

Ammonia Facts

Significance of Ammonia (NH₃) in the United States

CAS # 7664-41-7 UN # 2672, 2073, 1005

Ammonia is often used for agricultural purposes, for refrigeration, and as a cleaner when dissolved in water. At room temperature it is a colorless, flammable gas with a pungent, suffocating odor. It becomes a clear, colorless liquid under increased pressure. Ammonia is usually shipped as a compressed liquid in steel cylinders.

Anhydrous ammonia is the form used primarily in refrigeration and agriculture. Ammonia dissolves in water to form ammonium hydroxide, a corrosive solution. Concentrations of ammonium hydroxide vary from 5 percent to 10 percent for household use and 25 percent or more for industrial use. The sheer volume of ammonia required to meet the needs of users places it on the list of the top ten chemicals produced in the U.S.

Ammonia Releases in North Carolina

The information in this report was collected by staff in the North Carolina Hazardous Substances Emergency Events Surveillance (HSEES) Program. Ammonia releases in North Carolina have resulted in injuries, hospitalizations, and workplace evacuations (Table 1). Some examples of ammonia releases in NC include:

- n After exposure to industrial strength ammonia cleaner fumes, two clothing store employees suffered nausea, skin irritation, and dizziness. They were transported to a hospital for observation.*
- n An ammonia cylinder ruptured at a distribution facility releasing 60 pounds. One worker was treated at the scene for respiratory irritation, and 4 volunteer firefighters were transported to a nearby hospital and treated for respiratory irritation.*
- n A chemical reaction of ammonia and solid cake deodorizer in a porta-john caused an emission of vapors. The area was sealed until the vapors dissipated. One person was treated and released from the hospital for respiratory and eye irritation.*
- n A poultry-processing plant was evacuated after 100 pounds of ammonia was released from a plate chiller due to a malfunctioning relief valve. Seventeen employees were transported to the hospital for observation due to respiratory irritation.*
- n Ninety-six pounds of anhydrous ammonia were released when a liquid-to-vapor crossover line on a 20,000-gallon tank was accidentally opened. Two workers complaining of respiratory irritation were evaluated at a hospital.*

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Of the 82 ammonia releases that occurred between 1993-1997 in North Carolina, 77 (93.9 percent) occurred in fixed facilities and 5 (6.1 percent) took place in transit. Most of the fixed-facility spills resulted from unintended releases from process vessels (N = 21, 26.5 percent), piping (N = 18, 22.8 percent), and storage above-ground (N = 12, 15.2 percent). Efforts to identify the factors contributing to chemical releases were initiated in 1995. Of the 45 ammonia events that occurred from mid-1995 to 1997, 31 (68.9 percent) were caused by equipment failure. Operator error was cited as the major contributing factor in another 7 (15.6 percent) incidents. These events are summarized in Table 1. Table 2 lists the types of industries involved in ammonia releases. Locations of ammonia releases are shown in Map 1.

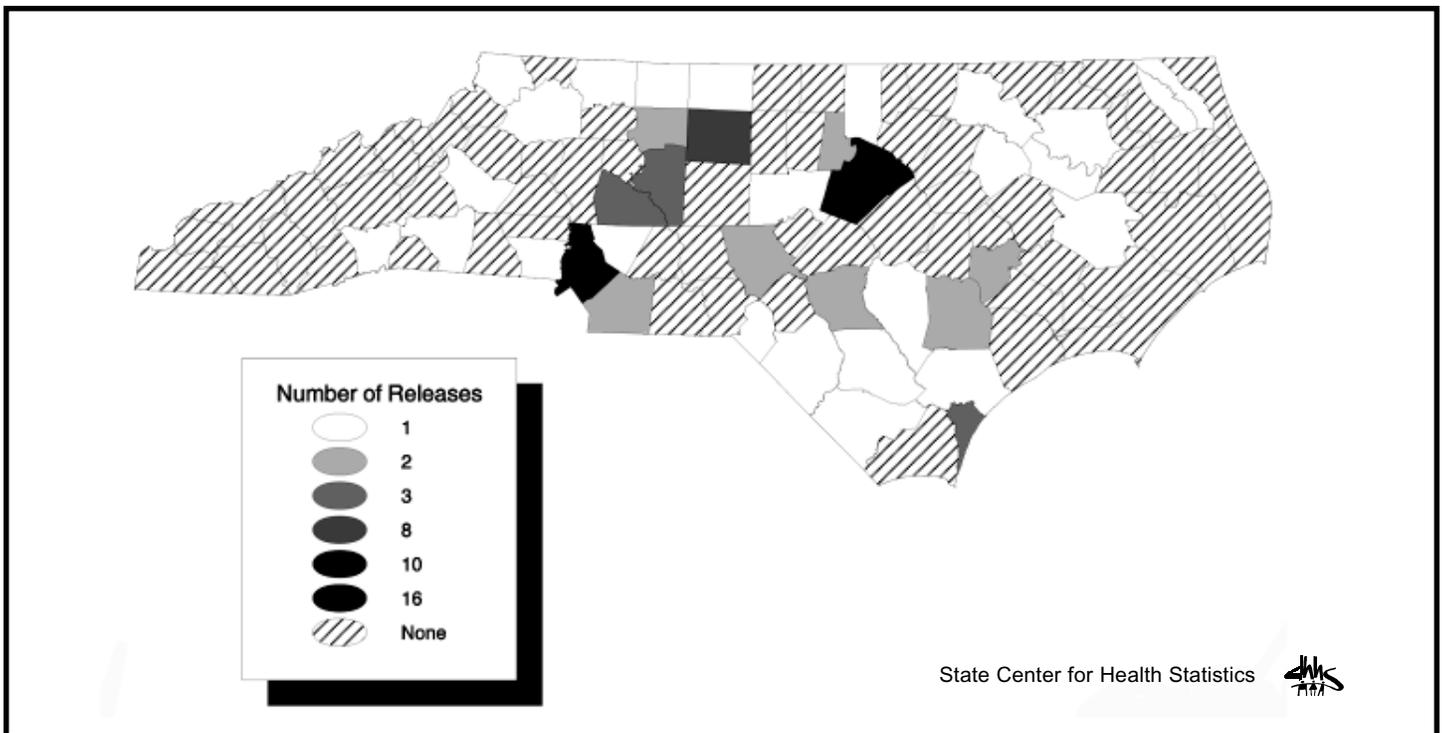
Table 1: Summary of HSEES Data on Ammonia Releases in North Carolina, 1993-1997

Survey Question	Number
Number of ammonia releases	82
Number of events involving victims	10
Number of victims	39
Types of injuries	
▪ Respiratory	31
▪ Eye irritation	8
▪ Headache	6
▪ Burns (4 chemical, 1 thermal)	5
▪ Skin irritation	4
▪ Nausea/vomiting	2
▪ Dizziness	2
▪ Shortness of breath/chest tightness	1
▪ Total:	59
Range of amounts released (pounds)	1 to 46,100
Type of ammonia release	
▪ Spill only	13
▪ Air release only	51
▪ Spill and air release	15
▪ Air release and explosion	1
▪ Fire	1
▪ Spill and fire release	1
Events with decontamination	12
▪ No. of events with responders decontaminated	10
▪ No. of events with employees decontaminated	2
▪ No. of events with general public decontaminated	0
Events requiring evacuation	33
Number of events following a contingency/preparedness plan	81
Type of response	
▪ HAZMAT/response team's SOP	51
▪ Company's operating procedures	6
▪ Unknown (respondent did not know type of response)	24

Table 2: Industries Involved in Ammonia Releases in North Carolina, 1993-1997

Type of NC Industry Releasing Ammonia	No. of Events
Meat products	15
Drugs, chemicals, and allied products	7
Railroads	7
Groceries and related products	6
Warehousing and storage	6
Dairy products	5
Industrial and miscellaneous chemicals	5
Trucking service	5
Beverage industries	3
Other	23

Map 1: Location of Ammonia Releases across North Carolina, 1993-1997 (N = 82)



Common Routes of Ammonia Exposure

- **Inhalation.** The most common way for ammonia to enter the body is through the respiratory system. Signs and symptoms of ammonia inhalation can include:
 - Coughing
 - Hoarseness
 - Narrowing of bronchi
 - Narrowing of throat and swelling causing upper airway obstruction
 - Accumulation of fluid in the lungs
 - Chest pain
 - Runny nose
 - Tearing of the eyes
 - Impaired vision
 - Headache
 - Dizziness

- **Contact with the Skin.** Ammonia can irritate the skin and cause chemical burns ranging from mild to severe depending on the concentration of the ammonia solution. Concentrated vapor or solution may cause the victim to experience pain, redness of the skin, and blisters. Signs displayed by skin exposed to liquefied ammonia can include frostbite, tissue death, or severe burns with deep ulcerations.
- **Contact with the Eyes.** Ammonia, even at low concentrations, can irritate the eyes and cause burning, swelling, photophobia, sloughing of the surface cells of the eye, and may cause blindness.
- **Ingestion.** Immediate burning in the mouth and throat occur when ammonium hydroxide is swallowed. Ingestion of concentrated solution can cause severe pain in the mouth, chest, and abdomen, swallowing difficulty, drooling, and vomiting. Burns and perforation of the esophagus or stomach can occur.

Acute Health Effects of Ammonia Exposure

As the concentration of ammonia increases, the symptoms become more severe. Acute exposures to ammonia can cause immediate burning of the eyes, nose, throat and/or respiratory system and could even result in death. Itchy eyes, coughing and a burning nose can help to warn people of potentially hazardous exposure levels. But continued short-term exposure can lead to tolerance to the ammonia scent, and victims may no longer be aware of ammonia's presence. The very young, the very old, and people with health problems are at an increased risk from the health effects of ammonia exposure.

Chronic Health Effects of Repeated Exposure to Ammonia

Acute (short-term) exposures to ammonia do not often result in long-term or chronic health effects, except for eye injuries. Long-term effects are usually found with people who have repeated exposures to ammonia. These repeated ammonia exposures could have long-term effects on the lungs, nose, and eyes. Case reports have noted chronic inflammation of bronchi and airway hyperactivity and chronic irritation of the eye membranes. Consequences of chronic exposure may also include pneumonia, kidney damage, cataracts, glaucoma, ulceration and perforation of the cornea, and blindness.

Proper Handling and Storage Procedures for Ammonia

Before working with ammonia, you should be trained in its proper handling and storage and know how to use proper personal protective equipment.

Ammonia should be stored in a cool, dry, well-ventilated area in tightly sealed containers protected from exposure to weather, extreme temperature changes, and physical damage. Ammonia should be separated from oxidizers, combustible materials, heat, sparks, and open flame. As a liquefied gas, ammonia is flammable. Sources of ignition usually include smoking or open flames. Ammonia is considered a strong oxidizer and steps should be taken to separate ammonia and ammonia products from incompatible materials, such as copper, brass, bronze, galvanized steel, tin, or zinc.

If a fire occurs in the immediate vicinity of ammonia cylinders, remove them promptly if it can be done safely. If removal is not possible, cool cylinders by spraying with water. Do not extinguish flames as explosive re-ignition may occur. Allow the fire to burn out. If the fire cannot be brought under control, evacuate the area because of explosion hazards and toxic fumes.

Personal Protective Equipment

■ **Clothing**

Avoid skin contact with ammonia. Wear protective gloves and chemical-resistant clothing. The National Institute for Occupational Safety and Health (NIOSH) recommends wearing gloves made of Butyl, Teflon or Viton for up to 8 hours of exposure and Nitrile gloves for up to 4 hours of exposure. Keep clothing clean and free of oils and grease.

■ Eye Protection

Wear safety glasses when handling cylinders. During change-out or when exposure to gas is a risk, wear vapor-proof goggles and a face shield.

■ Respiratory Protection (respirators)

Respiratory protection should be approved by NIOSH specifically for ammonia and used in accordance with the OSHA Respiratory Protection Standard, 29 CFR (Code of Federal Regulations) 1910.134. Under routine exposures where the ambient concentration of ammonia exceeds 25ppm¹, use an air purifying, full-face respirator equipped with chemical cartridges appropriate for ammonia. For exposures of unknown concentrations of ammonia, such as uncontrolled releases, only a pressure-demand SCBA (self-contained breathing apparatus) is appropriate. Respirator use must be limited to individuals who have been medically cleared, adequately trained and fitted for the respirator face piece. Companies are also referred to 29 CFR 1910.119, Process Safety Management of Highly Hazardous Chemicals Standard. Ammonia presents a potential for a catastrophic event at or above the threshold quantity of 10,000 pounds according to the List of Highly Hazardous Chemicals, Toxics and Reactives (Mandatory) in 29 CFR 1926.64 Appendix A.

First Aid Management

Prompt action is essential if there is an ammonia spill or leak. If an ammonia spill or leak occurs, take the following actions:

1. Remove the exposed person(s) to fresh air.
2. Call 911 immediately and notify company safety personnel.
3. If the victim is contaminated with ammonia follow the steps for decontamination prior to administering first aid.
4. If the victim is not breathing, begin artificial respiration.
5. If the victim is breathing, place them in a seated position or lying down with the head and upper body in an upright position. Encourage slow, deep, regular breaths. Have a health professional administer oxygen as soon as possible.
6. Keep the person warm and quiet.
7. Seek medical attention. Persons with serious symptoms may need to be hospitalized.

Decontamination

Clothing or skin that is soaked with ammonia solutions may be caustic and expose rescuers, as well as victims, to vapors. To decontaminate:

1. Remove soaked clothing from the victim and double-bag it immediately.
2. Flush exposed skin and hair with soap and water for 15 minutes, call a physician, and seek medical attention immediately if frostbite has occurred. **Do not wash or rub skin.**
3. Flush exposed or irritated eyes with water or saline for 15 minutes. If the person is wearing contact lenses, try to remove them. See a physician/ophthalmologist immediately.
4. For ingested ammonia, give the victim at least 2 glasses of water or milk immediately. Refer to material safety data sheet (MSDS), call poison control center (1-800-848-6946), or call physician on instructions for inducing vomiting.

Spill Management

Ammonia spills will become increasingly dangerous if they are not contained promptly. If a spill or leak has occurred, take the following actions:

- Notify trained personnel immediately, such as the company HAZMAT team or the local fire department. **Untrained persons or those without proper personal protective equipment must not enter areas with high concentrations of ammonia.**

¹ American Conference of Governmental Industrial Hygienists, *2000 Threshold Limit Values and Biological Exposure Indices*, p. 24.

- Evacuate people from the hazardous area for at least 50 feet in all directions and have them stay upwind from the ammonia release. They should be sheltered in a building with the doors and windows shut and air conditioners turned off.
- Stop or control the source of exposure. If the exposure is from a leaking cylinder, take the cylinder outdoors or to an open area until it has completely drained and the contents have evaporated.
- Ventilate potentially explosive atmospheres by opening windows.
- Keep combustibles such as wood, paper, and oil away from the leak.
- Remove all sources of heat and ignition.
- Refer to the manufacturer's Material Safety Data Sheet (MSDS) for more information about ammonia hazards.

North Carolina HSEES Program

The North Carolina Department of Health and Human Services, Division of Public Health studies and describes the public health effects associated with releases of hazardous substances, such as ammonia, as part of the Agency for Toxic Substances and Disease Registry's Hazardous Substances Emergency Events Surveillance (HSEES) system. North Carolina is one of 16 participating states. Data are analyzed to determine trends and areas for prevention. The information is then used to develop ways to protect health and prevent or minimize hazardous substance releases.

The Division of Public Health staff are notified about spills by several sources. The primary sources of information are the NC Division of Emergency Management, the US Coast Guard's National Response Center, and the US Department of Transportation's Hazardous Materials Information System (HMIS). To gather specific information about each spill, staff contacts local emergency management personnel, fire department personnel, emergency medical personnel, and/or industry representatives.

To plan appropriate prevention strategies, we rely on accurate and timely reporting. If you are contacted about a hazardous chemical spill, please answer the questions as precisely and truthfully as possible. The information you provide is critical to preventing future spills and reducing the risk of injury to employees, responders, and the public. Contact the NC HSEES Program at 919-733-1145 or visit our web site at www.schs.state.nc.us/epi/oii/hsees.html.

Resources and Information

■ Occupational Safety and Health Administration (OSHA)

OSHA provides specific information about proper handling, storage, and safety and health management of ammonia. Publications can be obtained by written request or through the OSHA web page.

OSHA Publications Office,
200 Constitution Avenue NW
Room N3101
Washington, DC 20210
(202) 219-8151
www.osha.gov

For specific ammonia information: http://www.osha-slc.gov/OshStd_data/1910_0111.html

■ National Institute of Occupational Safety and Health (NIOSH)

NIOSH Publications
4676 Columbia Parkway, Mail Stop C-13
Cincinnati, OH 45226-1998
1-800-35-NIOSH (1-800-356-4674)
<http://www.cdc.gov/niosh/homepage.html>

■ Environmental Protection Agency (EPA)

Ariel Rios Building
1200 Pennsylvania Avenue, NW
Washington, DC 20460
202-260-2090
www.epa.gov

■ Region IV EPA (includes North Carolina)

Atlanta Federal Building
61 Forsyth Street, SW
Atlanta, GA 30303-3104
404-562-9900
1-800-241-1754

■ North Carolina Department of Health and Human Services Occupational and Environmental Epidemiology Branch

HSEES Program
1912 Mail Service Center
Raleigh, NC 27699-1912
(919) 733-3410
www.schs.state.nc.us/epi/oii/hsees.html



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Division of Public Health
<http://www.dhhs.state.nc.us/dph>

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