AMMONIA

Synonyms
Anhydrous ammonia, ammonia gas.

Description
Ammonia is a colourless gas at ordinary temperatures and liquifies under pressure. Aqueous ammonia (ammonium hydroxide) is a colourless liquid. Both have a strong, penetrating odour. When aqueous ammonia is heated to decomposition it emits toxic fumes of ammonia and nitrogen oxides.
Used in manufacturing plastics, fertilizer, dyes, pharmaceuticals, explosives, rocket fuels and chemicals. Used in pulp and paper processing, in rubber, textile and leather manufacturing, as a refrigerant, as a bleaching agent, and mixed with detergents as a cleaning agent.
Naturally abundant gas in environment, formed from decaying organic matter.
Industrial strength ammonia solution contains 27-30% ammonia.
Household ammonia contains 5-10% ammonia. Sudsy ammonia is a household cleaner generally containing < 5% ammonia with detergents; pH may be up to 12.5. Window glass cleaners with ammonia usually contain < 4% ammonia; pH is usually < 10.5. Aromatic spirits of ammonia inhalant ampoules (smelling salts) contain 0.33 mL of 18% ammonia and 36% ethanol.
Mixing ammonia with chlorine or hypochlorite solutions (bleach) generates chloramine gas; similar to chlorine gas in toxicity. **See** CHLORINE.

Toxicity
Corrosive alkali burns may result from ingestion, skin or eye contact, or inhalation of gas.
Penetrates more rapidly than other alkalis and has a greater tendency to cause corneal epithelial damage, iritis and lens damage.
Because of high water solubility, upper airway injury is primarily seen after inhalation exposures. Massive exposures can result in extensive injury to lower airways and alveoli.

Mechanism of Toxicity
Ammonia acts as an alkali. Highly water soluble and reacts with water to form ammonium hydroxide. For mechanism of tissue injury, **see** ALKALI.

Toxic Dose
Toxicity from inhalation depends on concentration, length of exposure, and depth of inhalation. Threshold limit value (TLV-TWA) is 25 ppm. Inhalation of 2500-6500 ppm can lead to fatal pulmonary edema, apnea or upper airway obstruction. Immediate death from laryngospasm and respiratory arrest may be seen with levels > 5000 ppm.
Toxicity from ingestion depends on concentration, duration of tissue contact, pH of the substance, viscosity and amount ingested. **See** ALKALI.
Industrial strength ammonia (27-30%) is likely to cause burns. Household ammonia (5-10%) rarely causes severe burns.
Dilute solutions (< 5%) rarely cause burns and are moderately irritating.
Addition of chlorine or hypochlorite (bleach) produce chloramine gas; inhalation causes toxicity similar to inhalation of chlorine gas, **see** CHLORINE.

Case Reports
A 15-year-old ingested 30 mL sudsy ammonia (3.6% ammonia, pH 11.5) and developed oral pain, drooling and dysphagia. His tongue and oropharynx were white and blistered. Endoscopy revealed esophageal burns with friable, boggy mucosa without perforations. Patient recovered with no sequelae.
Twenty-two workers were exposed to concentrated anhydrous ammonia vapours for durations from seconds up to 20 minutes. Fourteen patients developed symptoms of mild irritation, 6 developed transient bronchospasm and edema of lips and oral mucosa, and 2 developed loss of consciousness, respiratory failure and/or skin burns. One of the severely exposed patients died from respiratory failure 2 weeks later, and the survivor developed restrictive lung disease and chronic bronchitis. Five of the workers developed photophobia and eye pain; 4 of these patients had corneal damage.

Clinical Effects
- **Topical:** Soapiness and burning sensation of skin. Low concentrations of ammonia may cause mild edema and erythema; high concentrations may cause severe edema with liquefaction necrosis and deeply penetrating burns. **See** ALKALI.
  Exposure to liquid anhydrous ammonia stored at -33 degrees C may cause frostbite injury.

- **Ocular:** Solution and vapors can cause irritation at low concentrations. Conjunctivitis, iritis, cataracts, corneal burns, temporary or permanent blindness may occur after exposure to high concentrations. Ammonia tends to cause more damage to corneal endothelium, corneal stroma, iritis and lens, and less immediate pearly gray or white opacification of corneal stroma than other alkalis. **See** ALKALI.
  Solutions of 8.5% ammonium hydroxide can increase pH in anterior chamber within 15 seconds of exposure (animal data)

- **Inhalation:** Low concentrations can result in cough, bronchospasm, laryngitis, dyspnea, and wheezing. High concentrations can result in laryngeal edema, burns to tracheobronchial mucosa, rapid shock, coma, noncardiogenic pulmonary edema and respiratory arrest.
  Initial pulmonary edema, hemorrhage and atelectasis with apparent clinical improvement within 48-72 hours followed by gradual onset of airway obstruction and respiratory failure has been reported.
  Acute, high dose exposures have led to persistent obstructive pulmonary disease.
  Chronic exposures to low concentrations have resulted in chronic cough, dyspnea, asthma, laryngitis and decreased pulmonary function in some workers.
  Inhalation of chloramine gas can cause pneumonitis, **see** CHLORINE.

- **Ingestion: See** ALKALI.

Treatment

1. **Topical:** Wash immediately with running water until skin is free of soapiness. Rewarm frostbitten areas completely in a warm water bath (40-42 degrees C). Elevate frostbitten extremities; separate digits with sterile absorbent cotton. **See** ALKALI.

2. **Ocular:** Flush eyes immediately with a gentle stream of tepid water for at least 15-30 minutes prior to transport to health care facility. In a health care facility, irrigate with normal saline until the pH of the tear film approaches pH 8 (check with litmus paper). Perform slit lamp exam and refer to an ophthalmologist if necessary. **See** ALKALI.

3. **Inhalation**: Provide respiratory support as required. Administer oxygen as needed. **See** ALKALI.

4. For chloramine gas, **see** CHLORINE.

5. **Ingestion: See** ALKALI.

Key Points

- ✓ Corrosive alkali burns may result from ingestion, skin or eye contact, or inhalation of gas.
- ✓ Penetrates more rapidly than other alkalis and has a greater tendency to cause ocular damage.
- ✓ Upper airway injury is primarily seen after inhalation exposures. Immediate death from laryngospasm and respiratory arrest can be seen with inhalation of high concentrations.
- ✓ Treatment is as for ALKALI.