Ammonia and Ammonium hydroxide: Human health tier II assessment

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Chemicals in this assessment

Chemical Name in the Inventory	CAS Number
Ammonium hydroxide	1336-21-6
Ammonia	7664-41-7

Preface

This assessment was carried out by staff of the National Industrial Chemicals Notification and Assessment Scheme (NICNAS) using the Inventory Multi-tiered Assessment and Prioritisation (IMAP) framework.

The IMAP framework addresses the human health and environmental impacts of previously unassessed industrial chemicals listed on the Australian Inventory of Chemical Substances (the Inventory).

The framework was developed with significant input from stakeholders and provides a more rapid, flexible and transparent approach for the assessment of chemicals listed on the Inventory.

Stage One of the implementation of this framework, which lasted four years from 1 July 2012, examined 3000 chemicals meeting characteristics identified by stakeholders as needing priority assessment. This included chemicals for which NICNAS already held exposure information, chemicals identified as a concern or for which regulatory action had been taken overseas, and chemicals detected in international studies analysing chemicals present in babies' umbilical cord blood.

Stage Two of IMAP began in July 2016. We are continuing to assess chemicals on the Inventory, including chemicals identified as a concern for which action has been taken overseas and chemicals that can be rapidly identified and assessed by using Stage One information. We are also continuing to publish information for chemicals on the Inventory that pose a low risk to human health or the environment or both. This work provides efficiencies and enables us to identify higher risk chemicals requiring assessment.

The IMAP framework is a science and risk-based model designed to align the assessment effort with the human health and environmental impacts of chemicals. It has three tiers of assessment, with the assessment effort increasing with each tier. The Tier I assessment is a high throughput approach using tabulated electronic data. The Tier II assessment is an evaluation of risk on a substance-by-substance or chemical category-by-category basis. Tier III assessments are conducted to address specific concerns that could not be resolved during the Tier II assessment.

These assessments are carried out by staff employed by the Australian Government Department of Health and the Australian Government Department of the Environment and Energy. The human health and environment risk assessments are conducted and published separately, using information available at the time, and may be undertaken at different tiers.

This chemical or group of chemicals are being assessed at Tier II because the Tier I assessment indicated that it needed further investigation.

For more detail on this program please visit:**www.nicnas.gov.au**

Disclaimer

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ACRONYMS & ABBREVIATIONS

Grouping Rationale

The chemical, ammonia (CAS No. 7664-41-7) dissolves readily in water to form the solution described as ammonium hydroxide (CAS No. 1336-21-6). In biological fluids, the chemicals mostly exist in the ionised form as ammonium ions (NH_4^+), with approximately 99 % ionised in blood within the normal pH range (ASTDR, 2004; OECD, 2007). Although ammonia is a gas and ammonium hydroxide is a solution, given the high vapour pressure of ammonium hydroxide, inhalation is considered a relevant exposure route for assessing both chemicals.

The chemicals have similar uses.

Import, Manufacture and Use

Australian

The following Australian industrial uses were reported under previous mandatory and/or voluntary calls for information.

Ammonia has reported site-limited use as a laboratory chemical and in manufacturing other chemicals for uses such as:

- cleaning/washing agents and additives; and
- explosives.

Ammonia has reported commercial uses including as a:

- pH regulating agent;
- cleaning/washing agent;
- photochemical; and

- flotation agent.

Ammonia is listed on the 2006 High Volume Industrial Chemicals List (HVICL) with a total reported volume of 100000–999999 tonnes.

International

The following international uses have been identified through European Union Registration, Evaluation, Authorisation and Restriction of Chemicals (EU REACH) dossiers; the Organisation for Economic Cooperation and Development Screening Information Dataset Initial Assessment Report (OECD SIAR); Galleria Chemica; Substances and Preparations in the Nordic countries (SPIN) database; the European Commission Cosmetic Ingredients and Substances (CosIng) database; United States (US) Personal Care Product Council International Nomenclature of Cosmetic Ingredients (INCI) dictionary, the US National Library of Medicine's Hazardous Substances Data Bank (HSDB) and various international assessments (IPCS, 1986; ASTDR, 2004).

The chemicals have reported cosmetic use with the identified functions of buffering, masking and as denaturants. The majority of identified products for ammonium hydroxide are hair dye kits which are reported to contain the chemical at concentrations up to 7 % (Household Products Database, US Department of Health and Human Services).

The chemicals have reported domestic use in a range of domestic products up to a concentration of 2 % for ammonia and 5 % for ammonia hydroxide. Identified products include home maintenance products such as adhesives and sealants, auto products such as cleaners and tyre repair products, and a range of cleaning products (Household Products Database, US Department of Health and Human Services).

The chemicals have reported commercial uses including:

- in textile and leather processing;
- in paper processing;
- as corrosion inhibitors;
- as pH-regulating agents; and
- as photochemicals.

Ammonia has reported site-limited uses including:

- in the manufacturing of other chemicals including explosives and fertilisers;
- in condensation polymerisation;
- in metal extraction, refining and processing of metals;
- as complexing agents;
- as heat transferring agents/refrigerant;
- as laboratory chemicals; and
- as reducing agents.

The chemicals have reported non-industrial uses including:

- in disinfectants;
- in agricultural and pharmaceuticals products; and
- food processing.

Restrictions

Australian

The chemicals are listed in the *Poisons Standard*—the Standard for the Uniform Sheduling of Medicines and Poisons (SUSMP) in Schedules 5 and 6 (SUSMP, 2013).

Schedule 6:

'AMMONIA (excluding its salts and derivatives other than ammonium hydroxide) **except**:

(a) when included in Schedule 5;

(b) in preparations for human internal therapeutic use;

(c) in preparations for inhalation when absorbed in an inert solid material; or

(d) in preparations containing 0.5 per cent or less of ammonia.' (SUSMP, 2013)

Schedule 5

'AMMONIA (excluding its salts and derivatives other than ammonium hydroxide) in preparations containing 5 percent or less of ammonia **except**:

(a) in preparations for human internal therapeutic use;

(b) in preparations for inhalation when absorbed in an inert solid material; or

(c) in preparations containing 0.5 per cent or less of free ammonia.' (SUSMP, 2013)

Schedule 6 chemicals are described as 'Substances with a moderate potential for causing harm, the extent of which can be reduced through the use of distinctive packaging with strong warnings and safety directions on the label'. Schedule 6 chemicals are labelled with 'Poison' (SUSMP, 2013).

Schedule 5 chemicals are described as 'Substances with a low potential for causing harm, the extent of which can be reduced through the use of appropriate packaging with simple warnings and safety directions on the label.' Schedule 5 chemicals are labelled with 'Caution' (SUSMP, 2013).

International

The chemicals are listed on EU Cosmetics Regulation 1223/2009 Annex III—List of substances which cosmetic products must not contain except subject to the restrictions laid down. The maximum concentration in ready for use preparations is 6 % (as NH_3). Products containing > 2 % must be labelled 'contains ammonia'.

Ammonia is listed on the following (Galleria Chemica):

- The Association of Southeast Asian Nations (ASEAN) Cosmetic Directive Annex III Part 1—List of substances which cosmetic products must not contain except subject to restriction and conditions laid down;
- Canada Environmental Protection Act (CEPA) 1999—Schedule 1 Toxic Substances List;
- New Zealand Cosmetics Group Standard (2006) Schedule 5— Components cosmetic products must not contain except subject to the restrictions and conditions laid down; and
- *New Zealand Hazardous Substances and New Organisms (HSNO) Act*—Scheduled Toxic Substances.

Existing Worker Health and Safety Controls

Hazard Classification

Ammonia is classified as hazardous, with the following risk phrases for human health in the Hazardous Substances Information System (HSIS) (Safe Work Australia):

T; R23 (Toxic by inhalation)

C; R34 (Causes burns)

Ammonium hydroxide is classified as hazardous, with the following risk phrases for human health in the (HSIS) (Safe Work Australia):

C; R34 (Causes burns)

Exposure Standards

Australian

Ammonia has an exposure standard of 17 mg/m³ (25 ppm) time weighted average (TWA) and 24 mg/m³ (35 ppm) short-term exposure limit (STEL).

International

The following exposure standards for ammonia are identified (Galleria Chemica).

An exposure limit of 14–18 mg/m³ (20–25 ppm) TWA and 24–36 mg/m³ (35–50 ppm) STEL in different countries such as Egypt, Canada (Yukon), Finland, Singapore and South Africa.

The American Conference of Governmental Industrial Hygienists (ACGIH) recommends a threshold limit value (TLV) of 25 ppm (17 mg/m³) TWA and 35 ppm (24 mg/m³) STEL for ammonia. 'These values are intended to minimize the potential for acute ocular and respiratory tract irritation' (ACGIH, 2011).

Health Hazard Information

As the chemicals exist in biological solutions as ammonium ions, data for ammonium chloride (CAS No. 12125-02-9) have been included where data relating to systemic effects are not available.

Toxicokinetics

Ammonia is present in body fluids of animals as a by-product of protein and nucleic acid metabolism and is a component of the diet. Metabolically-produced ammonia is conjugated and excreted. Toxicity only occurs when these mechanisms are defective or if excessive exposure to the chemical occurs.

The chemicals can be absorbed following inhalation and oral exposure. Reviews state that 'absorption through the eye has been documented' (refer to **Corrosivity: Animal data: eye** for more information) (ASTDR, 2004; OECD, 2007). Whilst in vitro studies in human skin indicate that it can act as a barrier to dermal absorption (REACH), the corrosive nature of the chemicals might destroy this protective barrier.

A significant proportion of inhaled ammonia is eliminated in expired air (without absorption). In biological fluids the chemicals mostly exist in the ionised form as ammonium ions (NH_4^+), with approximately 99 % ionised in blood within the normal pH range (ASTDR, 2004; OECD, 2007). After oral ingestion in rats, ammonium ions are rapidly absorbed through the gastrointestinal tract. Thereafter, they are metabolised to urea or glutamine and excreted in urine (within six hours) as urea (ASTDR, 2004; OECD, 2007).

Acute Toxicity

Oral

The chemical, ammonium hydroxide, has moderate acute toxicity based on a result from an animal test following oral exposure. The median lethal dose (LD50) for aqueous ammonia in rats is reported to be 350 mg/kg. In an acute oral toxicity study, 10 male Wistar rats received a single oral dose (by gavage) of ammonium hydroxide (concentration not specified) at various dose levels and were observed for 14 days. Clinical signs included sedation, staggering, abnormal posture, convulsions, tremors, salivation, diarrhoea, ataxia (a lack of voluntary muscle coordination during movement) and laboured breathing. The LD50 in rats is 350 mg/kg bw (OECD, 2007; REACH).

Oral exposure is not considered a relevant route of occupational exposure for ammonia gas.

Dermal

No data are available.

Inhalation

Ammonia is classified as hazardous with the risk phrase ‘Toxic by inhalation’ (T; R23) in HSIS (Safe Work Australia). Whilst the reported median lethal concentration (LC50) values in rats do not support this classification, substantially lower values were observed in mice. Levels that cause lethality are dependent on exposure duration and frequency. In addition, death has been observed in humans exposed to ammonia (see **Acute toxicity: Observation in humans**). Overall, the existing classification is supported.

A one hour study in various species of animals exposed to high concentrations of gaseous ammonia reported the LC50 values as 2961 mg/m^3 in mice and 5137 mg/m^3 in rats. Reported signs of toxicity included excessive respiratory irritation, nasal and mouth secretions, depressed respiratory rates, lung oedema and haemorrhage (OECD, 2007).

In another acute inhalation toxicity study using 10 Wistar rats (both sexes), the animals were exposed to varying concentrations of an ammonia/air mixture over various exposure periods (10, 20, 40 or 60 minutes). After a one hour exposure period, the LC50 values reported were: 9850 mg/m^3 in male and 13770 mg/m^3 in female rats. Reported signs of toxicity included eye irritation, laboured breathing and nasal discharge. In mice, an LC50 of 2940 mg/m^3 was observed after a one hour exposure (OECD, 2007; REACH).

Observation in humans

There are a number of reported cases of death from inhaling ammonia. Concentrations of 3480–6953 mg/m^3 (5000–10000 ppm) are reported to cause almost immediate death, with concentrations of 1738–4519 mg/m^3 (2500–6500 ppm) causing death within 30 minutes. Post-mortem examination findings include burns and oedema to the skin, eyes and respiratory, and blocked larynx and lungs (IPCS, 1986; ASTDR, 2004; OECD, 2007). Irritant effects have occurred following exposure to lower concentrations (see **Irritation/Corrosion: Observation in humans**). Death has also been observed following ingestion of an unknown amount of ammonium hydroxide (ASTDR, 2004).

Corrosion / Irritation

Corrosivity

The chemicals in this group are classified as hazardous with the risk phrase 'Causes burns' (R34) in HSIS (Safe Work Australia). The available data in humans and animals support this classification. In addition, based on effects observed in the respiratory tract, the Globally Harmonized System of Classification (GHS) classification 'Corrosive to the respiratory tract' (AUH071) should apply (refer to **Recommendation** section). The available data for ammonium hydroxide also support the concentration cut-off values currently in HSIS.

Animal data: Skin

In an acute dermal irritation/corrosion study (comparable to OECD Test Guidelines (TG) 404) in rabbits, a 20 % ammonium hydroxide solution tested positive for skin corrosion (OECD, 2007). In another similar study, 0.5 mL of various concentrations of ammonium hydroxide solution (10 % and 12 %) were applied to the shaved skin of 12 female New Zealand White rabbits in a occlusive patch. After a four hour exposure period, a positive corrosive response was observed with the 12 % solution—positive results were based on observed visible tissue destruction in at least two rabbits. The 10 % concentration was not corrosive (Vernot et al., 1977; REACH).

Animal data: Eye

In rabbits, ammonia has been shown to penetrate the cornea rapidly due to its lipid solubility, and to cause burns in the range of 200 –1000 ppm. Highly irritant effects were observed in the eye of a rabbit following exposure to ammonium hydroxide for 30 seconds (OECD, 2007).

Animal data: Respiratory tract

In acute toxicity studies, severe lesions in the respiratory tract were observed in animals exposed to acutely lethal concentrations (ASTDR, 2004).

Observation in humans

There have been several reported cases in which humans have been accidentally exposed to ammonia (as a gas or pressurised liquid). Reported effects include:

- full thickness burns on the skin;
- temporary blindness, corneal abrasions, sustained corneal damage; and
- damage to the respiratory tract such as stripping the bronchial walls of the epithelial lining (IPCS, 1986; ASTDR, 2004; OECD, 2007).

Respiratory and ocular irritation has been observed in workers exposed to lower concentrations, down to 50 ppm (35 mg/m^3). Tolerance appears to develop with repeated exposure (IPCS, 1986; ASTDR, 2004; OECD, 2007).

Oesophageal lesions and oedema were reported in people who ingested ammonium hydroxide, and ulcerative lesions on the tongue and/or on the buccal mucosa were reported in children following biting ammonia pellets/capsules (ASTDR, 2004).

Sensitisation

Skin Sensitisation

No data are available.

Repeated Dose Toxicity

Oral

No data are available for the chemicals. Based on the data for ammonium chloride (CAS No: 12125-02-9) (NICNAS), the chemicals are not expected to cause systemic effects following oral exposure, although local effects in the gastrointestinal tract could occur. Metabolic acidosis has been observed following long-term exposure to ammonium salts such as ammonium chloride, but this is not relevant for these basic chemicals (NICNAS).

Dermal

No data are available.

Inhalation

A number of repeated dose inhalation studies are available for the chemicals. These are all older studies that were not conducted in accordance with current guidelines. In general, no systemic effects were observed, although irritation effects for the eye and respiratory tract were reported (IPCS, 1986; ASTDR, 2004; OECD, 2007).

Mild haematological changes were observed in a 12 week study (non-guideline) in rats following exposure to 100 mg/m^3 for a period of 25 or 60 mins every 48 hours.

In a 90-day continuous exposure study, Sprague Dawley (SD) and Long-Evans rats (both sexes) were exposed to various concentrations of gaseous ammonia (127, 262, 455 and 470 mg/m^3) 24 hours per day. Additionally, 15 Princeton-derived guinea pigs (both sexes), three male New Zealand White rabbits, two purebred male Beagle dogs and three male squirrel monkeys were exposed to a concentration of 470 mg/m^3 of gaseous ammonia. At a dose of 455 mg/m^3, mortalities were observed in 50/51 rats. At the highest concentration, mortalities occurred in 13/15 rats and 4/15 guinea pigs. Eye irritation (including; discharge, erythema, opacity and excessive lacrimation) was observed in both the dogs and rabbits. Nasal discharge was also observed in dogs. Irritation to the lungs was also observed in two rabbits (moderate lung congestion) and one dog (haemorrhagic lesion). In a similar study, but over a shorter exposure period, (30 days, eight hours per day, five days per week) no mortalities were observed up to an exposure concentration of 770 mg/m^3.

Observation in humans

Ocular and respiratory tract irritation has been reported for workers repeatedly exposed to ammonia. Tolerance appears to develop with repeated exposure (see **Corrosivity/Irritation: Observation in humans** for more information).

Genotoxicity

Based on the weight of evidence of the limited available data, the chemicals are not considered to have significant genotoxic potential.

In an Ames assay (OECD TG 471) with five strains of *Salmonella typhimurium* (TA98, TA100, TA1535, TA1537, TA1538) and *Escherichia coli* (WP2uvrA) with varying test doses to a maximum dose of 25,000 ppm with and without metabolic activation—ammonia did not induce gene mutations in any of the strains tested (OECD, 2007). Whilst positive results were observed in an Ames assay with *E. coli*, this was only at toxic doses (ASTDR, 2004). Ammonium hydroxide was negative for genotoxic effects in a non-standard bacterial reverse mutation assay using *E.coli* (REACH).

Equivocal results were reported in studies (in vivo) (mutagenic lethality, sex-linked recessive lethal mutations and dominant lethality) in *Drosophila melanogaster*, with positive results only observed at toxic levels (ASTDR, 2004).

Increased frequency of chromosomal aberrations (CAs) and sister chromatid exchanges (SCEs), increased mitotic index (MI), and increased frequency of CAs and SCEs with increasing length of exposure, were observed in workers exposed to ammonia in a fertiliser factory (ASTDR, 2004). However, there is a number of limitations in this study including gaps in the analysis, small study size and possible confounding factors such as smoking and exposure to other chemicals (UK HPA, 2007).

The weight of evidence indicates that the analogue chemical, ammonium chloride, is not genotoxic (NICNAS).

Carcinogenicity

Based on the limited data available, the chemicals are considered to have a low potential to cause carcinogenic effects.

In a 24-week study, 40 male SD rats were exposed to ammonium hydroxide (0.01 %) in their drinking water daily ad libitum. A significantly higher number of gastric tumours were observed in the exposed group when compared with the control group (OECD, 2007).

In a lifetime study, 50 Swiss and 40 C3H mice (both sexes) were exposed to ammonium hydroxide in their drinking water (0.3 % and 0.1 % solution respectively) ad libitum. No carcinogenic effects were observed (OECD, 2007).

No carcinogenic effects were reported in a study in male and female rats (OECD TG 451), on the analogue chemical, ammonium chloride. In another study in rats and mice, this chemical was found to not be a promoter of carcinogenic effects (NICNAS).

Reproductive and Developmental Toxicity

Based on the available data, the chemicals are not expected to cause specific reproductive or developmental toxicity.

In a six-week reproductive study (non-guideline), two groups of 40 Chester White, Yorkshire and Hampshire female pigs were exposed to average atmospheric ammonia concentrations of 7 and 36 ppm. After six weeks of exposure, half of the pigs were sacrificed and half of the pigs were mated with non-exposed mature boars then sacrificed at day 30 of gestation. No adverse effects on reproductive parameters or foetal developmental effects were observed (ASTDR, 2007).

In developmental studies with the analogue chemical, ammonium chloride, limited effects on foetal development were observed. The reduced foetal growth observed in one study was considered due to maternal toxicity (NICNAS).

Risk Characterisation

Critical Health Effects

The critical health effects for risk characterisation include corrosivity and acute toxicity from inhalation exposure.

Public Risk Characterisation

Although use in cosmetic/domestic products in Australia is not known, the chemical is reported to be used in cosmetic/domestic products overseas at concentrations up to 7 %.

The chemicals are currently listed on Schedules 5 and 6 of the SUSMP. At concentrations between 0.5 % and 5 % the label 'Caution' applies. At concentrations >5 % (and particularly >20 %), a number of warning statements, first aid instructions and safety directions relating to eye, skin and respiratory exposure apply.

The current controls are considered adequate to minimise the risk to public health posed by domestic and cosmetic products containing the chemical, therefore, the chemical is not considered to pose an unreasonable risk to public health.

Occupational Risk Characterisation

During product formulation, dermal, ocular and inhalation exposure of workers to the chemicals can occur, particularly where manual or open processes are used. These could include transfer and blending activities, quality control analysis, and cleaning and maintaining equipment. Worker exposure to the chemicals at lower concentrations might also occur while using formulated products containing the chemicals. The level and route of exposure will vary depending on the method of application and work practices employed.

Given the critical systemic acute and local health effects, the chemicals could pose an unreasonable risk to workers unless adequate control measures to minimise dermal, ocular and inhalation exposure to the chemicals are implemented. The chemicals should be appropriately classified and labelled to ensure that a person conducting a business or undertaking (PCBU) at a workplace (such as an employer) has adequate information to determine appropriate controls.

The data available support an amendment to the hazard classification in HSIS for ammonium hydroxide (refer to **Recommendation** section).

NICNAS Recommendation

Assessment of the chemicals are considered to be sufficient, provided that the recommended amendment to the classification is adopted, and labelling and all other requirements are met under workplace health and safety and poisons legislation as adopted by the relevant state or territory.

Regulatory Control

Public Health

Products containing the chemicals should be labelled in accordance with state and territory legislation (SUSMP).

Work Health and Safety

The chemicals are recommended for classification and labelling under the current approved criteria and adopted GHS as below. This assessment does not consider classification of physical hazards and environmental hazards.

NOTE: The acute toxicity oral classification applies to ammonium hydroxide (CAS No. 1336-21-6) only.

Hazard	Approved Criteria (HSIS)[a]	GHS Classification (HCIS)[b]
Acute Toxicity	Harmful if swallowed (Xn; R22) Toxic by inhalation (T; R23)*	Harmful if swallowed - Cat. 4 (H302) Toxic if inhaled - Cat. 3 (H331)
Irritation / Corrosivity	Causes burns (C; R34)*	Corrosive to the respiratory tract (AUH071) Causes severe skin burns and eye damage - Cat. 1 (H314)

[a] Approved Criteria for Classifying Hazardous Substances [NOHSC:1008(2004)].

[b] Globally Harmonized System of Classification and Labelling of Chemicals (GHS) United Nations, 2009. Third Edition.

[*] Existing Hazard Classification. No change recommended to this classification

Advice for consumers

Products containing the chemicals should be used according to the instruction on the label.

Advice for industry

Control measures

Control measures to minimise the risk from oral/dermal/ocular/inhalation exposure to the chemicals should be implemented in accordance with the hierarchy of controls. Approaches to minimise risk include substitution, isolation and engineering controls. Measures required to eliminate or minimise risk arising from storing, handling and using a hazardous chemical depend on the physical form and the manner in which the chemical is used. Examples of control measures which may minimise the risk include, but are not limited to:

- using closed systems or isolating operations;
- using local exhaust ventilation to prevent the chemical from entering the breathing zone of any worker;
- air monitoring to ensure control measures in place are working effectively and continue to do so;
- minimising manual processes and work tasks through automating processes;
- work procedures that minimise splashes and spills;
- regularly cleaning equipment and work areas; and
- using protective equipment that is designed, constructed, and operated to ensure that the worker does not come into contact with the chemical.

Guidance on managing risks from hazardous chemicals are provided in the *Managing risks of hazardous chemicals in the workplace—Code of practice* available on the Safe Work Australia website.

Personal protective equipment should not solely be relied upon to control risk and should only be used when all other reasonably practicable control measures do not eliminate or sufficiently minimise risk. Guidance in selecting personal protective equipment can be obtained from Australian, Australian/New Zealand or other approved standards.

Obligations under workplace health and safety legislation

Information in this report should be taken into account to assist with meeting obligations under workplace health and safety legislation as adopted by the relevant state or territory. This includes, but is not limited to:

- ensuring that hazardous chemicals are correctly classified and labelled;
- ensuring that (material) safety data sheets ((m)SDS) containing accurate information about the hazards (relating to both health hazards and physicochemical (physical) hazards) of the chemical are prepared; and
- managing risks arising from storing, handling and using a hazardous chemical.

Your work health and safety regulator should be contacted for information on the work health and safety laws in your jurisdiction.

Information on how to prepare an (m)SDS and how to label containers of hazardous chemicals are provided in relevant codes of practice such as the *Preparation of safety data sheets for hazardous chemicals— Code of practice* and *Labelling of workplace hazardous chemicals—Code of practice*, respectively. These codes of practice are available from the Safe Work Australia website.

A review of the physical hazards of the chemicals has not been undertaken as part of this assessment.

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Chemical Identities

Chemical Name in the Inventory and Synonyms	**Ammonium hydroxide** Ammonia aqua Ammonia water Aqueous ammonia Ammonium liquor
CAS Number	1336-21-6
Structural Formula	

	
Molecular Formula	H5NO
Molecular Weight	35.04

Chemical Name in the Inventory and Synonyms	**Ammonia** Ammonia anhydrous Ammonia gas Ammoniac
CAS Number	7664-41-7
Structural Formula	

	
Molecular Formula	H3N
Molecular Weight	17.03

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