1 Identification of substance:

Product details:

Product name: Ammonium hydroxide, 25% NH₃

Stock number: 87903

Manufacturer/Supplier:

Alfa Aesar, A Johnson Matthey Company
Johnson Matthey Catalog Company, Inc.
30 Bond Street
Ward Hill, MA 01835-8099
Emergency Phone: (978) 521-6300
CHEMTREC: (800) 424-9300
Web Site: www.alfa.com

Information Department: Health, Safety and Environmental Department

Emergency information:

During normal hours the Health, Safety and Environmental Department. After normal hours call Chemtrec at (800) 424-9300.

2 Composition/Data on components:

Chemical characterization:

Description: (CAS#)
Ammonia (CAS# 7664-41-7), 25%
Water (CAS# 7732-18-5), Balance

Identification number(s):
EINECS Number: 215-647-6
EU Number: 007-001-01-2

3 Hazards identification

Hazard description:

C Corrosive
N Dangerous for the environment

Information pertaining to particular dangers for man and environment
R 34 Causes burns.
R 50 Very toxic to aquatic organisms.

Classification system
HMIS ratings (scale 0-4)
(Hazardous Materials Identification System)

<table>
<thead>
<tr>
<th>HEALTH</th>
<th>FIRE</th>
<th>REACTIVITY</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>0</td>
<td>2</td>
</tr>
</tbody>
</table>

Health (acute effects) = 3
Reactivity = 2

4 First aid measures

General information
Immediately remove any clothing soiled by the product.

After inhalation
Supply fresh air. If required, provide artificial respiration. Keep patient warm.
Seek immediate medical advice.

After skin contact
Immediately wash with water and soap and rinse thoroughly.

(Contd. on page 2)
5 Fire fighting measures

Suitable extinguishing agents
Product is not flammable. Use fire fighting measures that suit the surrounding fire.

For safety reasons unsuitable extinguishing agents
Halogenated extinguisher

Protective equipment:
Wear self-contained respirator.
Wear fully protective impervious suit.

6 Accidental release measures

Person-related safety precautions:
Wear protective equipment. Keep unprotected persons away.
Ensure adequate ventilation

Measures for environmental protection:
Do not allow material to be released to the environment without proper governmental permits.

Measures for cleaning/collecting:
Absorb with liquid-binding material (sand, diatomite, acid binders, universal binders, sawdust).
Use neutralizing agent.
Dispose contaminated material as waste according to item 13.
Ensure adequate ventilation.

Additional information:
See Section 7 for information on safe handling
See Section 8 for information on personal protection equipment.
See Section 13 for disposal information.

7 Handling and storage

Handling
Information for safe handling:
Keep container tightly sealed.
Store in cool, dry place in tightly closed containers.
Ensure good ventilation at the workplace.

Information about protection against explosions and fires:
The product is not flammable

Storage
Requirements to be met by storerooms and receptacles:
No special requirements.

Information about storage in one common storage facility:
Do not store together with acids.
Store away from metals.

Further information about storage conditions:
Keep container tightly sealed.
Store in cool, dry conditions in well sealed containers.
8 Exposure controls and personal protection

Additional information about design of technical systems:
Properly operating chemical fume hood designed for hazardous chemicals and having an average face velocity of at least 100 feet per minute.

Components with limit values that require monitoring at the workplace:

Ammonia

<table>
<thead>
<tr>
<th></th>
<th>ppm</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACGIH TLV</td>
<td>25; 35-STELE</td>
</tr>
<tr>
<td>Austria MAK</td>
<td>25</td>
</tr>
<tr>
<td>Belgium TWA</td>
<td>25; 35-STELE</td>
</tr>
<tr>
<td>Denmark TWA</td>
<td>25</td>
</tr>
<tr>
<td>Finland TWA</td>
<td>25; 40-STELE</td>
</tr>
<tr>
<td>France VME</td>
<td>25; 50-VLE</td>
</tr>
<tr>
<td>Germany MAK</td>
<td>50</td>
</tr>
<tr>
<td>Hungary TWA</td>
<td>18; 27-STELE</td>
</tr>
<tr>
<td>Japan OEL</td>
<td>25</td>
</tr>
<tr>
<td>Korea TLV</td>
<td>25; 35-STELE</td>
</tr>
<tr>
<td>Netherlands MAC-TGG</td>
<td>25</td>
</tr>
<tr>
<td>Norway TWA</td>
<td>25</td>
</tr>
<tr>
<td>Poland TWA</td>
<td>20 mg/m3; 27 mg/m3-STELE</td>
</tr>
<tr>
<td>Russia TWA</td>
<td>25; 20 mg/m3-STELE</td>
</tr>
<tr>
<td>Sweden NGV</td>
<td>25; 50-TGV</td>
</tr>
<tr>
<td>Switzerland MAK-W</td>
<td>25; 50-KZG-W</td>
</tr>
<tr>
<td>United Kingdom TWA</td>
<td>25; 35-STELE</td>
</tr>
<tr>
<td>OSHA PEL</td>
<td>50</td>
</tr>
</tbody>
</table>

Additional information: No data

Personal protective equipment

General protective and hygienic measures
The usual precautionary measures for handling chemicals should be followed.

Keep away from foodstuffs, beverages and feed.
Remove all soiled and contaminated clothing immediately.
Wash hands before breaks and at the end of work.
Avoid contact with the eyes and skin.

Breathing equipment:
Use suitable respirator when high concentrations are present.

Protection of hands: Impervious gloves

Eye protection:
Safety glasses
Tightly sealed goggles
Full face protection

Body protection: Protective work clothing.

9 Physical and chemical properties:

<table>
<thead>
<tr>
<th>General Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>Form:</td>
</tr>
<tr>
<td>Liquid</td>
</tr>
<tr>
<td>Color:</td>
</tr>
<tr>
<td>Colorless</td>
</tr>
<tr>
<td>Odor:</td>
</tr>
<tr>
<td>Ammonia-like</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Change in condition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Melting point/Melting range:</td>
</tr>
<tr>
<td>Not determined</td>
</tr>
<tr>
<td>Boiling point/Boiling range:</td>
</tr>
<tr>
<td>Not determined</td>
</tr>
</tbody>
</table>
Material Safety Data Sheet
acc. to OSHA and ANSI

Printing date 05/16/2006
Reviewed on 02/13/2006

Product name: Ammonium hydroxide, 25% NH3

(Contd. of page 3)

<table>
<thead>
<tr>
<th>Property</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sublimation temperature / start:</td>
<td>Not determined</td>
</tr>
<tr>
<td>Flash point:</td>
<td>Not determined</td>
</tr>
<tr>
<td>Ignition temperature:</td>
<td>Not determined</td>
</tr>
<tr>
<td>Decomposition temperature:</td>
<td>Not determined</td>
</tr>
<tr>
<td>Danger of explosion:</td>
<td>Product does not present an explosion hazard.</td>
</tr>
<tr>
<td>Explosion limits:</td>
<td></td>
</tr>
<tr>
<td>Lower:</td>
<td>Not determined</td>
</tr>
<tr>
<td>Upper:</td>
<td>Not determined</td>
</tr>
<tr>
<td>Vapor pressure:</td>
<td>Not determined</td>
</tr>
<tr>
<td>Density:</td>
<td>Not determined</td>
</tr>
<tr>
<td>Solubility in / Miscibility with</td>
<td></td>
</tr>
<tr>
<td>Water:</td>
<td>Not determined</td>
</tr>
</tbody>
</table>

10 Stability and reactivity

Thermal decomposition / conditions to be avoided:
Decomposition will not occur if used and stored according to specifications.

Materials to be avoided:
Acids
Halogens
Oxidizing agents
Aqueous solutions are incompatible with alkali and alkaline earth metals and many reactive organic and inorganic chemicals.

Dangerous reactions No dangerous reactions known
Dangerous products of decomposition:
Ammonia
Nitrogen oxides

11 Toxicological information

Acute toxicity:
LD50/LC50 values that are relevant for classification:
ORL-HMN LDLo: 43 MG/KG (SOLUTIONS 12-44% NH3)
ORL-RAT LD50: 350 MG/KG (SOLUTIONS 12-44% NH3)
INH-HMN LC50: 5000 PPM (SOLUTIONS 12-44% NH3)
EYE-RBT: 44 UG: SEV (SOLUTIONS 12-44% NH3)

Primary irritant effect:
on the skin:
Corrosive effect on skin and mucous membranes.
Irritant to skin and mucous membranes.
on the eye:
Strong corrosive effect.
Irritating effect.
Sensitization: No sensitizing effects known.

(Contd. on page 5)
Product name: Ammonium hydroxide, 25% NH₃

Subacute to chronic toxicity:
Corrosive materials are acutely destructive to the respiratory tract, eyes, skin and digestive tract. Eye contact may result in permanent damage and complete vision loss. Inhalation may result in respiratory effects such as inflammation, edema, and chemical pneumonitis. May cause coughing, wheezing, laryngitis, shortness of breath, headache, nausea and vomiting. Ingestion may cause damage to the mouth, throat and esophagus. May cause skin burns or irritation depending on the severity of the exposure.

Additional toxicological information:
Swallowing will lead to a strong corrosive effect on mouth and throat and to the danger of perforation of esophagus and stomach.
To the best of our knowledge the acute and chronic toxicity of this substance is not fully known.
No classification data on carcinogenic properties of this material is available from the EPA, IARC, NTP, OSHA or ACGIH.

12 Ecological information:
Ecotoxicological effects:
Remark: Very toxic for fish
General notes:
Also poisonous for fish and plankton in water bodies.
Do not allow material to be released to the environment without proper governmental permits.
Very toxic for aquatic organisms

13 Disposal considerations:
Product:
Recommendation
Consult state, local or national regulations to ensure proper disposal.

Uncleaned packagings:
Recommendation: Disposal must be made according to official regulations.

14 Transport information:
DOT regulations:

Hazard class:
Identification number: UN2672
Packing group: III
Proper shipping name (technical name): AMMONIA SOLUTION
Label corrosive
Material Safety Data Sheet
acc. to OSHA and ANSI

Product name: Ammonium hydroxide, 25% NH₃

Land transport ADR/RID (cross-border)

<table>
<thead>
<tr>
<th>ADR/RID class:</th>
<th>8 (C5) Corrosive substances</th>
</tr>
</thead>
<tbody>
<tr>
<td>Danger code (Kemler):</td>
<td>80</td>
</tr>
<tr>
<td>UN-Number:</td>
<td>2672</td>
</tr>
<tr>
<td>Packaging group:</td>
<td>III</td>
</tr>
<tr>
<td>Description of goods:</td>
<td>2672 AMMONIA SOLUTION</td>
</tr>
</tbody>
</table>

Maritime transport IMDG:

| IMDG Class: | 8 |
| UN Number: | 2672 |
| Label | 8 |
| Packaging group: | III |
| Proper shipping name: | AMMONIA SOLUTION |

Air transport ICAO-TI and IATA-DGR:

| ICAO/IATA Class: | 8 |
| UN/ID Number: | 2672 |
| Label | 8 |
| Packaging group: | III |
| Proper shipping name: | AMMONIA SOLUTION |

15 Regulations

Product related hazard informations:

Hazard symbols:
C Corrosive
N Dangerous for the environment

Risk phrases:
34 Causes burns.
50 Very toxic to aquatic organisms.

Safety phrases:
26 In case of contact with eyes, rinse immediately with plenty of water and seek medical advice.
36/37/39 Wear suitable protective clothing, gloves and eye/face protection.
45 In case of accident or if you feel unwell, seek medical advice immediately.
61 Avoid release to the environment. Refer to special instructions/Safety data sheets

National regulations
All components of this product are listed in the U.S. Environmental Protection Agency Toxic Substances Control Act Chemical substance Inventory.
Product name: Ammonium hydroxide, 25% NH₃

All components of this product are listed on the Canadian Domestic Substances List (DSL).

Information about limitation of use:
For use only by technically qualified individuals.
This product is subject to the reporting requirements of section 313 of the Emergency Planning and Community Right to Know Act of 1986 and 40CFR372.

16 Other information:
Employers should use this information only as a supplement to other information gathered by them, and should make independent judgement of suitability of this information to ensure proper use and protect the health and safety of employees. This information is furnished without warranty, and any use of the product not in conformance with this Material Safety Data Sheet, or in combination with any other product or process, is the responsibility of the user.

Department issuing MSDS: Health, Safety and Environmental Department.
Contact: Darrell R. Sanders