundered separately. Launder contaminated clothing before re-use.
- Use good occupational work practice.
- Observe manufacturer's storing and handling recommendations.
- Atmosphere should be regularly checked against established exposure standards to ensure safe working conditions are maintained.

Empty containers may contain residual dust which has the potential to accumulate following settling. Such dusts may explode in the presence of an appropriate ignition source.

- Do NOT cut, drill, grind or weld such containers
- In addition ensure such activity is not performed near full, partially empty or empty containers without appropriate workplace safety authorisation or permit.

SUITABLE CONTAINER

- Polyethylene or polypropylene container.
- Check all containers are clearly labelled and free from leaks.

STORAGE INCOMPATIBILITY

- Avoid strong acids, acid chlorides, acid anhydrides and chloroformates.
- Nitriles may polymerise in the presence of metals and some metal compounds.
- They are incompatible with acids; mixing nitriles with strong oxidising acids can lead to extremely violent reactions.
- Nitriles are generally incompatible with other oxidising agents such as peroxides and epoxides.
- The combination of bases and nitriles can produce hydrogen cyanide. Nitriles are hydrolysed exothermally in both aqueous acid and base to give carboxylic acids (or salts of carboxylic acids).
- Nitriles can react vigorously with reducing agents.
- The covalent cyano group is endothermic and many organic nitriles are reactive under certain conditions; N-cyano derivatives are reactive or unstable.
- The majority of endothermic compounds are thermodynamically unstable and may decompose explosively under various circumstances of initiation.
- Many but not all endothermic compounds have been involved in decompositions, reactions and explosions and, in general, compounds with significantly positive values of standard heats of formation, may be considered

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suspect on stability grounds.
BRETHERICK L.: Handbook of Reactive Chemical Hazards.
Dicyandiamide:
• forms explosive compounds with many substances including oxidisers, diazo- and nitro- compounds, diazonium or hydrazinium salts, azides, tetrazenes, tetrazoles, triazenes and triazoles
• reacts with strong acids to produce hydrogen cyanide.
• Avoid reaction with oxidising agents.

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

SAFE STORAGE WITH OTHER CLASSIFIED CHEMICALS

+	X	+	X	X	+

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

Section 8 - EXPOSURE CONTROLS / PERSONAL PROTECTION

EXPOSURE CONTROLS
The following materials had no OELs on our records
• dicyandiamide: CAS:461- 58- 5
• melamine: CAS:108- 78- 1

MATERIAL DATA
DICYANDIAMIDE:
■ It is the goal of the ACGIH (and other Agencies) to recommend TLVs (or their equivalent) for all substances for which there is evidence of health effects at airborne concentrations encountered in the workplace.
At this time no TLV has been established, even though this material may produce adverse health effects (as evidenced in animal experiments or clinical experience). Airborne concentrations must be maintained as low as is practically possible and occupational exposure must be kept to a minimum.
NOTE: The ACGIH occupational exposure standard for Particles Not Otherwise Specified (P.N.O.S) does NOT apply.
The concentration of dust, for application of respirable dust limits, is to be determined from the fraction that penetrates a separator whose size collection efficiency is described by a cumulative log-normal function with a median aerodynamic diameter of 4.0 µm (+-) 0.3 µm and with a geometric standard deviation of 1.5 µm (+-) 0.1 µm, i.e..generally less than 5 µm.

MELAMINE:
■ It is the goal of the ACGIH (and other Agencies) to recommend TLVs (or their equivalent) for all substances for which there is evidence of health effects at airborne concentrations encountered in the workplace.
At this time no TLV has been established, even though this material may produce adverse health effects (as evidenced in animal experiments or clinical experience). Airborne concentrations must be maintained as low as

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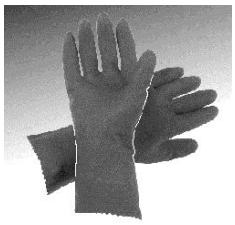
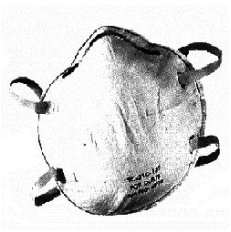
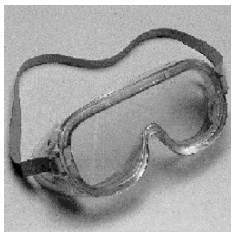
is practically possible and occupational exposure must be kept to a minimum.
NOTE: The ACGIH occupational exposure standard for Particles Not Otherwise Specified (P.N.O.S) does NOT apply.
CEL TWA: 10 mg/m3 inhalable particles
CEL TWA: 5 mg/m3 respirable particles (compare WEEL TWA)

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. Important factors in the selection of gloves include: such as:
• frequency and duration of contact,
• chemical resistance of glove material,
• glove thickness and
• dexterity
Select gloves tested to a relevant standard (e.g. Europe EN 374, US F739).
• When prolonged or frequently repeated contact may occur, a glove with a protection class of 5 or higher (breakthrough time greater than 240 minutes according to EN 374) is recommended.
• When only brief contact is expected, a glove with a protection class of 3 or higher (breakthrough time greater than 60 minutes according to EN 374) is recommended.
• Contaminated gloves should be replaced.
Gloves must only be worn on clean hands. After using gloves, hands should be washed and dried thoroughly. Application of a non-perfumed moisturiser is recommended.
Experience indicates that the following polymers are suitable as glove materials for protection against undissolved, dry solids, where abrasive particles are not present.
• polychloroprene
• nitrile rubber
• butyl rubber
• fluorocaoutchouc
• polyvinyl chloride
Gloves should be examined for wear and/ or degradation constantly.

OTHER
• Overalls.
• P.V.C. apron.
• Barrier cream.
• Skin cleansing cream.
• Eye wash unit.

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- Respirators may be necessary when engineering and administrative controls do not adequately prevent exposures.
- The decision to use respiratory protection should be based on professional judgment that takes into account toxicity information, exposure measurement data, and frequency and likelihood of the worker's exposure - ensure users are not subject to high thermal loads which may result in heat stress or distress due to personal protective equipment (powered, positive flow, full face apparatus may be an option).
- Published occupational exposure limits, where they exist, will assist in determining the adequacy of the selected respiratory . These may be government mandated or vendor recommended.
- Certified respirators will be useful for protecting workers from inhalation of particulates when properly selected and fit tested as part of a complete respiratory protection program.
- Use approved positive flow mask if significant quantities of dust becomes airborne.
- Try to avoid creating dust conditions.

RESPIRATOR

Protection Factor	Half- Face Respirator	Full- Face Respirator	Powered Air Respirator
10 x ES	P1 Air- line*	- -	PAPR- P1 -
50 x ES	Air- line**	P2	PAPR- P2
100 x ES	-	P3	-
		Air- line*	-
100+ x ES	-	Air- line**	PAPR- P3

* - Negative pressure demand ** - Continuous flow.

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

ENGINEERING CONTROLS

- Local exhaust ventilation is required where solids are handled as powders or crystals; even when particulates are relatively large, a certain proportion will be powdered by mutual friction.
- Exhaust ventilation should be designed to prevent accumulation and recirculation of particulates in the workplace.
- If in spite of local exhaust an adverse concentration of the substance in air could occur, respiratory protection should be considered. Such protection might consist of:

(a): particle dust respirators, if necessary, combined with an absorption cartridge;
(b): filter respirators with absorption cartridge or canister of the right type;
(c): fresh-air hoods or masks

- Build-up of electrostatic charge on the dust particle, may be prevented by bonding and grounding.
- Powder handling equipment such as dust collectors, dryers and mills may require additional protection measures such as explosion venting.

Air contaminants generated in the workplace possess varying "escape" velocities which, in turn, determine the "capture velocities" of fresh circulating air required to efficiently remove the contaminant.

Type of Contaminant:	Air Speed:
direct spray, spray painting in shallow booths, drum filling, conveyer loading, crusher dusts, gas discharge (active generation into zone of rapid air motion)	1- 2.5 m/s (200- 500 f/min.)
grinding, abrasive blasting, tumbling, high speed wheel generated dusts (released at high initial velocity into zone of very high rapid air motion).	2.5- 10 m/s (500- 2000 f/min.)

Within each range the appropriate value depends on:

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Lower end of the range	Upper end of the range
1: Room air currents minimal or favourable to capture	1: Disturbing room air currents
2: Contaminants of low toxicity or of nuisance value only	2: Contaminants of high toxicity
3: Intermittent, low production.	3: High production, heavy use
4: Large hood or large air mass in motion	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 (in simple cases). Therefore the air speed at the extraction point should be adjusted, accordingly, after reference to distance from the contaminating source. The air velocity at the extraction fan, for example, should be a minimum of 4-10 m/s (800-2000 f/min) for extraction of crusher dusts generated 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. 2 m

Section 9 - PHYSICAL AND CHEMICAL PROPERTIES

APPEARANCE
Odourless white crystals; mixes with water (2.26% @ 13 C). Soluble in liquid ammonia, alcohol, ammonium hydroxide, acetone. Solutions above 80 deg. C decompose slowly, yielding ammonia. Particle size typically < 3um

PHYSICAL PROPERTIES
Solid.
Mixes with water.
Contact with acids liberates very toxic gas.

State	Divided solid	Molecular Weight	84.10
Melting Range (°C)	209.5	Viscosity	Not Applicable
Boiling Range (°C)	252 (solidifies)	Solubility in water (g/L)	Miscible
Flash Point (°C)	Not available	pH (1% solution)	Not available.
Decomposition Temp (°C)	Not available.	pH (as supplied)	Not applicable
Autoignition Temp (°C)	Not available	Vapour Pressure (kPa)	Negligible
Upper Explosive Limit (%)	Not available	Specific Gravity (water=1)	1.40
Lower Explosive Limit (%)	Not available	Relative Vapour Density (air=1)	>1
Volatile Component (%vol)	Negligible	Evaporation Rate	Not applicable

Material	Value
DICYANDIAMIDE:	
log Kow - 0.52 (25 C)	

Section 10 - CHEMICAL STABILITY AND REACTIVITY INFORMATION

CONDITIONS CONTRIBUTING TO INSTABILITY
• Presence of incompatible materials.
• Product is considered stable.
• Hazardous polymerisation will not occur.
For incompatible materials - refer to Section 7 - Handling and Storage.

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Section 11 - TOXICOLOGICAL INFORMATION

POTENTIAL HEALTH EFFECTS

ACUTE HEALTH EFFECTS

SWALLOWED
■ Accidental ingestion of the material may be harmful; animal experiments indicate that ingestion of less than 150 gram may be fatal or may produce serious damage to the health of the individual.
■ Nitrile poisoning exhibits similar symptoms to poisoning due to hydrogen cyanide. The substances irritate the eyes and skin, and are absorbed quickly and completely through the skin. The use of the term "organic nitriles" should be discouraged.

EYE
■ Although the material is not thought to be an irritant (as classified by EC Directives), direct contact with the eye may cause transient discomfort characterised by tearing or conjunctival redness (as with windburn). Slight abrasive damage may also result. The material may produce foreign body irritation in certain individuals.

SKIN
■ Skin contact with the material may be harmful; systemic effects may result following absorption.
■ The material is not thought to be a skin irritant (as classified by EC Directives using animal models). Abrasive damage however, may result from prolonged exposures. Good hygiene practice requires that exposure be kept to a minimum and that suitable gloves be used in an occupational setting.
■ Open cuts, abraded or irritated skin should not be exposed to this material.
■ Entry into the blood-stream, through, for example, cuts, abrasions or lesions, may produce systemic injury with harmful effects. Examine the skin prior to the use of the material and ensure that any external damage is suitably protected.

INHALED
■ Inhalation of dusts, generated by the material, during the course of normalhandling, may be harmful.
■ The material is not thought to produce respiratory irritation (as classified by EC Directives using animal models). Nevertheless inhalation of dusts, or fumes, especially for prolonged periods, may produce respiratory discomfort and occasionally, distress.
■ Persons with impaired respiratory function, airway diseases and conditions such as emphysema or chronic bronchitis, may incur further disability if excessive concentrations of particulate are inhaled.
If prior damage to the circulatory or nervous systems has occurred or if kidney damage has been sustained, proper screenings should be conducted on individuals who may be exposed to further risk if handling and use of the material result
in excessive exposures.
■ Effects on lungs are significantly enhanced in the presence of respirableparticles.

CHRONIC HEALTH EFFECTS
■ Substance accumulation, in the human body, may occur and may cause some concern following repeated or long-term occupational exposure.
Overexposure to respirable dust may cause coughing, wheezing, difficulty in breathing and impaired lung function. Chronic symptoms may include decreased vital lung capacity, chest infections
Repeated exposures, in an occupational setting, to high levels of fine- divided dusts may produce a condition known as pneumoconiosis which is the lodgement of any inhaled dusts in the lung irrespective of the effect. This is particularly true when a significant number of particles less than 0.5 microns (1/50,000 inch), are present. Lung shadows are seen in the X-ray. Symptoms of pneumoconiosis may include a progressive dry cough, shortness of breath on exertion (exertional dyspnea), increased chest expansion, weakness and weight loss. As the disease progresses the cough produces a stringy mucous, vital capacity decreases further and shortness of breath becomes more severe. Other signs or symptoms include altered breath sounds, diminished lung capacity, diminished oxygen uptake during exercise, emphysema and pneumothorax (air in lung cavity) as a rare complication.
Removing workers from possibility of further exposure to dust generally leads to halting the progress of the lung abnormalities. Where worker-exposure potential is high, periodic examinations with emphasis on lung

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dysfunctions should be undertaken
Dust inhalation over an extended number of years may produce pneumoconiosis.. Pneumoconiosis is the accumulation of dusts in the lungs and the tissue reaction in its presence. It is further classified as being of noncollagenous or collagenous types. Noncollagenous pneumoconiosis, the benign form, is identified by minimal stromal reaction, consists mainly of reticulin fibres, an intact alveolar architecture and is potentially reversible.
Chronic exposure to cyanides and certain nitriles may result in interference to iodine uptake by thyroid gland and its consequent enlargement. This occurs following metabolic conversion of the cyanide moiety to thiocyanate. Thyroid insufficiency may also occur as a result of metabolic conversion of cyanides to the corresponding thiocyanate. Exposure to small amounts of cyanide compounds over long periods are reported to cause loss of appetite, headache, weakness, nausea, dizziness, abdominal pain, changes in taste and smell, muscle cramps, weight loss, flushing of the face, persistent runny nose and irritation of the upper respiratory tract and eyes. These symptoms are not specific to cyanide exposure and therefore the existence of a chronic cyanide toxicity remains speculative. Repeated minor contact with cyanides produce a characteristic rash with itching, papules (small, superficial raised spots on the skin) and possible sensitisation. Concerns have been expressed that low-level, long term exposures may result in damage to the nerves of the eye.
Guanidine hydrochloride causes decrease in bone marrow activity usually shown as gastrointestinal disturbance and "pins and needles" in the lips, face and extremities. Irritability, tremor, inco-ordination and seizures can occur, rarely, there is low blood pressure, skin reactions, low blood glucose and increased levels of creatinine. Asians may be more susceptible. Chronic exposure may cause kidney damage.

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

TOXICITY	IRRITATION
Oral (rat) LD50: 10000 mg/kg *	Nil Reported
Inhalation (rat) LC50: >0.259 mg/L/4h**	
*[Cyanamide]	
Dermal (rabbit) LD50: 10000 mg/kg *	

■ Dicyandiamide is considered to be irritating to the skin in guinea pigs. Data on eye irritation are not available. No sensitising potential has been demonstrated in guinea pigs in three maximization studies. The potential was not clearly demonstrated in human. Most workers did not become sensitive to this substance, however, there might be some workers who became sensitive for specific reasons (cross sensitisation or adjuvant effect of co-factors).
A combined repeated dose toxicity study with the reproduction/developmental toxicity screening test [OECD TG 422] was conducted using SD rats. The substance had no effect on clinical signs, body weights, food consumption or necropsy findings. The organ weights were similar among all groups. No histopathological changes ascribable to this substance in these organs were found in either sex. The NOAEL for the repeat dose toxicity is considered to be 1,000 mg/kg/day for both sexes.
The reverse mutation studies in bacteria [OECD TG 471 and 472] gave negative results. The in vitro chromosomal aberration test with Chinese hamster lung cells (CHL/IU) [OECD TG 473] with and without metabolic activation was also negative. Therefore, this substance is not genotoxic.
A combined repeated dose toxicity study with the reproduction/developmental toxicity screening test [OECD TG 422] (0, 40, 200, 1,000 mg/kg/day) was conducted using SD rats. This substance had no effects on reproductive parameters such as the mating index, fertility index, numbers of corpora lutea or implantations, implantation index, delivery index, gestation index, gestation length, parturition or maternal behavior. On examination of neonates there were no significant differences between the control and treated groups in the number of offspring or live offspring, sex ratio, live birth index, viability index or body weight. No abnormal findings ascribable to this substance were found for external examination or clinical signs or on necropsy of the offspring. The NOAEL for reproductive and developmental toxicity is considered to be 1,000 mg/kg/day.
A carcinogenicity study was conducted in male and female Fischer 344 rats fed diets containing this substance at 0, 2.5 and 5% (male: 837.2 and 1958.6, female: 1001.3 and 2169.2 mg/kg bw/day) for up to 2 years. The study did not suggest an association of the substance with an increased tumor incidence.
Oral (rat) TDLo: 273000 mg/kg/13W-C **[SKW]
Inhalation (rat) TCLo: 2.4 mg/m³/4W-I

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

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TOXICITY
Oral (rat) LD50: 3161 mg/kg
Inhalation (rat) LC50: 3248 mg/m³ *TNO
Nutrition & Food Research Institu
Dermal (rabbit) LD50: >1000 mg/kg
Inhalation (rat) LC50: >5190 mg/m³/4hours*

IRRITATION
Eye (rabbit): 500 mg/24h Mild

■ 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 be irritating to the eye, with prolonged contact causing inflammation. Repeated or prolonged exposure to irritants may produce conjunctivitis.
for melamine:
The toxicity of melamine to mammals is also low. Melamine is not metabolized and is rapidly eliminated via urine in a study with oral application to rats. The elimination half-life in plasma is about 3 hours .
Studies ranging from skin irritation to carcinogenicity are available. Melamine is not genotoxic but it causes carcinomas of the urinary bladder at high doses in male rats only. Formation of bladder stones occurred and these calculi are necessary for the induction of tumours. Carcinomas are induced by continuous irritation of the bladder epithelium by the calculi, so that melamine acts only indirectly as a non-genotoxic carcinogen. A threshold concept can be used.
Melamine is not irritating to skin and eye, not sensitising and not teratogenic.
Acute toxicity The acute toxicity was investigated in 9 studies in different species (rat, mouse and rabbit) and by several routes of administration. The lowest LD50s are:
Oral (rat) LD50 = 3161 mg/kg bw.
Inhalation (rat) LC50 = 3.2 mg/l.
Dermal (rabbit) LD50 > 1000 mg/kg bw.
Intraperitoneal (mouse) LD50 = 112 mg/kg bw.
Melamine is not irritating to the skin and eye of rabbits and also to the skin of guinea pigs. Melamine is not a sensitiser in a human patch test and in a study with guinea pigs.
Repeated dose toxicity
Six studies with rats, oral administration of melamine with the feed and dosing periods of 14 days to 3 months are available. Additional studies with mice and also rather old studies with intraperitoneal administration, and rabbits and dogs were also reported.
Summarised findings of the different studies are: Depression of body weight gain and elevated water intake were observed at higher doses of about. 500 mg.kg-1.d-1. The target organ system is the urinary tract. Melamine has a diuretic effect, it produces urinary bladder stones (urolithiasis), hyperplastic epithelial changes of the urinary bladder and calcerous deposits in the proximal kidney tubules. In mice ulceration as well as hyperplasias of the bladder occurred. Changes in the urinary bladder were noted in the studies depending on the dose and the species used. A GLP 28 days study in rats (19) to evaluate urolithiasis indicated a dose dependent incidence of urinary bladder calculi and hyperplasia. The rat and especially the male rat is more susceptible than the mouse.
About 63 and 240 mg.kg-1.d-1 are regarded as the lowest NOELs from a 13 weeks study and a 28 days study. This applies also for stone formation. Long term studies, give a higher NOEL of 126 mg/kg bw in male rats than the 13 weeks study so that no further safety factor has to be applied, when taking NOEL = ca. 63 mg.kg-1.d-1 also for long term exposure.
Genotoxicity A lot of studies with different endpoints (point mutation, chromosome aberration, DNA damage, cell transformation) and with different organisms and cells were performed. The studies included the usually performed assays as Ames test (6 studies), micronucleus test (2 studies), cytogenetics in vitro, HGPRT assay, etc. but also some not as common assays as e.g. a bioluminescence assay.
20 out of the 22 available studies were negative. 1 sister chromatid exchange test with CHO cells was equivocal as 1 of 2 trials without metabolic activation was positive. Another sister chromatid exchange test was negative.
The microscreen assay with lambda prophage induction in E. coli was positive with and without metabolic activation. This test is one of the assays which is not as common as others and where the relevance of the

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Section 11 - TOXICOLOGICAL INFORMATION

results still lacks a broad acceptance. Not much weight is therefore given to the result. Altogether melamine is considered to be not genotoxic and not mutagenic.
Reproduction / developmental toxicity No indication of an effect to the reproductive organs was obtained from the repeated dose and chronic toxicity studies: Mammary glands, ovaries, prostate, seminal vesicles, testes and uterus were examined macroscopically and microscopically in 13-weeks and in chronic toxicity studies with rats and mice and were found to be unaffected by melamine at each of the doses used. The lowest NOEL for general toxicity in these studies was ca. 63 mg.kg-1.d-1.
Melamine is not teratogenic in an investigation with rats The NOEL for the foetuses is ca.1060 mg.kg
based on no findings in the high dose used. A NOEL of ca. 400 mg.kg-1.d-1 (the medium dose in this study) is based on the maternal toxicity. Decreased body weight and feed consumption and haematuria of the dams were signs of maternal toxicity.
The substance is classified by IARC as Group 3:
NOT classifiable as to its carcinogenicity to humans.
Evidence of carcinogenicity may be inadequate or limited in animal testing.

CARCINOGEN

Melamine (NB: Overall evaluation downgraded from 2B to 3 with supporting evidence from other relevant data)	International Agency for Research on Cancer (IARC) - Agents Reviewed by the IARC Monographs	Group	3

Section 12 - ECOLOGICAL INFORMATION

Refer to data for ingredients, which follows:

MELAMINE:
DICYANDIAMIDE:
■ DO NOT discharge into sewer or waterways.

DICYANDIAMIDE:
■ On the basis of available evidence concerning either toxicity, persistence, potential to accumulate and or observed environmental fate and behaviour, the material may present a danger, immediate or long-term and /or delayed, to the structure and/ or functioning of natural ecosystems.
■ Soil Guidelines: Dutch Criteria:

free cyanide: 1 mg/kg (target)

20 mg/kg (intervention)

complex cyanide (pH 5): 5 mg/kg (target)

50 mg/kg (intervention)

Air Quality Standards: no safe guidelines recommended due to carcinogenic properties.
■ for dicyandiamide:
Henry's law Constant 2.25x10-10 atm.m3/mole
Vapour pressure <= 4.5x10-6 kPa (100 C)
log Kow -0.52 (25 C)
Environmental fate:
Dicyandiamide does not hydrolyse under environmental conditions (regardless of pH). Indirect photo-oxidation by hydroxy radicals in the atmosphere is predicted to occur with a half-life of 3.1 hours. Dicyandiamide is not readily biodegradable under aerobic condition within 28 days (BOD = 0 %). However, a prolonged study showed that this substance is completely biodegraded within 34 weeks under aerobic conditions, while two-

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thirds of the total is biodegraded within 60 weeks under anaerobic conditions. Dicyandiamide has a low bioaccumulative potential (BCF (Cyprinus carpio, 48days): equal or less than 3.1). Fugacity modeling (Mackay level III) predicts that if the substance is released to water, it will not migrate into other compartments.
When this substance is released to air or soil, it is mainly distributed to water and soil.
Ecotoxicity:
Fish LC50 (96 h): Oncorhynchus Mykiss 7700 mg/L
Daphnia Magna EC50 (48 h): 3177 mg/L
Pseudomonas Putida EC10: 131 mg/L
Dicyandiamide has been tested in aquatic species (algae, invertebrates and fish). An acute growth inhibition test was performed using green algae (OECD TG 201, Selenastrum capricornutum). The EC50 (biomass; 0-72 h) was 935 mg/L and the EC50 (growth rate; 24-72 h) was > 1,000 mg/L.
An acute toxicity test for invertebrates was performed using water fleas (OECD TG 202, Daphnia magna). The 48-h EC50 was > 1,000 mg/L.
An acute toxicity test [OECD TG 203] and a prolonged toxicity test [OECD TG 204] for fish were performed using Medaka (Oryzias latipes). The 96-h LC50 and the 14-d LC50 were both >100 mg/L.
A chronic reproduction toxicity test for invertebrates was performed using water fleas (OECD TG 211, Daphnia magna). The 21-d EC50 and the 21-d NOEC were 69.6 mg/L and 25.0 mg/L, respectively.
In microorganisms, dicyandiamide is known to have an inhibition activity of the nitrification of ammonium in various systems.

MELAMINE:

■ BOD20:	0.006
■ ThOD:	3.04
■ Half- life Soil - High (hours):	4320
■ Half- life Soil - Low (hours):	672
■ Half- life Air - High (hours):	10.5
■ Half- life Air - Low (hours):	1.05
■ Half- life Surface water - High (hours):	3480
■ Half- life Surface water - Low (hours):	62.4
■ Half- life Ground water - High (hours):	8640
■ Half- life Ground water - Low (hours):	1344
■ Aqueous biodegradation - Aerobic - High (hours):	4320
■ Aqueous biodegradation - Aerobic - Low (hours):	672
■ Aqueous biodegradation - Anaerobic - High (hours):	17280
■ Aqueous biodegradation - Anaerobic - Low (hours):	2688
■ Photolysis maximum light absorption - High (nano- m):	235
■ Photooxidation half- life water - High (hours):	3480
■ Photooxidation half- life water - Low (hours):	62.4
■ Photooxidation half- life air - High (hours):	10.5
■ Photooxidation half- life air - Low (hours):	1.05

■ for melamine:
BOD 5 : 0.006
ThOD : 3.04
Environmental fate:
The outstanding physical-chemical property in terms of environmental fate is a low n-octanol/water partition coefficient (log Kow -1.14, 25 C). Melamine is not readily biodegradable but adapted waste- water treatment plants can degrade it effectively. Water is the most relevant compartment in the environmental fate of the substance.
Elimination from the water compartment: Melamine can not be classified as readily biodegradable. Degradations of 0 % respectively 16 % were obtained in two Zahn-Wellens tests on inherent biodegradability. 80-90 % of melamine is eliminated by the waste water treatment plant (WWTP) of a producer. Complete elimination of melamine is found 8 hours after incubation with the activated sludge of the WWTP of another producer whereas no degradation occurred with the activated sludge of a domestic WWTP. It is concluded that microorganisms of WWTPs can adapt to melamine when continuously exposed.
Elimination from soil and sediment: Melamine is slowly degraded in soil with a half life of 2-3 years. Nitrification in soil was determined; up to about 18 % of the melamine-N nitrificates in 6-24 weeks. The adsorption to soil is estimated to be low.
Elimination from air: Apart from sedimentation of the melamine dust the only relevant information is the

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Section 12 - ECOLOGICAL INFORMATION

maximum of absorbance of melamine at 235 nm.
Bioaccumulation: No bioaccumulation of melamine is expected as a bioconcentration factor of < 0.38 was determined in fish
Ecotoxicity: Short term tests with species of 3 trophic levels are available and in addition studies on chronic toxicity and reproduction toxicity with Daphnia, early life stage toxicity with fish and chronic toxicity with algae. Melamine has a low acute and also low long term toxicity. The interspecies differences are not pronounced. The low bioconcentration factor gives no suspicion as to late effects after long term exposure. The lowest short term L(E)C50 is 940 mg/l taken from the study with algae.
Fish LC50 (96 h): >3000 mg/l
Fish NOEC (chronic test): >1000 mg/l
Daphnia LC50 (48 h): >2000 mg/l
Daphnia NOEC (21 days): 18 mg/l
Algae EC50: 940 mg/l
Algae NOEC: 320 mg/l
Bacteria EC50: >10000 mg/l
Terrestrial effects Short term growth studies with 4 species (Hordeum vulgare, Tritium aestivum, Raphanus sativus and Lepidum sativum) and one 14 days study with Pisum sativum/Phaseolus vulgaris were reported. The EC50s were between 530 and 1100 mg/l. The NOEC in the 14 days study was 1680 ppm
Other effects Tests with activated sludge and with Nitrosomonas sp. and Pseudomonas putida were reported. The toxicity of melamine is low in each case.
Results:
EC0 > 1992 mg/l for activated sludge;
EC0 > 100 mg/l for Nitrosomonas sp
EC10 > 10 000 mg/l for Pseudomonas putida.

Ecotoxicity

Ingredient	Persistence: Water/Soil	Persistence: Air	Bioaccumulation	Mobility
dicyandiamide	HIGH		LOW	HIGH
melamine	MED	LOW	LOW	HIGH

Section 13 - DISPOSAL CONSIDERATIONS

- Containers may still present a chemical hazard/ danger when empty.
- Return to supplier for reuse/ recycling if possible.

Otherwise:

- If container can not be cleaned sufficiently well to ensure that residuals do not remain or if the container cannot be used to store the same product, then puncture containers, to prevent re-use, and bury at an authorised landfill.
- Where possible retain label warnings and MSDS and observe all notices pertaining to the product.

Legislation addressing waste disposal requirements may differ by country, state and/ or territory. Each user must refer to laws operating in their area. In some areas, certain wastes must be tracked.
A Hierarchy of Controls seems to be common - the user should investigate:

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

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

- DO NOT allow wash water from cleaning or process equipment to enter drains.
- It may be necessary to collect all wash water for treatment before disposal.
- In all cases disposal to sewer may be subject to local laws and regulations and these should be considered first.
- Where in doubt contact the responsible authority.
- Recycle wherever possible.

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Section 13 - DISPOSAL CONSIDERATIONS

- Consult manufacturer for recycling options or consult local or regional waste management authority for disposal if no suitable treatment or disposal facility can be identified.
- Dispose of by: burial in a land-fill specifically licenced to accept chemical and / or pharmaceutical wastes or Incineration in a licenced apparatus (after admixture with suitable combustible material)
- Decontaminate empty containers. Observe all label safeguards until containers are cleaned and destroyed.

Section 14 - TRANSPORTATION INFORMATION

HAZCHEM:
None

NOT REGULATED FOR TRANSPORT OF DANGEROUS GOODS: UN, IATA, IMDG

Section 15 - REGULATORY INFORMATION

REGULATIONS

dicyandiamide (CAS: 461-58-5) is found on the following regulatory lists;
"Australia Inventory of Chemical Substances (AICS)","International Council of Chemical Associations (ICCA) - High Production Volume List","OECD Representative List of High Production Volume (HPV) Chemicals"
Regulations for ingredients

melamine (CAS: 108-78-1) is found on the following regulatory lists;
"Australia High Volume Industrial Chemical List (HVICL)","Australia Inventory of Chemical Substances (AICS)","International Agency for Research on Cancer (IARC) - Agents Reviewed by the IARC Monographs","OECD Representative List of High Production Volume (HPV) Chemicals"

Section 16 - OTHER INFORMATION

Denmark Advisory list for selfclassification of dangerous substances

Substance	CAS	Suggested codes
melamine	108- 78- 1	

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
Advice to Doctor	5	16- Jul- 2008	Appearance	4	9- Mar- 2007	Chronic Health	5	16- Jul- 2008
First Aid (inhaled)	5	16- Jul- 2008	Acute Health (eye)	5	16- Jul- 2008	Toxicity and Irritation (Other)	5	16- Jul- 2008
Storage (storage incompatibility)	5	16- Jul- 2008	Acute Health (inhaled)	5	16- Jul- 2008	Environmental	5	16- Jul- 2008
Personal Protection (eye)	5	16- Jul- 2008	Acute Health (skin)	5	16- Jul- 2008	Transport	4	9- Mar- 2007
Personal Protection (hands/feet)	5	16- Jul- 2008						

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Section 16 - OTHER INFORMATION

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: 20-Oct-2017