Product Safety Summary for ε-Caprolactam

SUBSTANCE NAME

ε-caprolactam
epsilon-Caprolactam
Caprolactam
omega-Caprolactam
2H-Azeptin-2-one, hexahydro- (8CI, 9CI)
Aminocaproic lactam
2-Oxohexamethylenimine
2-Ketohexamethylenimine
2-Perhydroazepinone
6-Hexanelactam
Hexahydro-2H-azepin-2-one
6-Caprolactam
2-Azacycloheptanone
Hexahydro-2-azepinone
Hexanoic acid, 6-amino-, cyclic lactam
1-Aza-2-cycloheptanone
azeepan-2-one

GENERAL STATEMENT

Caprolactam is used as an intermediate in the chemical industry to produce polyamides. Currently 73% of the polyamide is being used for fiber based applications (carpets and clothing), while the remainder 27% is used for the production of engineering plastics (gear wheels, drive systems, intermediates into Nylon-6).

CHEMICAL IDENTITY

EC Name: ε-caprolactam
EC-No.: 203-313-2
CAS-No.: 105-60-2
IUPAC name: azepan-2-one
Molecular formula: C6H11NO
Structural formula:

USES AND APPLICATIONS

Caprolactam is used in industrial applications as a monomer for the manufacture of polyamide, polymers, thermoplastics, resins and thermo-hardened resins. Caprolactam is also used in the laboratory as a reagent. Consumer uses include the use of ready-to-use products, such as coatings, paints and adhesives containing caprolactam, and for which no dilution and mixing steps are necessary.
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PHYSICAL CHEMICAL PROPERTIES

Caprolactam is a white organic solid with a characteristic odor.

- **Melting point/range:** 69.3 °C
- **Boiling point/boiling range:** 270.8 °C at 1013.25 hPa
- **Auto-flammability:** non-flammable
- **Explosive properties:** non-explosive
- **Auto-ignition temperature:** 395 °C at 1013.25 hPa
- **Molecular weight:** 113.1576
- **Water solubility:** 866.89 g/l solution at 22°C
- **LogPow:** 0.12 at 25°C
- **Vapor pressure:** 0.0013 hPa at 20°C
- **Relative density:** 1.105 g/cm³ at 20°C

HEALTH EFFECTS

Based on the classification of the substance (REGULATION (EC) No 1272/2008) acute exposure to Caprolactam may result in irritation and burning of the eyes, nose, throat, and skin in humans. Caprolactam is considered harmful if swallowed, inhaled or absorbed through the skin.

<table>
<thead>
<tr>
<th>EFFECT ASSESSMENT</th>
<th>RESULT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acute Toxicity (oral/dermal/inhalation)</td>
<td>Caprolactam is harmful if swallowed and inhaled.</td>
</tr>
<tr>
<td>Irritation/Corrosivity (skin/eye/respiratory tract)</td>
<td>Caprolactam is a skin and eye irritant. Single exposure may cause respiratory irritation.</td>
</tr>
<tr>
<td>Sensitization</td>
<td>Caprolactam has not been found to be a skin sensitizer.</td>
</tr>
<tr>
<td>Repeated Exposure</td>
<td>This substance has not been found to be harmful through prolonged or repeated exposure.</td>
</tr>
<tr>
<td>Carcinogenicity</td>
<td>Caprolactam is not classified as a carcinogen.</td>
</tr>
<tr>
<td>Reproductive Toxicity</td>
<td>There is no evidence to indicate adverse reproductive or developmental potential to humans for Caprolactam.</td>
</tr>
</tbody>
</table>

ENVIRONMENTAL EFFECTS

Caprolactam is not classified as toxic to the environment or aquatic life. Caprolactam is not considered to hydrolyze rapidly when released to water and is readily biodegradable.

<table>
<thead>
<tr>
<th>EFFECT ASSESSMENT</th>
<th>RESULT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aquatic Toxicity</td>
<td>Not harmful to aquatic life.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>FATE AND BEHAVIOR</th>
<th>RESULT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Biodegradation</td>
<td>Readily biodegradable</td>
</tr>
<tr>
<td>Bioaccumulation potential</td>
<td>Due to the distribution coefficient n-octanol/water an accumulation in organisms is not expected</td>
</tr>
<tr>
<td>PBT/vPvB conclusion</td>
<td>Regarding all available data on biotic and abiotic degradation, bioaccumulation and toxicity it can be stated that the substance does not fulfill the PBT criteria (not a PBT) and not the vPvB criteria (not a vPvB).</td>
</tr>
</tbody>
</table>
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EXPOSURE

Human Health
The most relevant route of exposure to Caprolactam is by inhalation of workers involved in the manufacture and use of this compound, although dermal contact and eye contact routes have to be also taken into account. In an industrial setting, ingestion is not an anticipated route of exposure. The general population may, in the worst case, be exposed to traces of Caprolactam found in some consumer products like coatings, paints, adhesives and other ready-to-use products for which no dilution and mixing steps are necessary, such as printing inks and toners.

Environment
Caprolactam may be released to the environment in air and water from manufacturing and industrial use facilities. Identified uses of the substance have been assessed as safe for the environment. The substance is not known to be directly applied to sediment and an indirect release to sediment is unlikely since the substance is readily biodegradable.

RISK MANAGEMENT RECOMMENDATIONS

Only properly trained and authorized, personnel should be allowed to handle the substance. Caprolactam should be used in a closed system. Caprolactam is a skin irritant and therefore personal protection is required when there is the likelihood of exposure. Therefore, the use of chemical resistant protective gloves should be considered. Caprolactam is an eye irritant; therefore personal protection is required when there is the likelihood of exposure. Exposure to the eyes can occur in two ways: direct from the air (splashes, aerosols, dust) or indirect via hand-eye contact. The likelihood of hand-eye contact is considered to be very low for all contributing scenarios due to the fact that only properly trained or authorized personnel should be allowed to handle the substance. Combined with stringent use of safety glasses with side-shields for all exposure sources at which a likelihood of exposure exists, an effective prevention of potential eye irritation can be achieved. Caprolactam is harmful by inhalation and causes respiratory irritation; therefore suitable respiratory protective device shall be used when aerosol or mist is formed; respiratory filter device shall be used in case of brief exposure or low pollution; and self-contained respiratory protective device shall be used in case of intensive or longer exposure. For personal precautions in case of accidental release: Ensure adequate ventilation. Use breathing apparatus if exposed to vapors/dust/aerosol. For environmental precautions in case of accidental release: Do not empty into drains. Retain and dispose of contaminated wash water.

STATE AGENCY REVIEW

This substance has been registered under REACH (EC) No. 1907/2006. Caprolactam is included in EU HPV list (High Production Volume Chemicals) and in US HPV list. Caprolactam is listed in the following Chemical Inventories: TSCA, ENCS, EINECS, ISHL, AICS, DSL, KECI, PICCS, IESCS, and NZIoC.

REGULATORY INFORMATION/CLASSIFICATION AND LABELING

Classification of the substance according to REGULATION (EC) No 1272/2008:

Acute toxicity: Category 4; Oral; H302 Harmful if swallowed.
Acute toxicity: Category 4; Inhalation; H332 Harmful if inhaled.
Skin/Eye  
(Corrosion/irritation): Category 2; H315 Causes skin irritation.  
Category 2; H319 Causes serious eye irritation.

Specific target organ toxicity  
- Single exposure: Category 3; H335 May cause respiratory irritation.

Labeling according to REGULATION (EC) No 1272/2008:

Pictogram:

Signal word: Warning

Hazard statements:  
H302: Harmful if swallowed.  
H332: Harmful if inhaled.  
H315: Causes skin irritation.  
H319: Causes serious eye irritation.  
H335: May cause respiratory irritation.

CONTACT INFORMATION WITHIN COMPANY

For further information on this substance or product safety summaries in general, please contact:

Company: UBE Chemical Europe, S.A  
Department: Corporate Social Responsibility  
Address: Poligono Industrial El Serrallo, s/n  
Town/Country: Grao de Castellon (Castellon), Spain  
Postal code: 12100  
E-mail: sds.ube.eu@ube.es

Additional information can be found at:  
http://www.ube.es  

GLOSSARY

Acute toxicity: Harmful effect resulting from a single or short term exposure to a substance.

Biodegradation: Decomposition or breakdown of a substance under natural conditions (actions of micro organisms etc).

Bioaccumulation: Progressive accumulation in living organisms of a chemical substance present in the environment.

Canadian DSL: Domestic Substances List of Canada.

Carcinogenicity: Substance effects causing cancer.

CAS: Chemical Abstracts Service (division of the
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Chronic toxicity Harmful effect after repeated exposures or long term exposure to a substance.
EINECS European Inventory of Existing Commercial Chemical Substances
Flash point The lowest temperature at which vapor of the substance may form an ignitable mixture with air.
Genotoxicity Substance effect that causes damage to genes, including mutagenicity and clastogenicity.
GHS Globally Harmonized System of Classification and Labelling of Chemicals
HPV High Production Volume Chemicals.
Hydrolyze Undergo hydrolysis; decompose by reacting with water.
Intermediate Substance that is manufactured for and consumed in or used for chemical processing in order to be transformed into another substance.
Monomer Means a substance which is capable of forming covalent bonds with a sequence of additional like or unlike molecules under the conditions of the relevant polymer-forming reaction used for the particular process.
Mutagenicity Substance effect that cause mutation on genes.
PBT Persistent, bioaccumulative, toxic chemical.
Persistence Refers to the length of time a compound stays in the environment, once introduced.
Risk Management Measures Engineering controls, conditions and protective equipment needed to be implemented to ensure that the risks to human health and the environment are adequately controlled.
REGULATION (EC) No 1272/2008 European Commission Regulation on Classification, Labelling and Packaging of Substances and Mixtures.
Reprotoxicity Including teratogenicity, embryotoxicity and harmful effects on fertility.
Sensitizing Allergenic.
Sediment Topsoil, sand and minerals washed from land into water forming in the end a layer at the bottom of rivers and sea.
TSCA Toxic Substance Control Act
Vapor pressure A measure of a substance’s property to evaporate.
vPvB Very persistent, very bioaccumulative.

DATE OF ISSUE

December 2011
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REVISION
Version 1.0

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