ionz

SAFETY DATA SHEET

Updated on 26/09/2024

1. Material Identification

Product Name : Ammonia
Catalog Number : io-1703
CAS Number : 7664-41-7
Identified uses : Laboratory chemicals, manufacture of chemical compounds
Company : Ionz

>> R&D Use only

2. Hazards Identification

GHS Classification:

Flammable liquid (category 2)
Acute toxicity, oral (Category 3)
Acute toxicity, dermal (Category 3)
Acute toxicity, inhalation (Category 3)
Specific target organ toxicity, single exposure (Category 1)

Note

>> Pictograms displayed are for > 99.9% (3511 of 3512) of reports that indicate hazard statements. This chemical does not meet GHS hazard criteria for < 0.1% (1 of 3512) of reports.

Pictogram(s)

GHS Hazard Statements

>> H221 (87.7%): Flammable gas [Danger Flammable gases]

>> H280 (29.6%): Contains gas under pressure; may explode if heated [Warning Gases under pressure]

>> H314 (> 99.9%): Causes severe skin burns and eye damage [Danger Skin corrosion/irritation]

>> H331 (87.6%): Toxic if inhaled [Danger Acute toxicity, inhalation]

>> H332 (11.6%): Harmful if inhaled [Warning Acute toxicity, inhalation]

>> H335 (11.8%): May cause respiratory irritation [Warning Specific target organ toxicity, single exposure; Respiratory tract irritation]

>> H400 (> 99.9%): Very toxic to aquatic life [Warning Hazardous to the aquatic environment, acute hazard]

>> H411 (29.2%): Toxic to aquatic life with long lasting effects [Hazardous to the aquatic environment, long-term hazard]

Precautionary Statement Codes

>> P210, P260, P261, P264, P271, P273, P280, P301+P330+P331, P302+P361+P354, P304+P340, P305+P354+P338, P316, P317, P319, P321, P363, P377, P381, P391, P403, P403+P233, P405, P410+P403, and P501

NFPA 704 Diamond

NFPA Health Rating

>> 3 - Materials that, under emergency conditions, can cause serious or permanent injury.

NFPA Fire Rating

>> 1 - Materials that must be preheated before ignition can occur. Materials require considerable preheating, under all ambient temperature conditions, before ignition and combustion can occur.

NFPA Instability Rating

>> 0 - Materials that in themselves are normally stable, even under fire conditions.

Highly Hazardous Substance:

This section provides information on this chemical as a highly hazardous substance (due to potential safety and hazards issues from its high toxicity and/or reactivity). The information in this section is from two sources: (1) Annex XVII to REACH (Registration, Evaluation, Authorisation and Restriction of Chemicals) from the European Chemicals Agency (ECHA), (2) ECHA's Candidate List of Substances of Very High Concern (SVHC) for Authorisation and (3) the List of Highly Hazardous Chemicals, Toxics and Reactives (29 CFR 1910.119 Appendix A).

OSHA Highly Hazardous Chemicals, Toxics and Reactives

>> Chemical: Ammonia, Anhydrous

>> Threshold: 10000 [lb]

>> Note: Ammonia, Anhydrous in quantities at or above above 10000lb presents a potential for a catastrophic event as a toxic or reactive highly hazardous chemical.

Health Hazards:

>> Excerpt from ERG Guide 125 [Gases - Toxic and/or Corrosive]:

>> TOXIC and/or CORROSIVE; may be fatal if inhaled, ingested or absorbed through skin. Vapors are extremely irritating and corrosive. Contact with gas or liquefied gas may cause burns, severe injury and/or frostbite. Fire will produce irritating, corrosive and/or toxic gases. Runoff from fire control or dilution water may cause environmental contamination. (ERG, 2024)

ERG 2024, Guide 125 (Ammonia, anhydrous)

>> TOXIC and/or CORROSIVE; may be fatal if inhaled, ingested or absorbed through skin.

>> Vapors are extremely irritating and corrosive.

>> Contact with gas or liquefied gas may cause burns, severe injury and/or frostbite.

>> Fire will produce irritating, corrosive and/or toxic gases.

>> Runoff from fire control or dilution water may cause environmental contamination.

>> Excerpt from ERG Guide 125 [Gases - Toxic and/or Corrosive]:

>> Some may burn but none ignite readily. Vapors from liquefied gas are initially heavier than air and spread along ground. Some of these materials may react violently with water. Cylinders exposed to fire may vent and release toxic and/or corrosive gas through pressure relief devices. Containers may explode when heated. Ruptured cylinders may rocket. For UN1005: Anhydrous ammonia, at high concentrations in confined spaces, presents a flammability risk if a source of ignition is introduced. (ERG, 2024)

ERG 2024, Guide 125 (Ammonia, anhydrous)

>> Some may burn but none ignite readily.

>> Vapors from liquefied gas are initially heavier than air and spread along ground.

>> Some of these materials may react violently with water.

>> Cylinders exposed to fire may vent and release toxic and/or corrosive gas through pressure relief devices.

>> Containers may explode when heated.

>> Ruptured cylinders may rocket.

>> For UN1005: Anhydrous ammonia, at high concentrations in confined spaces, presents a flammability risk if a source of ignition is introduced.

>> Flammable. Cylinder may explode in heat of fire. Gas/air mixtures are explosive.

Hazards Identification

ERG Hazard Classes

>> Toxic/poison by inhalation (TIH/PIH)

3. Composition/Information On Ingredients

Chemical name : Ammonia
CAS Number : 7664-41-7
Molecular Formula : H3N
Molecular Weight : 17.0310 g/mol

4. First Aid Measures

First Aid:

>> Excerpt from ERG Guide 125 [Gases - Toxic and/or Corrosive]:

>> Refer to the "General First Aid" section. Specific First Aid: In case of contact with liquefied gas, only medical personnel should attempt thawing frosted parts. In case of skin contact with hydrogen fluoride, anhydrous (UN1052), if calcium gluconate gel is available, rinse 5 minutes, then apply gel. Otherwise, continue rinsing until medical treatment is available. (ERG, 2024)

ERG 2024, Guide 125 (Ammonia, anhydrous)

>> General First Aid:

>> Call 911 or emergency medical service.

>> Ensure that medical personnel are aware of the material(s) involved, take precautions to protect themselves and avoid contamination.

>> Move victim to fresh air if it can be done safely.

>> Administer oxygen if breathing is difficult.

>> If victim is not breathing:

>> DO NOT perform mouth-to-mouth resuscitation; the victim may have ingestedor inhaled the substance.

>> If equipped and pulse detected, wash face and mouth, then give artificial respiration using a proper respiratory medical device (bag-valve mask, pocket mask equipped with a one-way valve or other device).

>> If no pulse detected or no respiratory medical device available, provide continuouscompressions. Conduct a pulse check every two minutes or monitor for any signs of spontaneous respirations.

>> Remove and isolate contaminated clothing and shoes.

>> For minor skin contact, avoid spreading material on unaffected skin.

>> In case of contact with substance, remove immediately by flushing skin or eyes with running water for at least 20 minutes.

>> For severe burns, immediate medical attention is required.

>> Effects of exposure (inhalation, ingestion, or skin contact) to substance may be delayed.

>> Keep victim calm and warm.

>> Keep victim under observation.

>> For further assistance, contact your local Poison Control Center.

>> Note: Basic Life Support (BLS) and Advanced Life Support (ALS) should be done by trained professionals.

>> Specific First Aid:

>> In case of contact with liquefied gas, only medical personnel should attempt thawing frosted parts.

>> In case of skin contact with hydrogen fluoride, anhydrous (UN1052), if calcium gluconate gel is available, rinse 5 minutes, then apply gel. Otherwise, continue rinsing until medical treatment is available.

>> In Canada, an Emergency Response Assistance Plan (ERAP) may be required for this product. Please consult the shipping paper and/or the "ERAP" section.

First Aid Measures

Inhalation First Aid

>> Fresh air, rest. Half-upright position. Administration of oxygen may be needed. Refer immediately for medical attention.

Skin First Aid

>> Rinse skin with plenty of water or shower for at least 15 minutes. ON FROSTBITE: rinse with plenty of water, do NOT remove clothes. Refer immediately for medical attention .

Eye First Aid

>> Rinse with plenty of water for several minutes (remove contact lenses if easily possible). Refer immediately for medical attention.

5. Fire Fighting Measures

>> Under prolonged exposure to fire or intense heat the containers may rupture violently and rocket.

>> Excerpt from ERG Guide 125 [Gases - Toxic and/or Corrosive]:

>> SMALL FIRE: Dry chemical or CO2.

>> LARGE FIRE: Water spray, fog or regular foam. If it can be done safely, move undamaged containers away from the area around the fire. Do not get water inside containers. Damaged cylinders should be handled only by specialists.

>> FIRE INVOLVING TANKS: Fight fire from maximum distance or use unmanned master stream devices or monitor nozzles. Cool containers with flooding quantities of water until well after fire is out. Do not direct water at source of leak or safety devices; icing may occur. Withdraw immediately in case of rising sound from venting safety devices or discoloration of tank. ALWAYS stay away from tanks in direct contact with flames. (ERG, 2024)

>> Wear positive pressure breathing apparatus and full protective clothing.

>> Small fires: dry chemical or carbon dioxide. Large fires: water spray, fog or foam. Apply water gently to the surface. Do not get water inside container. Move container from fire area if you can do it without risk. Stay away from ends of tanks. Cool containers that are exposed to flames with water from the side until well after fire is out. Isolate area until gas has dispersed. (EPA, 1998)

>> Excerpt from ERG Guide 154 [Substances - Toxic and/or Corrosive (Non-Combustible)]:

>> SMALL FIRE: Dry chemical, CO2 or water spray.

>> LARGE FIRE: Dry chemical, CO2, alcohol-resistant foam or water spray. If it can be done safely, move undamaged containers away from the area around the fire. Dike runoff from fire control for later disposal.

>> FIRE INVOLVING TANKS, RAIL TANK CARS OR HIGHWAY TANKS: Fight fire from maximum distance or use unmanned master stream devices or monitor nozzles. Do not get water inside containers. Cool containers with flooding quantities of water until well after fire is out. Withdraw immediately in case of rising sound from venting safety devices or discoloration of tank. ALWAYS stay away from tanks in direct contact with flames. (ERG, 2024)

>> In case of fire in the surroundings, use appropriate extinguishing media. In case of fire: keep cylinder cool by spraying with water.

>> Ammonia is flammable.

>> Fire will produce irritating, corrosive, and/or toxic gases.

>> Never direct water jet straight at liquid ammonia.

>> For small fires use dry chemical or carbon dioxide.

>> For large fires use water spray, fog, or regular foam. Move containers from the fire area if possible to do so without risk to personnel. Do not get water inside containers. Damaged cylinders should be handled by a specialist only.

>> For fire involving tanks, fight fire from a maximum distance or use unmanned hose holders or monitor nozzles. Cool containers with flooding quantities of water until well after fire is out. Do not direct water at source of leak or safety device; icing may occur. Withdraw immediately in case of rising sound from venting safety device or discoloration of tank. Always stay away from tanks engulfed in fire.

>> Run-off from fire control may cause pollution.

>> If the situation allows, control and properly dispose of run-off (effluent).

6. Accidental Release Measures

Isolation and Evacuation:

Isolation and evacuation measures to take when a large amount of this chemical is accidentally released in an emergency.

>> Excerpt from ERG Guide 125 [Gases - Toxic and/or Corrosive]:

>> IMMEDIATE PRECAUTIONARY MEASURE: Isolate spill or leak area for at least 100 meters (330 feet) in all directions.

>> SPILL: Increase the immediate precautionary measure distance, in the downwind direction, as necessary.

>> FIRE: If tank, rail tank car or highway tank is involved in a fire, ISOLATE for 1600 meters (1 mile) in all directions; also, consider initial evacuation for 1600 meters (1 mile) in all directions. (ERG, 2024)

Evacuation: ERG 2024, Guide 125 (Ammonia, anhydrous)

>> Immediate precautionary measure

>> Isolate spill or leak area for at least 100 meters (330 feet) in all directions.

>> Spill

>> For non-highlighted materials: increase the immediate precautionary measure distance, in the downwind direction, as necessary.

>> Fire

>> If tank, rail tank car or highway tank is involved in a fire, ISOLATE for 1600 meters (1 mile) in all directions; also, consider initial evacuation for 1600 meters (1 mile) in all directions.

Isolation

>> Small spill:

>> ISOLATE in all directions: 30 m (100 ft)

>> Large spill:

>> ISOLATE in all Directions:

>> Rail tank car: 300 m (1000 ft)

>> Highway tank truck or trailer: 150 m (500 ft)

>> Agricultural nurse tank: 60 m (200 ft)

>> Multiple small cylinders: 30 m (100 ft)

Protection

>> Small spill:

>> PROTECT people from downwind during DAY time: 0.1 km (0.1 mi)

>> PROTECT people from downwind during NIGHT time: 0.2 km (0.1 mi)

>> Large spill:

>> PROTECT people from downwind during DAY time:

>> Rail tank car:

>> - - Low wind (< 6 mph (<10 km/h)): 1.6 km (1.0 mi)

>> - - Moderate wind (6-12 mph (10-20 km/h)): 1.2 km (0.8 mi)

>> - - High wind (> 12 mph (>20 km/h)): 1.0 km (0.6 mi)

>> Highway tank truck or trailer:

>> - - Low wind (< 6 mph (<10 km/h)): 0.8 km (0.5 mi)

>> - - Moderate wind (6-12 mph (10-20 km/h)): 0.5 km (0.3 mi)

>> - - High wind (> 12 mph (>20 km/h)): 0.4 km (0.3 mi)

>> Agricultural nurse tank:

>> - - Low wind (< 6 mph (<10 km/h)): 0.5 km (0.3 mi)

>> - - Moderate wind (6-12 mph (10-20 km/h)): 0.3 km (0.2 mi)

>> - - High wind (> 12 mph (>20 km/h)): 0.3 km (0.2 mi)

>> Multiple small cylinders:

>> - - Low wind (< 6 mph (<10 km/h)): 0.3 km (0.2 mi)

>> - - Moderate wind (6-12 mph (10-20 km/h)): 0.2 km (0.1 mi)

>> - - High wind (> 12 mph (>20 km/h)): 0.1 km (0.1 mi)

>> PROTECT people from downwind during NIGHT time:

>> - - Low wind (< 6 mph (<10 km/h)): 4.1 km (2.6 mi)

>> - - Moderate wind (6-12 mph (10-20 km/h)): 2.1 km (1.3 mi)

>> - - High wind (> 12 mph (>20 km/h)): 1.3 km (0.8 mi)

>> - - Low wind (< 6 mph (<10 km/h)): 1.8 km (1.1 mi)

>> - - Moderate wind (6-12 mph (10-20 km/h)): 0.7 km (0.4 mi)

>> - - High wind (> 12 mph (>20 km/h)): 0.6 km (0.4 mi)

>> - - Low wind (< 6 mph (<10 km/h)): 1.4 km (0.9 mi)

>> - - Low wind (< 6 mph (<10 km/h)): 0.7 km (0.5 mi)

>> - - High wind (> 12 mph (>20 km/h)): 0.2 km (0.1 mi)

Spillage Disposal:

Methods for containment and safety measures to protect workers dealing with a spillage of this chemical.

>> Evacuate danger area! Consult an expert! Personal protection: gas-tight chemical protection suit including self-contained breathing apparatus. Ventilation. Shut off cylinder if possible. Isolate the area until the gas has dispersed. Remove gas with fine water spray. NEVER direct water jet on liquid.

Accidental Release Measures

Public Safety: ERG 2024, Guide 125 (Ammonia, anhydrous)

>> CALL 911. Then call emergency response telephone number on shipping paper. If shipping paper not available or no answer, refer to appropriate telephone number listed on the inside back cover.

>> Keep unauthorized personnel away.

>> Stay upwind, uphill and/or upstream.

>> Many gases are heavier than air and will spread along the ground and collect in low or confined areas (sewers, basements, tanks, etc.).

>> Ventilate closed spaces before entering, but only if properly trained and equipped.

Spill or Leak: ERG 2024, Guide 125 (Ammonia, anhydrous)

>> Do not touch or walk through spilled material.

>> Stop leak if you can do it without risk.

>> If possible, turn leaking containers so that gas escapes rather than liquid.

>> Prevent entry into waterways, sewers, basements or confined areas.

>> Do not direct water at spill or source of leak.

>> Use water spray to reduce vapors or divert vapor cloud drift. Avoid allowing water runoff to contact spilled material.

>> Isolate area until gas has dispersed.

7. Handling And Storage

Safe Storage:

>> Fireproof. Separated from oxidants, acids and halogens. Cool. Keep in a well-ventilated room.

Storage Conditions:

>> Keep container tightly closed in a dry and well-ventilated place. Contents under pressure. Storage class (TRGS 510): Gases

8. Exposure Control/ Personal Protection

REL-TWA (Time Weighted Average)

>> 25 ppm (18 mg/m³)

REL-STEL (Short Term Exposure Limit)

>> 35 ppm (27 mg/m³)

>> TWA 25 ppm (18 mg/m3) ST 35 ppm (27 mg/m3)

>> 50.0 [ppm]

PEL-TWA (8-Hour Time Weighted Average)

>> 50 ppm (35 mg/m³)

>> 25.0 [ppm]

TLV-STEL

>> 35.0 [ppm]

>> 25 ppm as TWA; 35 ppm as STEL.

TLV-TWA (Time Weighted Average)

>> 25 ppm [1970]

TLV-STEL (Short Term Exposure Limit)

>> 35 ppm [1970]

EU-OEL

>> 14 mg/m

MAK (Maximale Arbeitsplatz Konzentration)

>> 14 mg/m

Emergency Response: ERG 2024, Guide 125 (Ammonia, anhydrous)

>> Small Fire

>> Dry chemical or CO2.

>> Large Fire

>> Water spray, fog or regular foam.

>> If it can be done safely, move undamaged containers away from the area around the fire.

>> Do not get water inside containers.

>> Damaged cylinders should be handled only by specialists.

>> Fire Involving Tanks

>> Fight fire from maximum distance or use unmanned master stream devices or monitor nozzles.

>> Cool containers with flooding quantities of water until well after fire is out.

>> Do not direct water at source of leak or safety devices; icing may occur.

>> Withdraw immediately in case of rising sound from venting safety devices or discoloration of tank.

>> ALWAYS stay away from tanks in direct contact with flames.

>> ERPG-1: 25 ppm - one hour exposure limit: 1 = mild transient health effects or objectionable odor [AIHA]

>> ERPG-2: 150 ppm - one hour exposure limit: 2 = impaired ability to take protective action [AIHA]

>> ERPG-3: 1500 ppm - one hour exposure limit: 3 = life threatening health effects [AIHA]

Inhalation Risk:

>> A harmful concentration of this gas in the air will be reached very quickly on loss of containment.

Effects of Short Term Exposure:

>> Rapid evaporation of the liquid may cause frostbite. The substance is corrosive to the eyes, skin and respiratory tract. Exposure could cause asphyxiation due to swelling in the throat. Inhalation may cause lung oedema, but only after initial corrosive effects on eyes and/or airways have become manifest.

>> Information regarding ammonia's potential as a carcinogen, developmental toxin or reproductive toxin from chronic or repeated exposure is inconclusive. Chronic or repeated exposure to ammonia may cause chronic respiratory tract

irritation, chronic cough, asthma, lung fibrosis, headaches, somnolence, chronic eye membrane irritation, and dermatitis.

Effects of Long Term Exposure:

>> Repeated or chronic inhalation of the vapour may cause chronic inflammation of the upper respiratory tract. Lungs may be affected by repeated or prolongated exposure. This may result in chronic obstructive pulmonary disorders (COPD).

Fire Prevention

>> NO open flames, NO sparks and NO smoking. Closed system, ventilation, explosion-proof electrical equipment and lighting.

Exposure Prevention

>> AVOID ALL CONTACT! IN ALL CASES CONSULT A DOCTOR!

Inhalation Prevention

>> Use ventilation, local exhaust or breathing protection.

Skin Prevention

>> Cold-insulating gloves. Protective clothing.

Eye Prevention

>> Wear face shield or eye protection in combination with breathing protection.

Exposure Control and Personal Protection

Protective Clothing: ERG 2024, Guide 125 (Ammonia, anhydrous)

>> Wear positive pressure self-contained breathing apparatus (SCBA).

>> Wear chemical protective clothing that is specifically recommended by the manufacturer when there is NO RISK OF FIRE.

>> Structural firefighters' protective clothing provides thermal protection but only limited chemical protection.

Exposure Summary

>> TIH (Toxic Inhalation Hazard) - Term used to describe gases and volatile liquids that are toxic when inhaled. Some are TIH materials themselves, e.g., chlorine, and some release TIH gases when spilled in water, e.g., chlorosilanes. [ERG 2016].

RD50 (Exposure concentration producing a 50% respiratory rate decrease)

>> 303.0 [ppm]

Maximum Allowable Concentration (MAK)

>> 20.0 [ppm]

9. Physical And Chemical Properties

Molecular Weight:

>> 17.031

Exact Mass:

>> 17.026549100

Physical Description:

>> Ammonia solutions (containing more than 35% but not more than 50% ammonia) appears as a clear colorless liquid consisting of ammonia dissolved in water. Corrosive to tissue and metals. Although ammonia is lighter than air, the vapors from a leak will initially hug the ground. Long term exposure to low concentrations or short term exposure to high concentrations may result in adverse health conditions from inhalation. Prolonged exposure of containers to fire or heat may result in their violent rupturing and rocketing.

>> COLOURLESS GAS OR COMPRESSED LIQUEFIED GAS WITH PUNGENT ODOUR.

Color/Form:

>> Colorless gas

Odor:

>> Sharp, cloying, repellent

Boiling Point:

>> -28.03 °F at 760 mmHg (EPA, 1998)

>> -33 °C

Melting Point:

>> -107.9 °F (EPA, 1998)

>> -78 °C

Flash Point:

>> 132 °C (270 °F) - closed cup

Solubility:

>> 34 % (NIOSH, 2024)

>> Solubility in water, g/100ml at 20 °C: 54

Density:

>> 0.6818 at -28.03 °F (EPA, 1998) - Less dense than water; will float

>> Relative density (water = 1): 0.7 (-33 °C)

Vapor Density:

>> 0.6 (EPA, 1998) - Lighter than air; will rise (Relative to Air)

>> Relative vapor density (air = 1): 0.60

Vapor Pressure:

>> 400 mmHg at -49.72 °F (EPA, 1998)

>> Vapor pressure, kPa at 26 °C: 1013

LogP:

>> log Kow = -2.66 /estimate for ammonium hydroxide which is the form of ammonia in water/

Stability/Shelf Life:

>> Stable under recommended storage conditions.

Autoignition Temperature:

>> 1204 °F (USCG, 1999)

>> 630 °C

Decomposition:

>> Hazardous decomposition products formed under fire conditions. - Nitrogen oxides (NOx)

Viscosity:

>> 0.475, 0.317, 0.276 and 0.255 cP at -69, -50, -40 and -33.5 °C, respectively

Corrosivity:

The ability of a chemical to damage or destroy other substances when it comes into contact.

>> Corrosive gas

Heat of Combustion:

>> 382.8 kJ/mol (gas)

Heat of Vaporization:

>> 5.581 kcal/mol

pH:

pH is an expression of hydrogen ion concentration in water. Specifically, pH is the negative logarithm of hydrogen ion (H+) concentration (mol/L) in an aqueous solution. The term is used to indicate basicity or acidity of a solution on a scale of 0 to 14, with pH 7 being neutral.

>> pH of 1.0N aqueous solution 11.6; 0.1N aqueous solution 11.1; 0.01N aqueous solution 10.6

Surface Tension:

>> 23.4 dynes/cm at 11.1 °C; 18.1 dynes/cm at 34.1 °C

Ionization Potential:

>> 10.18 eV

Odor Threshold:

>> Odor Threshold Low: 0.04 [ppm]

>> Odor Threshold High: 53.0 [ppm]

>> Detection odor threshold from AIHA (mean = 17 ppm)

Refractive Index:

>> Index of refraction: 1.3944 at -77 °C/D; 1.3327 at 20 °C/D

Dissociation Constants:

>> Aqueous ammonia: pKb 4.767, Kb 1.710X10-5 at 20 °C; pKb 4.751, Kb 1.774X10-5 at 25 °C; pKb 4.740, Kb 1.820X10-5 at 30 °C

10. Stability And Reactivity

>> Soluble in water with evolution of heat. The amount of heat generated may be large.

CSL No

>> CSL00056

Reactants/Reagents

>> CHLORINE + AMMONIA

Warning Message

>> Potentially explosive in the presence of chlorine, bromine or iodine

GHS Category

>> Explosive

Reference Source

>> User-Reported

Modified Date

>> 7/8/18

Create Date

>> 6/27/17

Reaction Scale

>> Not Available

DOI Link

>> https://pubs.acs.org/doi/pdf/10.1021/ed054p132.1

11. Toxicological Information

Toxicity Summary:

>> IDENTIFICATION AND USE: Ammonia is a colorless gas or liquid. Ammonia is used in the production of ammonium sulfate and ammonium nitrate for fertilizers; and in the manufacture of nitric acid, soda, synthetic urea, synthetic fibers, dyes, and plastics. Ammonia, or dissociated ammonia, is used in such metal treating operations as nitriding, carbo-nitriding, bright annealing, furnace brazing, sintering, sodium hydride descaling, atomic hydrogen welding, and other applications where protective atmospheres are required. The petroleum industry utilizes anhydrous ammonia in neutralizing the acid constituents of crude oil and in protecting equipment such as bubble plate towers, heat exchangers, condensers, and storage tanks from corrosion. It is also used as medication. Ammonia in an aqueous environment exists in equilibrium between ionized ammonium cation and the non-ionized ammonia. This equilibrium can be affected by buffers, pH, temperature, and salinity. Thus, in many cases it is not possible to assign the associated toxicity to the ionized or non-ionized form of the ammonia-nitrogen. HUMAN EXPOSURE AND TOXICITY: Studies using low levels of ammonia show that inhaled ammonia is temporarily dissolved in the mucus of the upper respiratory tract, and then a high percentage of it is released back into the expired air. Following exposure to 500 ppm ammonia for 10-27 min, healthy male subjects eliminated 70-80% of the inspired ammonia by this route. Short term exposure: eye or skin contact with ammonia can cause irritation, burns, frostbite (anhydrous), and permanent damage. Irritates the respiratory tract causing coughing,

wheezing, and shortness of breath. Higher exposure can cause pulmonary edema, a medical emergency, that can be delayed for several hours and is life-threatening. Exposure can cause headache, loss of sense of smell, nausea, and vomiting. Inhalation: nose and throat irritation have been reported at 72 ppm after 5 min exposure. Exposures of 500 ppm for 30 min have caused upper respiratory irritation, tearing, increased pulse rate, and blood pressure. Death has been reported after an exposure to 10,000 ppm for an unknown duration. Skin: Solutions of 2% ammonia can cause burns and blisters after 15 min of exposure. These burns may be slow to heal. Anhydrous ammonia may cause skin to freeze. Eyes: Levels of 70 ppm (gas) have caused eye irritation. If not flushed with water immediately, contact with eye may cause partial or complete blindness. Ingestion: ammonia will cause pain if swallowed and burning of the throat and stomach. May cause vomiting. One teaspoon of 28% aqua ammonia may cause death. Long term exposure: repeated exposure can cause chronic eye, nose, and throat irritation. Repeated lung irritation can result in bronchitis with coughing, shortness of breath, and phlegm. Analysis of blood samples from 22 workers exposed to ammonia in a fertilizer factory and 42 control workers not exposed to ammonia showed 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. ANIMAL STUDIES: Analysis of endogenous ammonia levels in the expired air of rats showed concentrations ranging from 10-353 ppb (mean = 78 ppb) in nose-breathing animals. The quantitative difference between inspired and expired ammonia suggests that small amounts are absorbed across the nasopharyngeal membranes into the systemic circulation. Absorbed ammonia is excreted by the kidneys as urea and urinary ammonium compounds, as urea in feces, and as components of sweat. Toxic levels do not develop as a result of chronic inhalation exposure because the body has multiple effective mechanisms for detoxifying and excreting it. Cardiovascular changes that may be analogous to those observed in humans have been observed in rabbits exposed to high concentrations of ammonia. Bradycardia was seen at 2,500 ppm, and hypertension and cardiac arrhythmias leading to cardiovascular collapse followed acute exposures to concentrations exceeding 5,000 ppm. Pathological correlates for these effects have not been demonstrated. Atrophy of pericardial fat has been observed in mice exposed to 4,000 ppm ammonia. Hepatic effects are usually not seen in animals exposed to ammonia gas. Liver necrosis has been observed following acute lethal exposure of mice to 3,440 ppm ammonia for 1 hour. Levels of 170 ppm of ammonia vapor caused mild changes in the spleens, kidneys, and livers of guinea pigs. Static exposures of cats and rabbits for 1 hr at 7000 mg/cu m resulted in the death of approx 50%. Postmortem exam showed severe effects on the upper respiratory tract. Less severe effects in the lower respiratory tract included damage to bronchioles and alveolar congestion, edema, atelectasis, hemorrhage, emphysema, and fluid. The search for the peripheral toxins responsible for the CNS impairment present in hepatic encephalopathy has shown that the administration of ammonia in normal rats reproduced behavioral and electrophysiological changes similar to those seen in galactosamine induced encephalopathy. No statistically significant differences were noted in ovarian or uterine weights of pigs exposed to about 7 or 35 ppm ammonia for 6 weeks. Female pigs that were continuously exposed to about 35 ppm ammonia from 6 weeks before breeding until day 30 of gestation had no statistically significant differences in age at puberty, number of live fetuses, or fetus-to-corpus luteum ratio compared to pigs exposed to only about 7 ppm. No unexposed controls were included in that study. No statistically significant difference in fetal length was evident at 30 days of gestation in offspring of pig dams that were continuously exposed to about 7 or 35 ppm ammonia from 6 weeks before breeding until day 30 of gestation. The mutagenicity of anhydrous ammonia was investigated in a Ames test in S. typhimurium TA98, TA100, TA1535, TA1537 and TA1538, and in E. coli WP2uvrA. The test method was modified appropriately to investigate a volatile test substance. Studies were performed in duplicate in the presence and absence of an exogenous metabolic activation system. No evidence of mutagenicity was seen under the conditions of this assay. ECOTOXICITY STUDIES: Ammonia is an environmental pollutant that is toxic to all aquatic animals. The major sources for atmospheric NH3 are agricultural activities and animal feedlot operations, followed by biomass burning (including forest fires) and to a lesser extent fossil fuel combustion. Close to its sources, acute exposures to NH3 can result in visible foliar injury on vegetation.

EPA Provisional Peer-Reviewed Toxicity Values:

This section provides the EPA Provisional Peer-Reviewed Toxicity Values (PPRTVs) and links of related assessment documents.

Chemical Substance

>> Ammonia

Reference Concentration (RfC), Subchronic

>> 1 x 10^-1 mg/m^3

PPRTV Assessment

>> PDF Document

Last Revision

>> 2005

USGS Health-Based Screening Levels for Evaluating Water-Quality:

This section provides the USGS Health-Based Screening Levels for Evaluating Water-Quality data.

Chemical

>> Nitrogen Ammonia

Reference

>> Smith, C.D. and Nowell, L.H., 2024. Health-Based Screening Levels for evaluating water-quality data (3rd ed.). DOI:10.5066/F71C1TWP

Carcinogen Classification:

This section provides the International Agency for Research on Cancer (IARC) Carcinogenic Classification and related monograph links. In the IARC Carcinogenic classification, chemicals are categorized into four groups: Group 1 (carcinogenic to humans), Group 2A (probably carcinogenic to humans), Group 2B (possibly carcinogenic to humans), and Group 3 (not classifiable as to its carcinogenicity to humans).

>> No indication of carcinogenicity to humans (not listed by IARC).

Health Effects:

>> Acute exposure to high levels of ammonia in air may be irritating to skin, eyes, throat, and lungs and cause coughing and burns. Lung damage and death may occur after exposure to very high concentrations of ammonia. Swallowing concentrated solutions of ammonia can cause burns in mouth, throat, and stomach. Splashing ammonia into eyes can cause burns and even blindness. (L958) Chronically high levels of ammonia in the blood are associated with nearly 20 different inborn errors of metabolism including: 3-Hydroxy-3-Methylglutaryl-CoA Lyase Deficiency, Argininemia, Argininosuccinic Aciduria, Beta-Ketothiolase Deficiency, Biotinidase deficiency, Carbamoyl Phosphate Synthetase Deficiency, Carnitine-acylcarnitine translocase deficiency, Citrullinemia Type I, Hyperinsulinism-Hyperammonemia Syndrome, Hyperornithinemia-hyperammonemia-homocitrullinuria syndrome, Isovaleric Aciduria, Lysinuric Protein Intolerance, Malonic Aciduria, Methylmalonic Aciduria, Methylmalonic Aciduria Due to Cobalamin-Related Disorders, Propionic acidemia, Pyruvate carboxylase deficiency and Short Chain Acyl CoA Dehydrogenase Deficiency (SCAD Deficiency). Hyperammonemia is one of the metabolic derangements that contribute to hepatic encephalopathy.

Exposure Routes:

>> The substance can be absorbed into the body by inhalation.

>> inhalation, ingestion (solution), skin and/or eye contact (solution/liquid)

Inhalation Exposure

>> Burning sensation. Cough. Laboured breathing. Shortness of breath. Sore throat.

Skin Exposure

>> Redness. Pain. Blisters. Skin burns. ON CONTACT WITH LIQUID: FROSTBITE.

Eye Exposure

>> Redness. Pain. Severe burns. ON CONTACT WITH LIQUID: FROSTBITE.

>> irritation eyes, nose, throat; dyspnea (breathing difficulty), wheezing, chest pain; pulmonary edema; pink frothy sputum; skin burns, vesiculation; liquid: frostbite

Ingestion Exposure

>> Mild to moderate: Nausea, vomiting (emesis), abdominal pain, burns of mouth, throat, esophagus, and stomach.

>> Severe: Swelling of lips, mouth, and voice box (larynx), severe corrosive damage or burns of mouth, throat and stomach.

>> Ingestion does not normally result in whole-body (systemic) toxicity.

Target Organs:

Organs that are affected by exposure to this chemical. Information in this section reflects human data unless otherwise noted.

>> Dermal (Skin), Neurological (Nervous System), Ocular (Eyes), Respiratory (From the Nose to the Lungs)

>> Respiratory

Adverse Effects:

An adverse effect is an undesired harmful effect resulting from a medical treatment or other intervention.

>> Chronic Bronchitis - Chronic bronchitis is persistent coughing and production of phlegm for at least 3 months out of the year for at least two successive years. (American Thoracic Society).

>> Toxic Pneumonitis - Inflammation of the lungs induced by inhalation of metal fumes or toxic gases and vapors.

>> Fibrogenic - Inducing tissue injury and fibrosis (scarring).

Toxicity Data:

>> LC50 (rat) = 2,000 ppm/4H

Minimum Risk Level:

The minimal risk level (MRL) is an estimate of the amount of a chemical a person can eat, drink, or breathe each day without a detectable risk to health

>> Acute Inhalation: 1.7 ppm (L134) Chronic Inhalation: 0.1 ppm (L134)

Treatment:

Treatment when exposed to toxin

>> Acute Exposure: EYES: irrigate opened eyes for several minutes under running water. INGESTION: do not induce vomiting. Rinse mouth with water (never give anything by mouth to an unconscious person). Seek immediate medical advice. SKIN: should be treated immediately by rinsing the affected parts in cold running water for at least 15 minutes, followed by thorough washing with soap and water. If necessary, the person should shower and change contaminated clothing and shoes, and then must seek medical attention. INHALATION: supply fresh air. If required provide artificial respiration. Chronic Exposure: Intravenous arginine (argininosuccinase deficiency), sodium phenylbutyrate and sodium benzoate (ornithine transcarbamoylase deficiency) are pharmacologic agents commonly used as adjunctive therapy to treat hyperammonemia in patients.

Interactions:

>> The present study investigated the simultaneous influence of particulate matter (PM10) and ammonia (NH3) on performance, lung lesions and the presence of Mycoplasma hyopneumoniae (M. hyopneumoniae) in finishing pigs. A pig herd experiencing clinical problems of M. hyopneumoniae infections was selected. In total, 1095 finishing pigs of two replicates in eight compartments each were investigated during the entire finishing period (FP). Indoor PM10 and NH3 were measured at regular intervals during the FP with two Grimm spectrometers and two Graywolf Particle Counters (PM10) and an Innova photoacoustic gas monitor (NH3). Average daily weight gain (ADG) and mortality were calculated and associated with PM10 and NH3 during the FP. Nasal swabs (10 pigs/compartment) were collected one week prior to slaughter to detect DNA of M. hyopneumoniae with nested PCR (nPCR). The prevalence and extent of pneumonia lesions, and prevalence of fissures and pleurisy were examined at slaughter (29 weeks). The results from the nasal swabs and lung lesions were associated with PM10 and NH3 during the FP and the second half of the FP. In the univariable model, increasing PM10 concentrations resulted in a higher odds of pneumonia lesions (second half of the FP: OR=8.72; P=0.015), more severe pneumonia lesions (FP: P=0.04, second half of the FP: P=0.009), a higher odds of pleurisy lesions (FP: OR=20.91; P<0.001 and second half of the FP: OR=40.85; P<0.001) and a higher number of nPCR positive nasal samples (FP: OR=328.00; P=0.01 and second half of the FP: OR=185.49; P=0.02). Increasing NH3 concentrations in the univariable model resulted in a higher odds of pleurisy lesions (FP: OR=21.54; P=0.003) and a higher number of nPCR positive nasal samples (FP: OR=70.39; P=0.049; second half of the FP: OR=8275.05; P=0.01). In the multivariable model, an increasing PM10 concentration resulted in a higher odds of pleurisy lesions (FP: OR=8.85; P=0.049). These findings indicate that the respiratory health of finishing pigs was significantly affected by PM10.

Antidote and Emergency Treatment:

>> Inhalation of ammonia gas: Observe carefully for signs of progressive upper airway obstruction, and intubate early if necessary. Administer humidified supplemental oxygen and bronchodilators for wheezing. Treat noncardiogenic pulmonary edema if it occurs. Asymptomatic or mildly symptomatic patients may be discharged after a brief observation period. Ingestion of aqueous solution: If a solution of 10% or greater has been ingested or if ther are any symptoms of corrosive injury (dysphagia, drooling, or pain), perform flexible endoscopy to evaluate for serious esophageal or gastric injury. Obtain chest and abdominal radiograph to look for mediastinal or abdominal free air, which suggests esophageal or gastrointestinal perforation. Eye exposure: After eye irrigation, perform fluorescein examination and refer the patient to an ophthalmologist if there is evidence of corneal injury.

Human Toxicity Excerpts:

>> /HUMAN EXPOSURE STUDIES/ A group of 6 healthy volunteers, not previously accustomed to working in an ammonia environment, were exposed 5 days/week to 25 ppm (2 hr/day), 50 ppm (4 hr/day), or 100 ppm (6 hr/day) of ammonia, or to 50 ppm of ammonia 6 hr/day for 6 weeks. End points monitored included subjective and objective measures of eye and throat irritation as well as pulse rate, respiration rate, pulmonary function (FVC, FEV), assessment of neurological function (reflex, balance, and coordination), and body weight. The exposure protocol consisted of a pre-exposure evaluation by a physician, 3 hr of exposure (this conflicts with exposure data on table 2 of the study and mentioned above), a mid-point physician's observation, lunch break, 3 additional hr of exposure, and a third physician's observation 30 min after exposure ceased. The conjunctiva and mucosa of the nose and throat were examined by a physician before and after each daily exposure and the degree of irritation noted was described as mild, moderate, or marked. Exposure to ammonia had no significant effect on the measures of respiratory function or in the neurological tests conducted. The results of the evaluations of irritation conducted by the physician showed no significant differences between the exposure groups, including the 0 ppm exposure group (preexposure). All subjects experienced some watering of the eyes and a sensation of dryness in the nose and throat, and there was one observation of definite redness in the mucosa of the nose after a 6-hour exposure to 100 ppm during which time, there was an excursion to 200 ppm ammonia. No redness was observed in this subject the following morning. Throughout the study, the physician observed 6 cases of eye irritation, 20 of nose irritation, and 9 of throat irritation, and most cases appeared to have

occurred the first week of the study during exposure to 50 ppm. It is difficult to determine in this study a no-observed adverse- effect level (NOAEL) or LOAEL for irritation due to the different exposure durations experienced by the subjects.

Non-Human Toxicity Excerpts:

>> /LABORATORY ANIMALS: Acute Exposure/ This study examined the acute median lethal concentration (LC50) and the non-lethal threshold concentration (LC01) of ammonia in male and female Wistar rats nose-only exposed at exposure durations of either 1 or 4 hr. Additional attributes characterizing the acute toxicity of inhaled ammonia were determined during a post-exposure period of 2 weeks. The objective of this study is to further refine the methodology applied to derive Emergency Response Planning Guideline (ERPG) values on potent sensory irritants in a controlled rat bioassay. In the more susceptible male rats the 1- and 4-hr LC50 (LC01) were 12,303 (10,067) and 4923 (4028) mg/cu m, respectively. At sublethal exposure levels the ventilation of rats was about one third of normal breathing. This change in ventilation and inhalation dosimetry was adjusted for Cxt-dependent lethal endpoints whereas sensory irritation-related phenomena were C-dependently adjusted. In summary, the outcome of this study shows that C- and C x t-dependent causes of toxicity need to be appreciated when extrapolating across species with species-specific inhalation dosimetry. It also appears to be indispensable that each exposure metric must be disentangled when translating C x t-dependent lethality and reflexively-induced, sensation-based C-dependent point of departures. For one hour exposure periods, these PODs were derived to be 1500 and 500 ppm, respectively.

Non-Human Toxicity Values:

>> LC50 Rabbit inhalation 7,050 mg/cu m/1 hr

Populations at Special Risk:

>> Since ammonia is a respiratory tract irritant, persons who are hyperreactive to other respiratory irritants, or who are asthmatic, would be expected to be more susceptible to ammonia inhalation effects. The results of an epidemiological study of a group of workers chronically exposed to airborne ammonia indicate that ammonia inhalation can exacerbate existing symptoms including cough, wheeze, nasal complaints, eye irritation, throat discomfort, and skin irritation.

12. Ecological Information

Resident Air (ug/m3)

>> 5.20e+02

Industrial Air (ug/m3)

>> 2.20e+03

MCL (ug/L)

>> 4.00e+00

Chronic Inhalation Reference Concentration (mg/m3)

>> 5.00e-01

Volatile

>> Volatile

Mutagen

>> Mutagen

Fraction of Contaminant Absorbed in Gastrointestinal Tract

>> 1

ICSC Environmental Data:

>> The substance is very toxic to aquatic organisms. It is strongly advised not to let the chemical enter into the environment.

Average Daily Intake:

The average amount of the compound taken into the body through eating, drinking, or breathing.

>> If untreated surface water is ingested, the average uptake would be 0.36 mg/day, assuming an ammonia concentration in untreated water of 0.18 mg/L and a consumption of 2 L/day(1).

13. Disposal Considerations

Spillage Disposal

>> Evacuate danger area! Consult an expert! Personal protection: gas-tight chemical protection suit including self-contained breathing apparatus. Ventilation. Shut off cylinder if possible. Isolate the area until the gas has dispersed. Remove gas with fine water spray. NEVER direct water jet on liquid.

Disposal Methods

>> SRP: Recycle any unused portion of the material for its approved use or return it to the manufacturer or supplier. Ultimate disposal of the chemical must consider: the material's impact on air quality; potential migration in air, soil or water; effects on animal, aquatic and plant life; and conformance with environmental and public health regulations. If it is possible or reasonable use an alternative chemical product with less inherent propensity for occupational harm/injury/toxicity or environmental contamination.

>> SRP: Wastewater from contaminant suppression, cleaning of protective clothing/equipment, or contaminated sites should be contained and evaluated for subject chemical or decomposition product concentrations. Concentrations shall be lower than applicable environmental discharge or disposal criteria. Alternatively, pretreatment and/or discharge to a permitted wastewater treatment facility is acceptable only after review by the governing authority and assurance that "pass through" violations will not occur. Due consideration shall be given to remediation worker exposure (inhalation, dermal and ingestion) as well as fate during treatment, transfer and disposal. If it is not practicable to manage the chemical in this fashion, it must be evaluated in accordance with EPA 40 CFR Part 261, specifically Subpart B, in order to determine the appropriate local, state and federal requirements for disposal.

>> Product: Burn in a chemical incinerator equipped with an afterburner and scrubber but exert extra care in igniting as this material is highly flammable. Offer surplus and non-recyclable solutions to a licensed disposal company. Contact a licensed professional waste disposal service to dispose of this material. Contaminated packaging: Dispose of as unused product.

>> Solutions of ammonia can be highly diluted with water, or alternatively, diluted with water and neutralized with HCl and then routed to the sewer system. The amount released to the receiving stream should not exceed the established limits for ammonia. Limited amounts of gaseous ammonia may be discharged to the atmosphere. Federal, state, and local guidelines should be consulted before disposal. Disposal of liquefied ammonia or of large quantities of gaseous or aqueous ammonia directly into water is not desirable, because of the large amount of heat generated. This generation of heat could increase exposure to personnel involved in the process. Recovery of ammonia from aqueous waste solutions is a viable option for many industries.

>> For more Disposal Methods (Complete) data for Ammonia (6 total), please visit the HSDB record page.

14. Transport Information

DOT

Ammonia
2.3

Reportable Quantity of 100 lb or 45

IATA

Ammonia
2.3, 8

15. Regulatory Information

DHS Chemicals of Interest (COI):

This section provides the Department of Homeland Security (DHS) Chemicals of Interest (COI) and related information (Ref: 6 eCFR part 27 - https://www.ecfr.gov/current/title-6/chapter-I/part-27).

Chemicals of Interest(COI)

>> Ammonia (anhydrous)

Release: Minimum Concentration (%)

>> 1

Release: Screening Threshold Quantities (in pounds)

>> 10000

Security Issue: Release - Toxic

>> Toxic chemical that can be released at a facility.

Clean Water Act Requirements:

The Clean Water Act (CWA) of 1972 establishes the basic structure for regulating discharges of pollutants into the waters of the United States and regulating quality standards for surface waters. Under CWA, the U.S. Environmental Protection Agency (EPA) developed the Toxic Pollutant List (40 CFR Part 401.15) and the Priority Pollutant List (40 CFR Part 423, Appendix A). These lists are to be used by EPA and States to develop the Effluent Guidelines regulations and ensure water quality criteria and standards.

>> Ammonia is designated as a hazardous substance under section 311(b)(2)(A) of the Federal Water Pollution Control Act and further regulated by the Clean Water Act Amendments of 1977 and 1978. These regulations apply to discharges of this substance. This designation includes any isomers and hydrates, as well as any solutions and mixtures containing this substance.

Regulatory Information

The Australian Inventory of Industrial Chemicals

>> Chemical: Ammonia

REACH Registered Substance

>> Status: Active Update: 12-05-2023 https://echa.europa.eu/registration-dossier/-/registered-dossier/15557

>> Status: Cease Manufacture Update: 26-03-2018 https://echa.europa.eu/registration-dossier/-/registered-dossier/23192

New Zealand EPA Inventory of Chemical Status

>> Ammonia, anhydrous: HSNO Approval: HSR001035 Approved with controls

16. Other Information

Toxic Combustion Products:

Toxic products (e.g., gases and vapors) produced from the combustion of this chemical.

>> Fire will produce irritating, corrosive, and/or toxic gases.

Other Safety Information

Chemical Assessment

>> IMAP assessments - Ammonia and Ammonium hydroxide: Human health tier II assessment

Methods of Dissemination

>> Indoor Air: Ammonia can be released into indoor air as a liquid spray (aerosol) or as a vapor.

>> Water: Ammonia can be used to contaminate water.

>> Food: Ammonia is unlikely to contaminate food due to unpalatable qualities rendered to food.

>> Outdoor Air: Ammonia can be released into outdoor air as a liquid spray (aerosol) or as a vapor.

>> Agricultural: If ammonia is released into the air as a liquid spray (aerosol), it has the potential to contaminate agricultural products. If ammonia is released as a vapor, it is highly unlikely to contaminate agricultural products.