File No: STD/1341

November 2009

NATIONAL INDUSTRIAL CHEMICALS NOTIFICATION AND ASSESSMENT SCHEME (NICNAS)

FULL PUBLIC REPORT

Magnesium, bromo(hexahydro-2H-azepin-2-onato-.kappa.N1)-

This Assessment has been compiled in accordance with the provisions of the *Industrial Chemicals (Notification and Assessment) Act 1989* (Cwlth) (the Act) and Regulations. This legislation is an Act of the Commonwealth of Australia. The National Industrial Chemicals Notification and Assessment Scheme (NICNAS) is administered by the Department of Health and Ageing, and conducts the risk assessment for public health and occupational health and safety. The assessment of environmental risk is conducted by the Department of the Environment, Water, Heritage and the Arts.

For the purposes of subsection 78(1) of the Act, this Full Public Report may be inspected at our NICNAS office by appointment only at 334-336 Illawarra Road, Marrickville NSW 2204.

This Full Public Report is also available for viewing and downloading from the NICNAS website or available on request, free of charge, by contacting NICNAS. For requests and enquiries please contact the NICNAS Administration Coordinator at:

Street Address:	334 - 336 Illawarra Road MARRICKVILLE NSW 2204, AUSTRALIA.
Postal Address:	GPO Box 58, SYDNEY NSW 2001, AUSTRALIA.
TEL:	+ 61 2 8577 8800
FAX	+ 61 2 8577 8888
Website:	www.nicnas.gov.au

Director
NICNAS

TABLE OF CONTENTS

FULL PUBLIC REPORT

Magnesium, bromo(hexahydro-2H-azepin-2-onato-.kappa.N1)-

1. APPLICANT AND NOTIFICATION DETAILS

APPLICANT(S)
Plastral Pty Ltd (ABN 68 000 144 132)
130 Denison St
HILLSDALE NSW 2036

NOTIFICATION CATEGORY
Standard: Chemical other than polymer (more than 1 tonne per year).

EXEMPT INFORMATION (SECTION 75 OF THE ACT)
Data items and details claimed exempt from publication:
Purity, Import volume, Additives/adjuvants.

VARIATION OF DATA REQUIREMENTS (SECTION 24 OF THE ACT)
Variation to the schedule of data requirements is claimed as follows:
Boiling point, Vapour pressure, Water solubility, Hydrolysis as a function of pH, Partition coefficient, Adsorption/desorption, Dissociation constant, Flash point, Autoignition temperature, Explosive properties, Acute toxicity – inhalation, Skin irritation, Ready biodegradability and Bioaccumulation.

NOTIFICATION IN OTHER COUNTRIES
EU, USA, Canada, Japan

2. IDENTITY OF CHEMICAL

MARKETING NAME(S)
Nyrim C1 Catalyst (10-25% notified chemical)

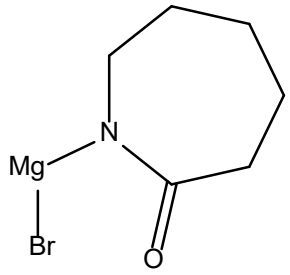
CHEMICAL NAME
Magnesium, bromo(hexahydro-2H-azepin-2-onato-.kappa.N1)-

OTHER NAME(S)
Bromo(hexahydro-2H-azepin-2-onato-N) magnesium
1-azanidacycloheptan-2-one; magnesium (+2) cation; bromide (IUPAC name)
2H-Azepin-2-one, hexahydro-, magnesium complex
Magnesium, bromo(hexahydro-2H-azepin-2-onato)-
Magnesium, bromo(hexahydro-2H-azepin-2-onato-N)-
epsilon.-Caprolactam magnesium bromide
Bromocaprolactam magnesium
Caprolactam magnesium bromide

CAS NUMBER
17091-31-5

MOLECULAR FORMULA
$C_6H_{10}BrMgNO$

STRUCTURAL FORMULA



MOLECULAR WEIGHT
216.36 Da.

ANALYTICAL DATA
Reference IR and HPLC spectra were provided.

3. COMPOSITION

DEGREE OF PURITY 10 - 25%

ADDITIVES/ADJUVANTS

Chemical Name	Hexahydro-2H-azepin-2-one		
CAS No.	105-60-2	*Weight %*	75-90
Hazardous Properties	Xn; R20/22 Xi; R36/37/38		

4. PHYSICAL AND CHEMICAL PROPERTIES

Due to the instability of the notified chemical in isolation, the following tests were conducted using the product, Nyrim C1 Catalyst, containing 10 - 25% notified chemical and 75 - 90% hexahydro-2H-azepin-2-one (ε-Caprolactam) (CAS No.105-60-2) unless otherwise stated.
During performance of these tests, measures do not appear to have been taken to avoid exposure of the test substance to humidity. Thus, some hydrolysis of the notified chemical may have occurred.

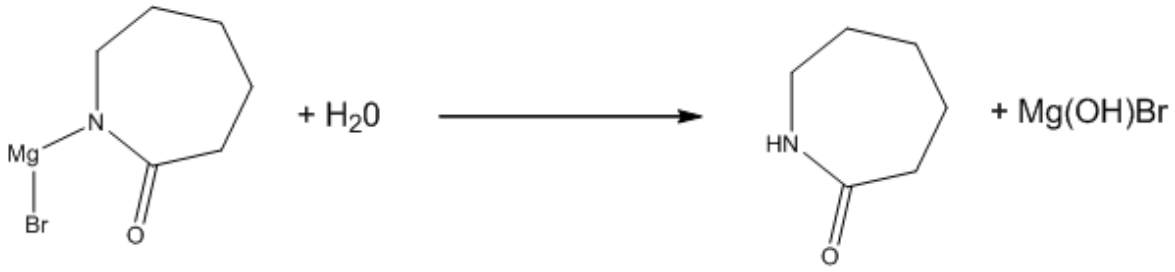
APPEARANCE AT 20°C AND 101.3 kPa: White powder/flakes

Property	Value	Data Source/Justification
Melting Point	86.1-87.5°C	Measured
Boiling Point*	270.8°C at 101.3 kPa	OECD (2001)
Density	1180 kg/m^3 at 20.9°C	Measured
Vapour Pressure*	1.3 x 10^{-4} kPa at 20°C	OECD (2001)
Water Solubility*	4560 g/L at 20°C	OECD (2001)
Hydrolysis as a Function of pH	Readily hydrolysable	Estimated
Partition Coefficient (n-octanol/water)*	log Pow = 0.12 at 20°C	OECD (2001)
Adsorption/Desorption	Not applicable	The notified chemical decomposes in the presence of water.
Dissociation Constant	Not applicable	The notified chemical decomposes in the presence of water.
Particle Size	Inhalable fraction (< 100 μm): < 1%	Measured
Flash Point*	152°C	EC (2000)
Flammability	Not highly flammable	Measured
Autoignition Temperature*	395°C	EC (2000)
Explosive Properties	Does not contain explosophores	Estimated

* Values for hexahydro-2H-azepin-2-one, which is the major component of the imported product, Nyrim C1 Catalyst, and also the degradation product of the notified chemical.

DISCUSSION OF PROPERTIES
Differential scanning calorimetry (DSC) indicated that decomposition of the Nyrim C1 Catalyst (containing 20% notified chemical) occurred at temperatures > 300ºC. For full details of tests on physical and chemical properties, please refer to Appendix A.

Reactivity
The notified chemical is a Grignard reagent that reacts readily with water and decomposes to hexahydro-2H-azepin-2-one (ε-caprolactam) and bromomagnesium hydroxide which reacts further to form the more stable species magnesium bromide (in water) as shown below:



Consequently, testing performed using aqueous solutions are likely to reflect the properties of the degradation products rather than the notified chemical.

5. INTRODUCTION AND USE INFORMATION

MODE OF INTRODUCTION OF NOTIFIED CHEMICAL (100%) OVER NEXT 5 YEARS
The notified chemical will be imported by sea at concentrations of 10 - 25% in the product Nyrim C1 Catalyst.

MAXIMUM INTRODUCTION VOLUME OF NOTIFIED CHEMICAL (100%) OVER NEXT 5 YEARS

Year	*1*	*2*	*3*	*4*	*5*
Tonnes	< 10	< 20	< 20	< 30	< 40

PORT OF ENTRY
Melbourne and Sydney

IDENTITY OF RECIPIENTS
The importer will be Plastral Pty Ltd.

TRANSPORTATION AND PACKAGING
The notified chemical will be imported in 50 kg drums or isotainers and stored in warehouses near the port of entry or at the customer site.

USE
The notified chemical will be used as a catalyst (Grignard reagent) in the production of plastic parts that may be used in heavy duty applications such as transport and pumps.

OPERATION DESCRIPTION
The product containing the notified chemical (10 - 25%) will be automatically fed into a sealed holding tank, from which it will be fed via an automated and closed system into heated moulds. Once injected into the mould, the notified chemical will react with other components to form a copolymer that will be incorporated into the plastic article.

Quality control analysis is also expected to occur.

6. HUMAN HEALTH IMPLICATIONS

6.1 Exposure assessment

6.1.1 Occupational exposure

EXPOSURE DETAILS
Exposure to the imported product containing the notified chemical at 10 - 25% is unlikely during transport and storage unless the packaging is breached.

Production workers may encounter dermal and ocular exposure to solids containing the notified chemical (10 - 25%) during connection and disconnection of equipment between the drums and holding tanks. These workers are expected to wear personal protective equipment (PPE) including rubber gloves, overalls, safety goggles and boots to minimise exposure during transfer to the holding tanks.

Once fed into the holding tanks, the transfer to moulds will occur via a closed, automated process and is expected to result in minimal exposure. It is anticipated that the notified chemical will be completely consumed during the reaction. Thus the amount of unreacted residue of the notified chemical is expected to be negligible and therefore, exposure is not expected after completion of the reaction. Production workers may experience dermal and ocular exposure to residues of the reaction by-products, hexahydro-2H-azepin-2-one and magnesium bromide, while cleaning the reaction equipment. These workers are expected to wear personal protective equipment (PPE) as described above in order to minimise exposure.

Quality control staff may encounter accidental dermal and ocular exposure during sampling. Any exposure to the notified chemical is expected to be minimised by the use of PPE such as laboratory coats, safety goggles and rubber gloves.

6.1.2. Public exposure
The notified chemical will be used only in industrial settings for the production of plastic articles. It is expected to be consumed completely in the production process and is therefore not anticipated to be available for exposure to the public in the finished plastic articles.

6.2. Human health effects assessment

The results from toxicological investigations conducted on the notified chemical and its decomposition products: hexahydro-2H-azepin-2-one and magnesium bromide (in water) are summarised in the table below. Details of studies on the notified chemical can be found in Appendix B.

Table 1 – Toxicity summary of the notified chemical and its decomposition products

Endpoint	*Notified chemical (20% in hexahydro-2H-azepin-2-one)*	*Hexahydro-2H-azepin-2-one[1]*	*Magnesium Bromide[2]*
Rat, acute oral toxicity (mg/kg bw)	LD50 > 2000	LD50 = 1475-1876	-
Rat, acute dermal toxicity mg/kg bw)	LD50 > 2000	LD50 > 2000	May be harmful
Rat, acute inhalation toxicity	-	LC50 = 8.16 mg/L/4hr (aerosol) 0.3 mg/L/2hr (powder) Harmful toxicity (HSIS, 2009)	May be harmful
Skin irritation	-	irritating (humans)	irritating
Rabbit, eye irritation	irritating	irritating (humans)	irritating
Guinea pig, skin sensitisation – adjuvant test.	no evidence of sensitisation	no evidence of sensitisation	-
Repeat dose toxicity	NOAEL = 250 mg/kg bw/day (rat, 28 days oral study)	NOAEL = 33 mg/kg bw/day (rat, 90 days feed study) NOAEL = 250 mg/kg	-

Endpoint	*Notified chemical (20% in hexahydro-2H-azepin-2-one)*	*Hexahydro-2H-azepin-2-one*[1]	*Magnesium Bromide*[2]
		bw/day males NOAEL = 125 mg/kg bw/day females (dog, 13 week feed study)	
Mutagenicity – bacterial reverse mutation	non mutagenic	non mutagenic	-
Genotoxicity – in vitro chromosomal aberration	-	non genotoxic	-
Genotoxicity – in vitro mouse lymphoma	-	non genotoxic	-
Genotoxicity – in vitro unscheduled DNA synthesis (primary rat hepatocytes)	-	non genotoxic	-
Genotoxicity – in vivo mammalian erythrocyte micronucleus test	non genotoxic	non genotoxic	-
Genotoxicity – in vivo mouse spot test		Induction of mitotic recombination	

[1] OECD (2001).

[2] Sigma-Aldrich (2008) Material Safety Data Sheet for Magnesium Bromide (CAS No. 7789-48-2) (98%).

During performance of tests on the notified chemical, measures were not taken to avoid exposure of the test substance to humidity. Many of the tests were performed using aqueous solvent and thus significant hydrolysis of the notified chemical to hexahydro-2H-azepin-2-one is expected to have occurred.

Toxicokinetics, metabolism and distribution

The notified chemical is expected to be readily absorbed following oral, dermal and inhalation exposure based on its low molecular weight (216 Da), estimated high water solubility and partition coefficient (log P_{ow} ~ 0.12). Oral absorption of the notified chemical is also suggested by the increased liver and kidney weights in animals at the high dose level in a repeat dose oral toxicity study in rats and the death of one mouse during the *in vivo* micronucleus test (following oral gavage). The notified chemical is expected to be rapidly hydrolysed *in vivo* to hexahydro-2H-azepin-2-one and magnesium bromide.

Acute toxicity

An acute oral toxicity study was conducted with the notified chemical at 20% in hexahydro-2H-azepin-2-one (using distilled water as vehicle) in 6 female rats according to OECD TG 423 (Phycher, 2008a). Effects were limited to a decrease in spontaneous activity (all animals) associated with a decrease in the righting reflex in 4 animals and piloerection in all 6 animals. However, these observations were absent 48 hours after treatment. Based on this study, the notified chemical at 20% in hexahydro-2H-azepin-2-one was found to have a low acute oral toxicity (LD50 > 2000 mg/kg bw). Acute oral toxicity testing on hexahydro-2H-azepin-2-one indicated harmful toxicity (OECD, 2001), and this is also reflected in the Safe Work Australia classification (HSIS, 2009) of this chemical as being harmful if swallowed (R22). Therefore the notified chemical may exhibit some toxicity after oral exposure but based on the available data there is insufficient evidence to warrant a R22 classification on the notified chemical itself.

An acute dermal toxicity study was conducted with the notified chemical at 20% in hexahydro-2H-azepin-2-one in 10 rats according to OECD TG 402 (Phycher, 2008b). No mortalities or abnormalities were observed and it was concluded that the LD50 > 2000 mg/kg bw.

An acute inhalation study was not conducted on the notified chemical. An acute inhalation toxicity study with aerosolised hexahydro-2H-azepin-2-one concluded that the LC50 was 8.16 mg/L/4hr (OECD, 2001), corresponding to low toxicity. However, Safe Work Australia classification (HSIS, 2009) of hexahydro-2H-azepin-2-one as a dust or vapour indicates it is harmful by inhalation (R20) and irritating to the respiratory system (R37). A 13-week inhalation study was performed in rats exposed to aerosolised hexahydro-2H-azepin-2-one. Local upper respiratory tract effects, including nasoturbinal and laryngeal tissue changes, were observed in all treated animals and thus the no observed adverse effect concentration (NOAEC) was established as the mid exposure concentration (70 mg/m^3). There were no adverse effects observed in the lower respiratory tract, and no

systemic or neurotoxicity effects were observed during the study.

In the sensitisation test (Magnusson and Kligman method) 2 animals died during the preliminary study when concentrations > 8.75% were administered by intradermal injection. This is indicative of acute toxicity via the intradermal route.

Irritation and Sensitisation
A skin irritation test on the notified chemical was not provided. However, observations on human exposure to hexahydro-2H-azepin-2-one suggest that it causes irritation to the skin (OECD, 2001). This is also consistent with Safe Work Australia classification (HSIS, 2009) of hexahydro-2H-azepin-2-one as being irritating to skin (R38). Magnesium bromide may also be irritating to the skin.

The notified chemical at 20% in hexahydro-2H-azepin-2-one produced irritant effects in the eyes of rabbits. Moderate effects were seen in the conjunctivae, iris and cornea, with effects in the conjunctivae lasting up to 9 days after treatment (see Appendix B for details). Observations on human exposure to hexahydro-2H-azepin-2-one suggest that it causes irritation to the eyes (OECD 2001). This is also consistent with Safe Work Australia classification (HSIS, 2009) of hexahydro-2H-azepin-2-one as being irritating to eyes (R36). Magnesium bromide may also be irritating to the eyes.

The notified chemical at 20% in hexahydro-2H-azepin-2-one was found not to be sensitising in a skin sensitisation test (Magnusson and Kligman method) (see Appendix B for details).

Repeated Dose Toxicity
In a 28-day subchronic oral toxicity study, the notified chemical at 20% in hexahydro-2H-azepin-2-one was administered to rats by oral gavage at dose levels of 0, 63, 250 and 1000 mg/kg bw/day. The No Observed Adverse Effect Level (NOAEL) was established as 250 mg/kg bw/day, based on the liver and kidney effects at the highest dose level (see Appendix B for details).

Genotoxicity
The notified chemical at 20% in hexahydro-2H-azepin-2-one was found not to be mutagenic in a bacterial reverse mutation test (see Appendix B for details).

In an *in vivo* micronucleus assay in the bone marrow of mice, the notified chemical at 20% in hexahydro-2H-azepin-2-one was found not to be genotoxic (see Appendix B for details).

Hexahydro-2H-azepin-2-one tested at up to 500 mg/kg bw in a mouse spot test produced equivocal findings. A slight increase in coloured spots was observed in treated embryos when compared to control embryos but these were not dose-dependent. The spots were thought to be a result of mitotic recombination induced by the high dosage of the chemical used in the test (OECD, 2001). *In vitro* studies with hexahydro-2H-azepin-2-one on human lymphocytes at cytotoxic concentrations (> 10 mM, ie. higher than that recommended by the test guideline) also caused chromosomal aberrations (OECD, 2001). However, the relevance of these results was not clear considering carcinogenicity studies with hexahydro-2H-azepin-2-one in rats and mice produced negative results (OECD, 2001).

The notified chemical is considered to have a low mutagenic and carcinogenic potential.

Other studies on hexahydro-2H-azepin-2-one
Hexahydro-2H-azepin-2-one was also found to cause no adverse effects on reproductive organs or function during a 3-generation study in rats (OECD, 2001).

No teratogenic effects were observed in rats or rabbits following oral administration of hexahydro-2H-azepin-2-one. The fetotoxic effects were only observed in these studies at doses that also produced maternal toxicity (OECD, 2001).

Hexahydro-2H-azepin-2-one was not carcinogenic in rats or mice when tested in two-year carcinogenicity studies at feed concentrations of up to 7500 ppm and 15000 ppm, respectively. In addition, these studies showed that it did not induce other toxic effects at these dose levels (OECD, 2001).

Health hazard classification
Based on the reported irritation effects of the notified chemical at 20% in hexahydro-2H-azepin-2-one in the eye of rabbits, and data/classification of hexahydro-2H-azepin-2-one, the breakdown product and a structurally related chemical (skin and respiratory system irritation, and effects upon acute inhalation exposure), the notified chemical should be classified as follows:
R36/37/38: Irritating to eyes, respiratory system and skin.
R20: Harmful by inhalation

6.3. Human health risk characterisation

6.3.1. Occupational health and safety
The hazards of the notified chemical and its decomposition products (hexahydro-2H-azepin-2-one and magnesium bromide) are similar, with the main concerns being irritation of the eye, skin and respiratory system.

The notified chemical and its decomposition products are not expected to be available for exposure during transport, transfer to holding tanks or plastics production. These processes are expected to occur using closed and/or automated procedures designed to prevent exposure of the notified chemical to moisture. In addition, workers would be expected to wear appropriate PPE during these processes to minimise any exposure to accidental leaks and therefore, the potential for irritation is expected to be negligible.

There is some potential for dermal and ocular exposure to the notified chemical and its decomposition products during sampling for quality control analysis and cleaning of the reaction vessels. Personnel involved in these activities are expected to wear appropriate PPE including safety goggles and protective gloves to minimise exposure and the potential for irritation is not expected to be significant.

Overall, the notified chemical and its decomposition products are not considered to present an unreasonable risk to workers provided that the appropriate PPE is used to minimise the potential for exposure.

6.3.2. Public health
The notified chemical or products containing it will not be sold to the public. The public may make dermal contact with finished articles incorporating the notified chemical. However, it is expected to be bound in an inert matrix and will be unavailable for exposure. Therefore the risk to the public from the notified chemical is not considered to be unacceptable.

7. ENVIRONMENTAL IMPLICATIONS

7.1. Environmental Exposure & Fate Assessment

7.1. Environmental Exposure & Fate Assessment

7.1.1 Environmental Exposure

RELEASE OF CHEMICAL AT SITE
As the notified chemical is not manufactured or reformulated domestically, and is imported in 50 kg drums or isotainers, environmental release will only arise from accidental breaches of drums during transport and handling. Due to the nature of the notified chemical (a Grignard reagent), it is expected that any released notified chemical will spontaneously decompose on exposure with water or oxygen to form the known degradation products hexahydro-2H-azepin-2-one and magnesium bromide via bromomagnesium hydroxide.

RELEASE OF CHEMICAL FROM USE
Environmental release of the notified chemical during use is not expected as it is handled in closed systems and is fully consumed (reacted) in the production of plastic articles. Further, the reacted notified chemical will be chemically bound in the solid thermoplastic article, with negligible unreacted notified chemical remaining. Any residual thermoplastic containing the reacted notified chemical arising from quality control sampling and/or cleaning of moulding equipment is expected to be either remelted and reused, or be sent to landfill for disposal. Empty import containers are expected to be sent to drum recyclers where any residual notified chemical is expected to be extracted, decompose (react with water and/or oxygen) and its degradation products be disposed of to landfill.

RELEASE OF CHEMICAL FROM DISPOSAL
Thermoplastic articles containing the reacted notified chemical are expected to be ultimately disposed of to landfill at the end of their serviceable life. In the landfill environment, the thermoplastics should very slowly degrade via biotic and abiotic processes.

7.1.2 Environmental fate

The notified chemical, and its primary organic degradation products were found to be degradable by both biotic processes and abiotic processes (photodegradation). For the details of the environmental fate studies please refer to Appendix C.

7.1.3 Predicted Environmental Concentration (PEC)

Release of notified chemical to the aquatic environment is not expected at any stage of its lifecycle in Australia. Further, even if an uncontrolled release did occur, the notified chemical is expected to exothermically react with water and decompose. Therefore, it is not possible to derive a PEC.

7.2. Environmental effects assessment

The results from ecotoxicological investigations conducted on the notified chemical are summarised in the table below. Details of these studies can be found in Appendix C.

Endpoint	*Result*	*GHS Assessment Conclusion*
Fish Toxicity	LC50 >1000 mg/L	Not harmful to fish
Daphnia Toxicity	EC50 3630 mg/L	Not harmful to daphnids
Algal Toxicity	EC50 4595 mg/L	Not harmful to algae
Inhibition of Bacterial Respiration	EC50 >2000 mg/L	Not inhibitory to sewage microbes
Bacterial Growth Inhibition	EC50 >1000 mg/L	Not inhibitory to *Pseudomonas putida*

The degradation products of the notified chemical were not found to be harmful/inhibitory to aquatic organisms at environmentally relevant concentrations.

7.2.1 Predicted No-Effect Concentration

Using the most sensitive trophic level (fish), the following PNEC has been calculated.

Predicted No-Effect Concentration (PNEC) for the Aquatic Compartment		
Fish Toxicity	>1000	mg/L
Assessment Factor	100	
PNEC:	>10	mg/L

7.3. Environmental risk assessment

As a PEC was not able to be derived, it is not possible to calculate a Risk Quotient (PEC/PNEC). However, given the lack of release to the aquatic environment throughout the lifecycle of the notified chemical, and that the notified chemical would spontaneously decompose in the presence of water and oxygen, even if release did occur, the proposed use pattern and volume of notified chemical is not expected to pose an unacceptable risk to the Australian aquatic environment.

8. CONCLUSIONS AND REGULATORY OBLIGATIONS

Hazard classification
Based on the available data the notified chemical is classified as hazardous under the *Approved Criteria for Classifying Hazardous Substances* [NOHSC:1008(2004)]. The classification and labelling details are:

R36 Irritating to eyes

Based on the reported irritation effects of the breakdown product (and structurally related chemical) hexahydro-2H-azepin-2-one, as irritating to respiratory system and skin (R37/38) and effects upon acute inhalation, the notified chemical should also be considered as though classified as:

R37/38 Irritating to respiratory system and skin
R20 Harmful by inhalation

and

As a comparison only, the classification of the notified chemical using the Globally Harmonised System for the Classification and Labelling of Chemicals (GHS) (United Nations 2003) is presented below. This system is not mandated in Australia and carries no legal status but is presented for information purposes.

	Hazard category	*Hazard statement*
Eye irritation	2A	Irritating to eyes
Specific target organ toxicity after single exposure	3	May cause respiratory irritation

GHS classification was determined for endpoints where sufficient data were available.

Human health risk assessment
Under the conditions of the occupational settings described, the notified chemical is not considered to pose an unacceptable risk to the health of workers.

When used in the proposed manner, the notified chemical is not considered to pose an unacceptable risk to public health.

Environmental risk assessment
On the basis of the reported use volume and pattern, the notified chemical is not considered to pose an unacceptable risk to the environment.

Recommendations

REGULATORY CONTROLS
Hazard Classification and Labelling

- Safe Work Australia should consider the following health hazard classification for the notified chemical:
  - R36/37/38 Irritating to eyes, respiratory system and skin
  - R20 Harmful by inhalation

- Use the following risk phrases for products/mixtures containing the notified chemical:
  - ≥ 20%: R36/37/38 Irritating to eyes, respiratory system and skin
  - ≥ 25%: R20 Harmful by inhalation

CONTROL MEASURES
Occupational Health and Safety

- Employers should implement the following isolation and engineering controls to minimise occupational exposure to the notified chemical as introduced in Nyrim C1 Catalyst:
  - Use closed, automated systems for transferring the product containing the notified chemical to reaction vessels.

- Employers should implement the following safe work practices to minimise occupational exposure during handling of the notified chemical as introduced in Nyrim C1 Catalyst:
  - S22 Do not breathe dust
  - S24/25 Avoid contact with skin and eyes

- Employers should ensure that the following personal protective equipment is used by workers to minimise occupational exposure to the notified chemical as introduced in Nyrim C1 Catalyst:
  - Eye protection, safety gloves and protective clothing.

  Guidance in selection of personal protective equipment can be obtained from Australian, Australian/New Zealand or other approved standards.

- A copy of the MSDS should be easily accessible to employees.

- If products and mixtures containing the notified chemical are classified as hazardous to health in accordance with the *Approved Criteria for Classifying Hazardous Substances* [NOHSC:1008(2004)] workplace practices and control procedures consistent with provisions of State and Territory hazardous substances legislation must be in operation.

Disposal

- The notified chemical should be disposed of to landfill.

Emergency procedures

- Spills or accidental release of the notified chemical should be handled by physical containment, collection and subsequent safe disposal.

Regulatory Obligations

Secondary Notification
This risk assessment is based on the information available at the time of notification. The Director may call for the reassessment of the chemical under secondary notification provisions based on changes in certain circumstances. Under Section 64 of the *Industrial Chemicals (Notification and Assessment) Act (1989)* the notifier, as well as any other importer or manufacturer of the notified chemical, have post-assessment regulatory obligations to notify NICNAS when any of these circumstances change. These obligations apply even when the notified chemical is listed on the Australian Inventory of Chemical Substances (AICS).

Therefore, the Director of NICNAS must be notified in writing within 28 days by the notifier, other importer or manufacturer:

(1) Under Section 64(2) of the Act; if
  - the function or use of the chemical has changed from a catalyst in the production of plastic articles, or is likely to change significantly;
  - the amount of chemical being introduced has increased from 40 tonnes, or is likely to increase, significantly;
  - the chemical has begun to be manufactured in Australia;
  - additional information has become available to the person as to an adverse effect of the chemical on occupational health and safety, public health, or the environment.

The Director will then decide whether a reassessment (i.e. a secondary notification and assessment) is required.

No additional secondary notification conditions are stipulated.

Material Safety Data Sheet
The MSDS of a product containing the notified chemical provided by the notifier was reviewed by NICNAS. The accuracy of the information on the MSDS remains the responsibility of the applicant.

APPENDIX A: PHYSICAL AND CHEMICAL PROPERTIES

Melting Point/Freezing Point 86.1-87.5ºC

Method	OECD TG 102 Melting Point/Melting Range. EC Directive 92/69/EEC A.1 Melting/Freezing Temperature.
Remarks	Test substance: 20% notified chemical in hexahydro-2H-azepin-2-one Measures do not appear to have been taken to ensure that humidity was excluded from the test substance. Thus, some hydrolysis of the notified chemical may have occurred.
Test Facility	LAUS GmbH (2008a)

Density 1180.4 ± 34.2 kg/m^3 at 20.9ºC

Method	OECD TG 109 Density of Liquids and Solids. EC Directive 92/69/EEC A.3 Relative Density.
Remarks	Test substance: 20% notified chemical in hexahydro-2H-azepin-2-one Measures do not appear to have been taken to ensure that humidity was excluded from the test substance. Thus, some hydrolysis of the notified chemical may have occurred.
Test Facility	LAUS GmbH (2008b)

Vapour Pressure 0.00014 kPa at 20ºC.

Remarks	The vapour pressure of the notified chemical itself cannot be determined as it is only stable in the presence of hexahydro-2H-azepin-2-one. The vapour pressure given above is for hexahydro-2H-azepin-2-one. The vapour pressure of the notified chemical (a salt) is expected to be much lower than hexahydro-2H-azepin-2-one (non-salt).
References	OECD (2001), EC (2000)

Water Solubility 4560 g/L at 20ºC

Remarks	The water solubility of the notified chemical cannot be determined due to its instability in water. The water solubility given above is for hexahydro-2H-azepin-2-one.
References	OECD (2001), EC (2000)

Hydrolysis as a Function of pH Readily hydrolysable

Method	Screening test
Remarks	The hydrolysis of the notified chemical can not be determined due to its instability in water. In a screening test, the notified chemical was dissolved in deionised water and the pH was measured. Immediately after mixing, the solution became cloudy and the pH was 9.85; within several days, the cloudiness and high pH was stable. This is a clear indication for the occurrence of hydrolysis in aqueous solution.
Test Facility	BrüggemannChemical, Heilbronn, Germany

Partition Coefficient (n-octanol/water) log Pow at 20ºC = 0.12

Method	OECD 107 Partition Coefficient (n-octanol/water): Shake Flask Method
Remarks	The partition coefficient of the notified chemical can not be determined due to its instability in water. The partition coefficient given above is for hexahydro-2H-azepin-2-one.
References	OECD (2001), EC (2000)

Particle Size

Method OECD TG 110 Particle Size Distribution/Fibre Length and Diameter Distributions.
Conducted by passing the test substance through a sieve with pore diameter of 125 µm.

Range (µm)	*Mass (%)*
< 125	< 0.05

Remarks Test substance: 20% notified chemical in hexahydro-2H-azepin-2-one
Measures do not appear to have been taken to ensure that humidity was excluded from the test substance. Thus, some hydrolysis of the notified chemical may have occurred.
Test Facility LAUS GmbH (2008c)

Flammability Not highly flammable

Method EC Directive 92/69/EEC A.10 Flammability (Solids).
Remarks Test substance: 20% notified chemical in hexahydro-2H-azepin-2-one
Measures do not appear to have been taken to ensure that humidity was excluded from the test substance. Thus, some hydrolysis of the notified chemical may have occurred.
Test Facility LAUS GmbH (2008d)

APPENDIX B: TOXICOLOGICAL INVESTIGATIONS

B.1. Irritation – eye

TEST SUBSTANCE: Notified chemical (20%) in hexahydro-2H-azepin-2-one

METHOD: OECD TG 405 Acute Eye Irritation/Corrosion.
EC Directive 92/69/EEC B.5 Acute Toxicity (Eye Irritation).

Species/Strain: Rabbit/New Zealand White
Number of Animals: 3
Observation Period: 9 Days
Remarks - Method: Measures do not appear to have been taken to ensure that humidity was excluded from the test substance. Thus, some hydrolysis of the notified chemical may have occurred. No other significant protocol deviations.

RESULTS

Lesion	*Mean Score* Animal No.*			*Maximum Value*	*Maximum Duration of Any Effect*	*Maximum Value at End of Observation Period*
	1	2	3			
Conjunctiva: redness	2	2	2	2	< 9 Days	0
Conjunctiva: chemosis	2	2	2	2	< 9 Days	0
Conjunctiva: discharge	1.33	1	0.67	3	< 4 Days	0
Corneal opacity	2	1	1.33	2	< 4 Days	0
Iridial inflammation	0.67	0.33	0.67	1	< 72 hrs	0

*Calculated on the basis of the scores at 24, 48, and 72 hours for EACH animal.

Remarks - Results: The test substance produced moderate chemosis of the conjunctivae in all animals, clearing by Day 7 or Day 9. Moderate redness of the conjunctivae was also observed in all animals, clearing by Day 8 or Day 9. Slight to moderate corneal opacity was observed in all animals, resolving by Day 3 or Day 4. Iridial inflammation was observed in all animals but had cleared completely by 48 or 72 hours.

CONCLUSION: The notified chemical is irritating to the eye.

TEST FACILITY: Phycher (2008c)

B.2. Skin sensitisation

TEST SUBSTANCE: Notified chemical (20%) in hexahydro-2H-azepin-2-one

METHOD: OECD TG 406 Skin Sensitisation – Magnusson and Kligman.
EC Directive 96/54/EC B.6 Skin Sensitisation – Magnusson and Kligman.

Species/Strain: Guinea pig/Dunkin-Hartley
PRELIMINARY STUDY: Maximum Non-irritating Concentration:
intradermal: 8.75%
topical: 40%
MAIN STUDY
Number of Animals: Test Group: 10 Control Group: 5
INDUCTION PHASE: Induction Concentration:
intradermal: 8.75% in isotonic sodium chloride solution.
topical: 80%
Signs of Irritation: Slight dryness of skin in 2 animals, 24 hrs after removal of the dressing.
CHALLENGE PHASE
1st challenge: topical: 40% and 20%
Remarks - Method: In a dose-finding study, both animals died following intradermal injection

	of the test substance at 70%, 35%, 17.5%, 8.75%, 4.375% and 2.1875% concentration. The concentration chosen for the induction phase in the main study was 8.75% in isotonic sodium chloride solution. In the challenge phase of the main study, each of the 10 test animals were treated with the test substance at 40% and 20% at two separate sites on the dorso-lumbar region. Measures were not taken to ensure that humidity was excluded from the test substance as an aqueous solution was used as the vehicle. Thus, hydrolysis of the notified chemical may have occurred.
RESULTS	
Remarks - Results	No signs of irritation or sensitisation were observed after challenge.
CONCLUSION	There was no evidence of reactions indicative of skin sensitisation to the notified chemical under the conditions of the test.
TEST FACILITY	Phycher (2008d).

B.3. Repeat dose toxicity

TEST SUBSTANCE	Notified chemical (20%) in hexahydro-2H-azepin-2-one
METHOD	OECD TG 407 Repeated Dose 28-day Oral Toxicity Study in Rodents.
Species/Strain	Rat:Wistar-Unilever
Route of Administration	Oral – gavage
Exposure Information	Total exposure days: 28 days; Dose regimen: 7 days per week; Dose levels: 0, 63, 250, 1000 mg/kg bw/day
Vehicle	Water
Remarks - Method	Measures were not taken to ensure that humidity was excluded from the test substance as water was used as the vehicle. Thus, hydrolysis of the notified chemical may have occurred. No other significant protocol deviations.

RESULTS

Mortality and Time to Death

No animal of the test item groups or the vehicle groups died during the study.

Clinical Observations

Increased bodyweight gains were observed in treated females; especially those in the high dose group.

Increased water consumption was observed in the high dose groups of both sexes.

On the last two days, the animals of the male high dose group appeared apathetic. No signs of illness, autonomic activity, stereotypies or behavioural reactions were observed during the study.

Laboratory Findings – Haematology

In male animals in the high dose group, statistically significant differences in haematology parameters were observed as follows:
Decreased creatinine, glutamic-oxaloacetic transaminase (GOT), mean corpuscular haemoglobin concentration (MCHC) (dr) level and clotting time, as well as elevated levels in chloride (dr), cholesterol, hematocrit, and mean corpuscular volume (MCV). In males of the medium dose group, chloride levels, leucocytes and MCV were also elevated, while MCHC was decreased. The low dose group showed elevated cholesterol and thrombocyte levels.

In the female high dose animals globulin, chloride, alanine aminotransferase (GPT), and alkaline phosphatase, and total protein levels were elevated, while the albumin/globulin ratio and creatinine levels were decreased. Globulin and leucocyte levels were also elevated in the medium dose animals, and the albumin/globulin ratio also decreased. In low dose females, the albumin/globulin ratio was also decreased.

Some of the changes in the parameters mentioned above were dose related whilst others were not. The study authors indicate that the changes noted in some of the parameters in male animals may indicate altered kidney function, whilst some of those noted in female animals may indicate altered liver function.

Effects in Organs

Statistically significant increases were observed in the absolute and relative kidney weights and the relative liver weights (> 10%) of males in the high dose group. Statistically significant increased absolute and relative liver weights (> 10%) were observed in females of the high dose group. Statistically significant decreases in relative brain, and heart weights and absolute and relative thymus weights were also observed in females of the high dose group; with statistically significant decreased absolute and relative heart weights also observed in females in the medium dose group.

At histopathological examination, a small number of microscopic findings were observed in the organs examined. Of particular note were the increased incidence and severity of basophilic tubules in the kidneys of males and females of the high dose group, as well as an increase in the severity of hyaline droplets in the kidneys of high dose males compared to controls.

Remarks – Results

The altered haematology parameters, increased weights of the liver and kidneys and water consumption, and some histopathological findings observed in animals of the high dose groups indicated a treatment-related response. Given the magnitude of the relative liver weight changes, they were considered to be adverse. The kidney changes were also considered to be adverse, given the corresponding haematological and histopathological effects.

CONCLUSION

The No Observed Adverse Effect Level (NOAEL) was established as 250 mg/kg bw/day in this study, based on the kidney and liver effects observed at the high dose level.

TEST FACILITY NewLab BioQuality (2008)

B.4. Genotoxicity – bacteria

TEST SUBSTANCE	Notified chemical (20%) in hexahydro-2H-azepin-2-one
METHOD	OECD TG 471 Bacterial Reverse Mutation Test. EC Directive 2000/32/EC B.13/14 Mutagenicity – Reverse Mutation Test using Bacteria. Plate incorporation procedure (Test 1) & Pre-incubation procedure (Test 2)
Species/Strain	*S. typhimurium*: TA1535, TA98, TA100, TA102, TA97a
Metabolic Activation System	S9 mix from rat liver induced with Aroclor 1254
Concentration Range in Main Test	a) With metabolic activation: 50 – 4995 µg/plate b) Without metabolic activation: 50 – 4995 µg/plate
Vehicle	Deionised water
Remarks - Method	Measures were not taken to ensure that humidity was excluded from the test substance as water was used as the vehicle. Thus, hydrolysis of the notified chemical may have occurred. No other significant protocol deviations.
RESULTS	
Remarks - Results	There was no precipitation or cytotoxicity observed in any of the strains in the presence or absence of metabolic activation. No substantial increases or decreases in the number of revertant colonies were seen in any strain either in the presence or absence of metabolic activation. There were also no significant reductions in the background lawn. The negative controls were within historical limits of the testing laboratory and the positive controls (Sodium azide, 4-Nitro-1,2-phenylene

diamine, (-S9); 2-Aminoanthracene (+S9)) demonstrated the sensitivity of the assay and the metabolising activity of the liver preparations.

CONCLUSION The notified chemical was not mutagenic to bacteria under the conditions of the test.

TEST FACILITY LAUS (2003e)

B.5. Genotoxicity – in vivo

TEST SUBSTANCE Notified chemical (20%) in hexahydro-2H-azepin-2-one

METHOD OECD TG 474 Mammalian Erythrocyte Micronucleus Test.
Species/Strain Mouse/NMRI
Route of Administration Oral – gavage
Vehicle Deionised water
Remarks - Method Measures were not taken to ensure that humidity was excluded from the test substance as water was used as the vehicle. Thus, hydrolysis of the notified chemical may have occurred. No other significant protocol deviations.

Group	*Number and Sex of Animals*	*Dose mg/kg bw*	*Sacrifice Time Hours (hr)*
I (vehicle control)	6 per sex	0	24
II (low dose)	6 per sex	437.5	24
III (mid dose)	6 per sex	875	24
IV (high dose)	12 per sex*	1750	24 and 48
V (positive control, CP)	6 per sex	40	24

CP = cyclophosphamide.
* Two high dose groups of 12 animals (6 per sex) were used

RESULTS
Doses Producing Toxicity Following administration of the test substance at 1750 mg/kg bw the following effects were observed within 24 hours:
Reduction of spontaneous activity*, abdominal position*, eyelid closure, ruffled fur*, apathy*, tumbling and Straub phenomenon.
* These effects were also observed in some animals treated at the low and mid doses, though they resolved sooner at these doses.

One female treated with 1750 mg/kg bw was found dead at the 6 hour observation.

Genotoxic Effects

Group	*Sacrifice Time hours*	*Dose mg/kg bw*	*PCEs with micronucleated nuclei (%)*	*PCE per 2000 erythrocytes*
vehicle control	24 hrs	0	0.054	1184
low dose	24 hrs	437.5	0.083	1259
mid dose	24 hrs	875	0.104$^{\alpha}$	1181
high dose	24 hrs	1750	0.092	1246
high dose	48 hrs	1750	0.150$^{\alpha}$	1217
positive control, CP	24 hrs	40	2.417	1175

PCE = Polychromatic erythrocyte
$^{\alpha}$ Statistically significant increase compared to the vehicle control.

Whilst some statistically significant increases in the % of micronucleated PCEs were observed (as shown above), the values were within the historical range for this strain (0.01-0.18%) and the increase was not dose-related. Therefore, this was not considered to be indicative of a genotoxic effect.

	The number of PCEs per 2000 erythrocytes was not significantly different in treatment groups when compared to the control group.
Remarks - Results	Cyclophosphamide was used as a positive control which induced a significant increase in the number of micronucleated PCEs confirming the sensitivity of the test system.
CONCLUSION	The notified chemical was not clastogenic under the conditions of the in vivo Mammalian Erythrocyte Micronucleus Test.
TEST FACILITY	Harlan CCR (2008)

APPENDIX C: ENVIRONMENTAL FATE AND ECOTOXICOLOGICAL INVESTIGATIONS

C.1. Environmental Fate

C.1.1. Ready biodegradability

TEST SUBSTANCE	Hexahydro-2H-azepin-2-one (ε-Caprolactam) Data from IUCLID 4 file (European Union)/OECD SIDS assessment
Remarks - Results	The determination of biodegradation of the notified chemical is not possible due to its instability with water. While several studies on ε-Caprolactam biodegradation are available in the EU IUCLID 4 dossier, none of the available studies were performed to the stringent test methods for ready biodegradability. Rather, all studies are described as biodegradation testing according to the test guidelines for inherent biodegradability (e.g. the OECD 302 series). For example, in one study, ε-Caprolactam was inoculated with activated sludge from different sources under aerobic conditions. The biodegradation started after a lag-phase of a maximum of 3.5 days and reached the plateau phase after 13 to 14 days, having degradation rates of 82 % to 95 %. According to the OECD SIDS (12th SIAM, 2001): *"Caprolactam is readily biodegradable according to OECD 301 C with 82% after 14 days (Chemical Industry Ecology-Toxicology & Information Center, Japan 1992). MITI does not publish information about the 10 day window. This result is supplemented by another biodegradation test. It is a combination method modified according to OECD 301 A and B. The analysis parameters are the decrease of DOC and the evolution of CO_2. Industrial activated sludge with a concentration of 150 mg/l dry matter was used as inoculum. The test concentration of caprolactam was 67 mg/l corresponding to 41.9 mg/l DOC. The degradation degree was 90-100 % DOC elimination and 60- 70 % CO_2 evolution after 28 days (BASF AG, 1995)."* From these data, it is reasonable to classify ε-Caprolactam, and therefore the notified chemical, as readily biodegradable. This is further supported by a test on inherent biodegradability conducted with Nyrim® Catalyst C1, as reported in C.1.3 below.
CONCLUSION	The test substance can be classed as ready biodegradable.

C.1.2. Bioaccumulation

TEST SUBSTANCE	Hexahydro-2H-azepin-2-one (ε-Caprolactam) Data from IUCLID 4 file (European Union)
Remarks - Results	According to the IUCLID 4 file the BCF was estimated to be < 1 based on a measured log Kow of -0.19 (Kow = 0.645). There will be no bioaccumulation in aquatic organisms since the log Pow is low and the water solubility is high. The bioaccumulation of the notified chemical will be in the same range because it is not stable in water and decomposes to ε-caprolactam and bromomagnesium hydroxide, which is not stable and forms magnesium bromide (ionic form in water). There is no evidence for bioaccumulation.

CONCLUSION The notified chemical is not expected to bioaccumulate.

C.1.3. Inherent biodegradability

TEST SUBSTANCE Notified chemical

METHOD OECD 302B Inherent Biodegradability: Zahn-Wellens/EMPA Test
EC Directive 88/302/EEC C.9 Biodegradation: Zahn – Wellens Test

Inoculum	Activated sludge from an STP mainly treating household sewage.
Exposure Period	28 days
Auxiliary Solvent	None
Analytical Monitoring	None
Remarks – Method	None

RESULTS

Test substance		*Aniline*	
Day	*% degradation*	*Day*	*% degradation*
8	96.9	8	>100
28	93.5 ± 3.5%	28	>100

Remarks – Results Lag phase 3 days

CONCLUSION The notified chemical can be classified as inherently biodegradable.

TEST FACILITY LAUS GmbH, Kirrweiler, Germany (1999a)

C.1.4. Biochemical/chemical oxygen demand (BOD/COD)

Test Substance Hexahydro-2H-azepin-2-one (ε-Caprolactam)
Data from IUCLID 4 file (European Union)

METHOD German DEV H5 (BOD/COD ratio)

Inoculum	Aerobic, source not identified
Exposure Period	5 days
Auxiliary Solvent	Not indicated
Analytical Monitoring	Not indicated
Remarks – Method	

Remarks – Results The biodegradation measured in two available experiments was 10% and 57 % after 5 days of incubation.

CONCLUSION ε-Caprolactam and the notified chemical (as degraded to ε-Caprolactam) can be considered to undergo biodegradation in the environment.

C.1.5. Photodegradation

TEST SUBSTANCE Hexahydro-2H-azepin-2-one (ε-Caprolactam)
Data from IUCLID 4 file (European Union)

METHOD

Light source and Spectrum	Not indicated
Relative Intensity	Not indicated
Spectrum of Test Substance	Not indicated
Exposure Period	Not indicated
Remarks – Method	Indirect photolysis, concentration of the test item was 500.000 molecules per cm^3

RESULTS

Remarks – Results	After 4.9 hours approximately 50 % of the molecules were degraded. The rate constant was estimated to be 7.9 x 10^{-11}/molecule x sec at 25°C.

CONCLUSION ε-Caprolactam and the notified chemical (as degraded to ε-Caprolactam) can be considered to undergo photodegradation in the environment.

C.2. Ecotoxicological Investigations

C.2.1. Acute toxicity to fish

TEST SUBSTANCE Notified chemical

METHOD	OECD TG 203 Fish, Acute Toxicity Test 96 h, static, limit test.
Species	*Leusciscus idus melanotus*
Exposure Period	96 h
Auxiliary Solvent	None
Water Hardness	Not reported
Analytical Monitoring	
Remarks – Method	No protocol deviations, however it is noted that due to the rapid decomposition of the notified chemical in the presence of water, the test also covers the degradation products of the notified chemical.

RESULTS

Concentration mg/L		*Number of Fish*	*Mortality*				
Nominal	*Actual*		*1 h*	*24 h*	*48 h*	*72 h*	*96 h*
1000		10	0	0	0	0	0

LC50	>1000 mg/L at 96 hours.
NOEC (or LOEC)	1000 mg/L at 96 hours.
Remarks – Results	

CONCLUSION The notified chemical is not harmful to *Leuscicus idus melanotus*.

TEST FACILITY LAUS MgbH, Neustadt/Wenstrasse, Germany (1999b)

C.2.2. Acute toxicity to aquatic invertebrates

TEST SUBSTANCE Notified chemical

METHOD	OECD TG 202 (1984) Daphnia sp. Acute Immobilisation Test and Reproduction Test – 24 h EC50 Acute Immobilisation Test (Static)
Species	*Daphnia magna*
Exposure Period	24 hours
Auxiliary Solvent	None
Water Hardness	Not reported
Analytical Monitoring	None
Remarks – Method	No protocol deviations, however it is noted that due to the rapid decomposition of the notified chemical in the presence of water, the test also covers the degradation products of the notified chemical.

RESULTS

Concentration mg/L		*Number of D. magna*	*Number Immobilised*	
Nominal	*Actual*		*24 h*	*% immobilised*
8000		20	20	100
5000		20	15	75
4500		20	14	70
4000		20	10	50
3000		20	7	35
2500		20	5	25
2000		20	0	0
0		20	0	0

EC50	3630 mg/L at 24 hours
NOEC	2000 mg/L at 24 hours
LOEC	2500 mg/L at 24 hours
Remarks – Results	No deviations reported

CONCLUSION The notified chemical is not harmful to *Daphnia magna*.

TEST FACILITY LAUS GmbH, Neustadt/Weinstrasse, Germany(1999d)

C.2.3. Algal growth inhibition test

TEST SUBSTANCE Notified chemical

METHOD	OECD TG 201 (1984) Alga, Growth Inhibition Test.
Species	*Scenedesmus subspicatus* Chodat (Green Algae)
Exposure Period	72 hours
Concentration Range Nominal	8000 – 1600 mg/L
Concentration Range Actual	Not analysed
Auxiliary Solvent	None
Water Hardness	Not reported
Analytical Monitoring	None
Remarks – Method	No protocol deviations, however it is noted that due to the rapid decomposition of the notified chemical in the presence of water, the test also covers the degradation products of the notified chemical.

RESULTS

Growth	
E_rC50 mg/L at 72 h	*NOEC mg/L*
4595	800

Remarks – Results The 72 h-E_rC100 was determined to be ≥8000 mg/L, the LOEC was 1600 mg/L.

CONCLUSION The notified chemical is not harmful to algae.

TEST FACILITY LAUS GmbH, Neustadt/Weinstrasse, Germany (1999e)

C.2.4. Inhibition of microbial activity

TEST SUBSTANCE	Notified chemical
METHOD	OECD TG 209 Activated Sludge, Respiration Inhibition Test. EC Directive 88/302/EEC C.11 Biodegradation: Activated Sludge Respiration Inhibition Test.
Inoculum	Sewage sludge from domestic sewage treatment plant
Exposure Period	3 hours
Concentration Range Nominal	2000 to 125 mg/L
Remarks – Method	First, in a limit test a concentration of 1000 mg/l (nominal) was tested. In a second test, five concentrations between 2000 and 125 mg/L were tested. The EC50 and NOEC were calculated from the second experiment. Activated sludge samples from a domestic sewage treatment plant were incubated with the test material, together with two controls containing no test compound. As a reference item, 3,5-dichlorophenol was tested in five concentrations to show the sensibility of the activated sludge. No protocol deviations, however it is noted that due to the rapid decomposition of the notified chemical in the presence of water, the test also covers the degradation products of the notified chemical.
RESULTS	
IC50	>2000 mg/L
NOEC	126 mg/L
Remarks – Results	Test validity criteria were satisfied.
CONCLUSION	The notified chemical may be considered at worst, slightly toxic to sewage treatment bacteria.
TEST FACILITY	LAUS GmbH, Kirrweiler, Germany (2008f)

C.2.5. Bacterial Growth Inhibition

TEST SUBSTANCE	Notified chemical
METHOD	EN ISO 10712, DEC 1995: *Pseudomonas putida* growth inhibition test.
Remarks – Method	Bacteria of the species *Pseudomonas putida* (strain *Migula*) were incubated at 23 °C in aqueous solution with different concentrations of the test item for 16 hours. The growth of the bacteria was determined by a photometrical method (optical density 436 nm) at test start (t = 0 h) and test end (t = 16 h). Each treatment was tested in triplicate. The growth inhibition was calculated from the mean biomass gain of the treatment compared with control. As a positive control, 3,5-dichlorophenol was tested in parallel. No protocol deviations, however it is noted that due to the rapid decomposition of the notified chemical in the presence of water, the test also covers the degradation products of the notified chemical.
RESULTS	The 16 h-EC50 was determined to be >1000 mg/L.
Remarks – Results	The test was considered to be valid according to the test guideline. The 16 h-EC50 of the positive control was 20 mg/L
CONCLUSION	The test item was not considered to be growth inhibiting for bacteria under the conditions of the experiment.
TEST FACILITY	LAUS GmbH, Kirrweiler, Germany (1999c)

BIBLIOGRAPHY

Brüggemann (2009) Stability of hydrolysis in demineralised water, (Study No. KA03809_EN, 02 April 2009), Unpublished report submitted by Brüggemann Chemical, Heilbronn, Germany

EC (2000) European Commission – European Chemicals Bureau IUCLID Dataset Existing Chemical EC 203-313-2 ε-Caprolactam, Year 2000 CD-ROM Edition, 18 February 2000. Available for download [12 September 2009]: http://ecb.jrc.ec.europa.eu/esis/

Harlan CCR (2008) Micronucleus Assay in Bone Marrow Cells of the Mouse with Bromo(hexahydro-2H-azepin-2-onato-N)magnesium. Study code 1215800. 64380 Rossdorf, Germany, Cytotest Cell Research GmbH Harlan CCR (formerly RCC Cytotest Cell research GmbH). 24 November 2008 (Unpublished report submitted by notifier).

HSIS (2009) Safe Work Australia Hazardous Substances Information System. Available online [26 October]: http://hsis.ascc.gov.au

LAUS (1999a) Determination of the aerobe biodegradability of organic substances in aqueous medium using the Zahn-Wellens Test. Project No. 0911301J03. 67433 Neustadt/Weinstr., Germany, LAUS – Libertäre Arbeitsgemeinschaft Umweltanalytik und Schadstoffberatung GmbH. 12 March 1999 (Unpublished report submitted by notifier).

LAUS (1999b) Determination of the acute toxicity of a product against *Leuciscus idus melanolus*. Project No. 0911301J04. 67433 Neustadt/Weinstr., Germany, LAUS – Libertäre Arbeitsgemeinschaft Umweltanalytik und Schadstoffberatung GmbH. 19 February 1999 (Unpublished report submitted by notifier).

LAUS (1999c) Determination of the 16h EC10 and EC50 of a substance against *Pseudomonas putida Migula*. Project No. 0911301J05. 67433 Neustadt/Weinstr., Germany, LAUS – Libertäre Arbeitsgemeinschaft Umweltanalytik und Schadstoffberatung GmbH. 23 February 1999 (Unpublished report submitted by notifier).

LAUS (1999d) Determination of the 24h-EC50 of a product against *Daphnia magna*. Project No. 0911301J01. 67433 Neustadt/Weinstr., Germany, LAUS – Libertäre Arbeitsgemeinschaft Umweltanalytik und Schadstoffberatung GmbH. 18 February 1999 (Unpublished report submitted by notifier).

LAUS (1999e) Determination of the 72h-EC50 of a product against *Scenedesmus subspicatus*. Project No. 0901301J02. 67433 Neustadt/Weinstr., Germany, LAUS – Libertäre Arbeitsgemeinschaft Umweltanalytik und Schadstoffberatung GmbH. 11 February 1999 (Unpublished report submitted by notifier).

LAUS (2008a) Determination of the melting point of Bromo(hexahydro-2H-azepin-2-onato-N)magnesium according to OECD 102 resp. EU A.1. Project No. 07120705G904. 67489 Kirrweiler, Germany, LAUS GmbH. 2 May 2008 (Unpublished report submitted by notifier).

LAUS (2008b) Determination of the density of Bromo(hexahydro-2H-azepin-2-onato-N)magnesium according to OECD 109 resp. EU A.3. Project No. 07120705G914. 67489 Kirrweiler, Germany, LAUS GmbH. 12 March 2008 (Unpublished report submitted by notifier).

LAUS (2008c) Determination of the Particle Size Distribution of Bromo(hexahydro-2H-azepin-2-onato-N)magnesium according to OECD 110 resp. ISO 13317-2. Project No. 07120705G972. 67489 Kirrweiler, Germany, LAUS GmbH. 17 December 2008 (Unpublished report submitted by notifier).

LAUS (2008d) Determination of the flammability of Bromo(hexahydro-2H-azepin-2-onato-N)magnesium according to EU A.10. Project No. 07120705G934. 67489 Kirrweiler, Germany, LAUS GmbH. 2 May 2008 (Unpublished report submitted by notifier).

LAUS (2008e) Determination of the mutagenic potential of Bromo(hexahydro-2H-azepin-2-onato-N)magnesium with the Bacterial Reverse Mutation Test following OECD 471 and EU B.13/14. Project No. 07120705G803. 67489 Kirrweiler, Germany, LAUS GmbH. 2 May 2008 (Unpublished report submitted by notifier).

LAUS (2008f) Determination of the Inhibition of the Respiration of Activated Sludge when exposed to Bromo(hexahydro-2H-azepin-2-onato-N)magnesium according to OECD 209 resp. EU C.11. Project No. 07120705G701. 67489 Kirrweiler, Germany, LAUS GmbH. 4 June 2008 (Unpublished report submitted by notifier).

NewLab BioQuality (2008) Toxicity Study on Bromo(hexahydro-2H-azepin-2-onato-N)magnesium – 28-days Oral Toxicity Test in Wistar Rats. Study Report L09-003. 48599 Gronau, Germany, NewLab BioQuality GmbH. 1 September 2008 (Unpublished report submitted by notifier).

NOHSC (1994) National Code of Practice for the Labelling of Workplace Substances [NOHSC:2012(1994)]. National Occupational Health and Safety Commission, Canberra, Australian Government Publishing Service.

NOHSC (2003) National Code of Practice for the Preparation of Material Safety Data Sheets, 2nd edition [NOHSC:2011(2003)]. National Occupational Health and Safety Commission, Canberra, Australian Government Publishing Service.

NOHSC (2004) Approved Criteria for Classifying Hazardous Substances, 3rd edition [NOHSC:1008(2004)]. National Occupational Health and Safety Commission, Canberra, AusInfo.

NTC (National Transport Commission) 2007 Australian Code for the Transport of Dangerous Goods by Road and Rail (ADG code), 7th Edition, Commonwealth of Australia OECD (2001) CAPROLACTUM CAS N°: 105-60-2 - SIDS Initial Assessment Report for 12th SIAM, UNEP Publications, 26 November 2001.

OECD (2001) SIDS Initial Assessment Report for SIAM 12. ε-caprolactam (CAS No. 105-60-2). OECD SIDS, UNEP Publications. 44 pp.

Phycher Bio D. (2008a) Bromo(hexahydro-2H-azepin-2-onato-N)magnesium – Acute Oral Toxicity in the Rat – Study No. TAO423-PH-08/0009. 33611 Cestas, France, Phycher Bio Développement. 28 March 2008 (Unpublished report submitted by notifier).

Phycher Bio D. (2008b) Bromo(hexahydro-2H-azepin-2-onato-N)magnesium – Acute Dermal Toxicity in the Rat. Study No. TAD-PH-08/0009. 33611 Cestas, France, Phycher Bio Développement. 22 May 2008 (Unpublished report submitted by notifier).

Phycher Bio D. (2008c) Bromo(hexahydro-2H-azepin-2-onato-N)magnesium – Eye Irritation Test in the Rabbit. Study No. IO-OCDE-PH-08/0009. 33611 Cestas, France, Phycher Bio Développement. 4 March 2008 (Unpublished report submitted by notifier).

Phycher Bio D. (2008d) Bromo(hexahydro-2H-azepin-2-onato-N)magnesium – Skin Sensitisation in the Guinea Pig – Magnusson and Kligman Maximisation Method. Study No. SMK-PH-08/0009. 33611 Cestas, France, Phycher Bio Développement. 27 March 2008 (Unpublished report submitted by notifier).

Sigma-Aldrich (2006) Material Safety Data Sheet. Magnesium Bromide, 98%. Available online [11 September 009]: test6.chem.wsu.edu/files/MSDS/M/Magnesium%20bromide.pdf

United Nations (2003) Globally Harmonised System of Classification and Labelling of Chemicals (GHS). United Nations Economic Commission for Europe (UN/ECE), New York and Geneva.