CYANAMIDE

Cyanamide F1000 / Cyanamide L500
From the leader in Cyanamide chemistry
CYANAMIDE
FOR THE SYNTHESIS OF PHARMACEUTICAL AND AGROCHEMICAL ACTIVES,
BIOCIDES, DYESTUFFS AND FINE CHEMICALS

Physical properties

<table>
<thead>
<tr>
<th>Property</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Melting point</td>
<td>46 °C</td>
</tr>
<tr>
<td>Vapour pressure (at 20 °C)</td>
<td>5 x 10^-3 mbar</td>
</tr>
<tr>
<td>Refraction index (melt)</td>
<td>n_d = 1.441</td>
</tr>
<tr>
<td>Crystal density</td>
<td>1.282 g/cm³</td>
</tr>
<tr>
<td>Enthalpy of formation (at 25 ºC)</td>
<td>+61.3 kJ/mol</td>
</tr>
<tr>
<td>Specific heat (0-39 ºC)</td>
<td>2.29 J/g x K</td>
</tr>
<tr>
<td>Heat of fusion</td>
<td>8.76 kJ/mol</td>
</tr>
<tr>
<td>Heat of vaporization</td>
<td>70.5 kJ/mol</td>
</tr>
<tr>
<td>Heat of solution (in water)</td>
<td>+15.1 kJ/mol</td>
</tr>
<tr>
<td>Enthalpy of dimerization (forming Dicyandiamide, at 25 ºC)</td>
<td>-48.8 kJ/mol</td>
</tr>
<tr>
<td>Enthalpy of hydration (forming urea, at 25 ºC)</td>
<td>-109 kJ/mol</td>
</tr>
<tr>
<td>Dissociation constant (forming HNCO⁻)</td>
<td>5.4 x 10^-11</td>
</tr>
<tr>
<td>pK_a = 10.3</td>
<td></td>
</tr>
</tbody>
</table>

Stability

Cyanamide can react with itself forming Dicyandiamide, liberating a reaction enthalpy of -1161 kJ/kg.

This dimerization reaction takes place in crystalline, molten or dissolved Cyanamide and is strongly accelerated by alkalies and heat. In aqueous solution dimerization proceeds between pH 6 and 11 with a maximum reaction speed at pH 9.6.

Dimerizing of Cyanamide forming Dicyandiamide can be prevented by adding special stabilizers and storing at low temperature. For four decades stabilized Cyanamide has been transported, stored and processed safely throughout the chemical industry.

The optimum condition for storing aqueous Cyanamide solutions is between pH 4.0 and 4.5. In acidic solutions Cyanamide adds water forming urea, releasing the reaction enthalpy of -2582 kJ/kg. Further hydrolysis leads to ammonium.

At pH values above 13, aqueous Cyanamide forms the relatively stable hydroycyanamide anion.

Dissociation of Cyanamide-water forms an eutecticum at -16.6 °C.

Reactivity

Cyanamide may be regarded as the amide of cyanic acid or as the nitrile of carbamic acid. The difunctional molecule is capable of reacting as a nucleophile at the amino group or as an electrophile at the cyano group. Many reactions with polyfunctional compounds include both reactive sites forming 5- or 6-membered heterocycles.
Physiologic Properties and Toxicology

The acute oral LD50 (rat) of pure crystalline Cyanamide is 142 mg/kg body weight. The corresponding value for Cyanamide L500 is 284 mg/kg. When applied dermally in rabbits, the LD50 of crystalline Cyanamide is 848 mg/kg. The dermal LD50 of Cyanamide L500 is 1700 mg/kg. Studies on the acute inhalation toxicity (rat) with Cyanamide L500 did not result in mortalities after a 4 hour exposure to 2000 mg/m³ at aerosol atmosphere.

Cyanamide is corrosive to the skin, eyes and mucous membranes. In exceptional cases Cyanamide can cause eczema-like rashes, even after short-term skin contact. Cyanamide has sensitizing properties in guinea pigs (method according to Magnusson and Kligman). The Ames Test, UDS Test and Micronucleus Test did not reveal indications for a mutagenic activity of Cyanamide.

Intake of Cyanamide (by swallowing or inhaling) in combination with alcohol consumption may cause a temporary vasomotoric reaction known as "Cyanamide flush". Shortness of breath, increased pulse frequency, dizziness, headache and distinct reddening of the skin are typical symptoms. This reaction is known to be disagreeable, but is not harmful in general. The symptoms will disappear within a short period. Only in exceptional cases they can last up to 24 hours.

Handling and Storage

Cyanamide is to be handled in accordance with good industrial hygiene and safety practice. The most important precautions for production and lab work are:

- Avoid contact with skin and eyes.
- Wear suitable protective clothing and safety goggles.
- Avoid swallowing or inhaling.
- Use adequate ventilation.
- Do not drink alcoholic beverages before, during and after working with Cyanamide.
- Keep the storage temperature for both Cyanamide LS50 and Cyanamide L1000 below 20 °C.
- In no case apply storage temperatures above 40 °C.
- Avoid prolonged storage over several months.
- Do not store surplus material.
- Do not try to purify Cyanamide by distillation, recrystallization, fractionation freezing or extraction.
- Spontaneous dimerization with an explosive heat release can result, because the stabilizer is removed.
- Do not add acidic or alkaline substances.
- Do not add strongly oxidizing agents.
- Store Cyanamide separately from alkalies, acids or oxidizing compounds.

RANGE OF STABILITY

<table>
<thead>
<tr>
<th>pH</th>
<th>UNSTABLE HYDROLYZES</th>
<th>LIMITED STABILITY</th>
<th>HIGHEST STABILITY</th>
<th>LIMITED STABILITY</th>
<th>UNSTABLE DIMERIZES</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4.0</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>4.5</td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>5.5</td>
<td></td>
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**SPECIFICATION**

**CAS (420-04-2)**

**CYANAMIDE F1000**

stabilized, crystalline Cyanamide
colourless, hygroscopic crystals
Assay min. 99 %
Dicyandiamide max. 1 %
Water max. 1 %
Stabilizer max. 0.5 %

**CYANAMIDE L500**

stabilized 50 % aqueous solution of Cyanamide
Assay 49-51 %
Dicyandiamide max. 1.5 %
Stabilizer max. 2 %

**INCLUDING**

AS THE LEADER IN CYANAMIDE CHEMISTRY, WE ARE PLEASED TO OFFER A FULL SERVICE FOR CYANAMIDE

» On time delivery all over the world
» Full technical service at your production plant
» Education and training of your staff to ensure safe handling
» Assistance in building storage facilities at your plant optimizing
» Assistance for your chemical synthesis
» Customized process development
» Custom synthesis with Cyanamide
» Return of surplus Cyanamide

We would be pleased to send you further information, product details or give assistance as needed.

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