

Ammonia Emergencies:



Medical Response

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The use of anhydrous ammonia is so commonplace among retailers that its transport, storage, and application are often viewed—and dangerously so—as routine, even hazard-free operations. More and more retail employees are coming in contact with some phase of ammonia handling, thus increasing potential risks. Promoting a safety ethic at your

business may help avoid needless injuries and fatalities caused by ammonia mishaps. Understanding ammonia properties (see box) and their effect on the body will also help you respond to an emergency if it does occur.

Potential For Injury

An anhydrous emergency can occur at

any step during the manufacture, storage, transportation, transfer, or use of the chemical. The greatest volume of release occurs during transportation accidents, especially rail car accidents where the rupture of a tank can form millions of cubic feet of ammonia vapor clouds.

On the other hand, transfer procedures in fields or at distribution sites are the greatest source of accidents, due primarily to the large number of transfers and the carelessness of workers involved. However, ruptured pipes, explosions of overpressurized storage tanks, and fires can also lead to a release.

In industry, there are two basic means of exposure: spray and gas. A spray of an ammonia stream from a ruptured tank or line can be expected to cause primarily eye and skin damage, while a gas cloud will cause varying degrees of lung injury and, depending on the concentration, eye and skin damage as well.

Impact on the Body

Anhydrous ammonia is an alkali. Compared to acids, which tend to burn and seal-off a wound, alkalis cause liquefaction of tissue. In other words, alkalis turn tissue into a sticky "goo" and mix with this tissue, causing further damage. As a result, anhydrous ammonia burns keep

Knowing NH₃ Properties

At room temperature, ammonia is a pungent colorless gas, but when pressurized or refrigerated in nurse or storage tanks, it is a colorless liquid. When released from its container, ammonia forms an expanding white cloud which is usually lighter than air and easily follows air currents.

With an expansion ratio of 850 to 1, a given volume of liquid ammonia will expand 850 times to encompass a potentially extensive area. Because liquid ammonia boils at minus 28 degrees, the expanding gas has the potential to freeze both equipment and flesh.

Ammonia is, under most conditions, a stable compound, but under conditions of high temperature and contact with certain metals or fuels, it can be explosive and may burn. Its inflamma-

bility limits are 16 to 25 percent by volume in air and its ignition temperature is 1,200 degrees.

Most anhydrous ammonia is manufactured by a process in which natural gas, air, and steam are reacted in the presence of a catalyst and pressure to produce ammonia. In this process, water is excluded, thus the term "anhydrous."

Anhydrous ammonia is easily absorbed by water—at a ratio of 1,176 to 1 at 32 degrees. That is, one volume of water can absorb 1,176 volumes of ammonia, a factor that aids firefighters in controlling ammonia clouds. But, it also contributes to human toxicity, since ammonia will keep spreading across contacted skin until the chemical is diluted by skin moisture. □

Ammonia/continued

spreading until the chemical is diluted.

In addition to liquefaction, supercooled anhydrous spray causes a freeze-dry effect like frostbite when it hits skin. The spray is also capable of freezing clothing to skin so that, if the clothing is incorrectly removed, whole sections of skin can be torn off. Other circumstances of injury in anhydrous emergencies include: blast effects from exploding tanks, burns from high temperature explosions, and chemical injection injuries.

As already mentioned, anhydrous primarily affects three areas of the body: the lungs, eyes, and skin. In the lungs, anhydrous causes destruction of delicate respiratory tissue, resulting in pulmonary and respiratory distress. The effect on the eyes depends on whether a spray or gas is involved, but everything from mild irritation to eye destruction can occur. Again, skin damage depends upon the length and concentration of exposure, and can range from mild irritation, to a darkened freeze-dry burn, to tissue destruction.

Immediate Response Steps

The specific response to an anhydrous ammonia emergency will depend upon the situation, of course, but there are some common steps to follow. In most instances, it will be possible to perform these steps in rapid succession or simultaneously. The four steps are: evacuation, cardiopulmonary resuscitation, decontamination (flushing), and alert.

■ **Evacuation.** The victimized worker must be removed from the source of the problem. This may simply mean pointing a nozzle away or turning off the valve to a ruptured line. However, it could mean being caught up in an expanding cloud of gas. Workers exposed to such a cloud should drop to the ground, put on respirators, and move upwind and upgrade if possible. A moist handkerchief over the nose and mouth can also be helpful. Fellow workers should not try to enter an ammonia cloud without protective equipment or they will risk becoming additions to the casualty list, thus compounding the problem. The source should be immediately shut off, if this can be done quickly and easily.

■ **Cardiopulmonary Resuscitation.** If the worker has stopped breathing, mouth-to-mouth resuscitation should be attempted as soon as safely possible. If there is no pulse, closed chest massage should be

Emergency Team Actions

Paramedics or ambulance crews responding to ammonia emergencies will continue and complete resuscitative procedures already begun by workers at the accident site. Before loading the victim in the ambulance, they will pay careful attention to thorough decontamination of the victim.

Clothing saturated with ammonia, for example, can release a cloud of gas within the closed confines of the ambulance and disable the crew. Therefore, following extensive flushing with water, exposed clothing will be removed, with careful attention to avoid removing skin with it.

In mass casualty situations, a triage scheme, based on wartime disasters, can be used to select those patients needing immediate care. In severe injuries, airways need to be established, intra-

venous lines started, and pulmonary problems aggressively treated.

Tetanus shots must be given if indicated and eye care begun at once. Specialized treatment units, like burn units and intensive care wards, may be utilized.

In less severely injured patients, X-rays, special laboratory tests, and careful examinations can be helpful in determining whether or not hospitalization or further treatment is necessary.

Many areas of the United States and Canada now have an Emergency Medicine Service system that organizes emergency response. Plant medical and safety people need to be aware of this system and should make prior arrangements for proper integration of responses. □

started. Prepare your workers for such an emergency by arranging CPR instruction from the local Red Cross.

■ **Flushing/Decontamination.** As quickly as possible, and simultaneously with first aid or CPR, decontaminate the victim. Starting with the eyes, the whole body or exposed area must be flushed with generous amounts of water; this includes the hair, ears, underchin, and armpits. Any water source is acceptable, such as showers, hoses, or irrigation canals. Contaminated clothing should be removed—but only after careful flushing and warming, to prevent the already-mentioned problem of skin sticking to the clothing.

A special point on skin burns, regardless of severity: creams, ointments or jellies should not be used for the first 24 hours because they "lock in" the ammonia in liquefied skin and extend the injury.

■ **Alert.** Call for help. Notify firefighters and ambulance personnel immediately and warn them about the type of hazard to which they are responding (see accompanying story). At the same time, tell them the safest approach route so response can be both rapid and free of mishap. In some situations the accident site may be so far from emergency teams that it would be quicker to bring the victim to the hospital. If that's the case, remember to decontaminate the victim before accompanying him in a closed vehicle.

Pre-planning for each of the four emergency response steps can help avoid

life-threatening indecision if an ammonia mishap occurs. Also, it is a good policy to have any exposed worker examined by a physician, regardless of the degree of injury. Certainly any worker with extensive skin damage, eye injury or breathing problems needs to be seen in a hospital emergency department as rapidly as possible.

The Aftermath

While engineers determine what caused the accident, safety people need to critically evaluate the emergency response. A meeting with ambulance personnel, workers, victims, nurses, and physicians can be valuable in identifying the heroes of the day who should be thanked or awarded. It can also be valuable in identifying breakdowns in emergency response procedures in need of improvement.

Aggressive rehabilitation of an injured worker is good policy; and it is probably best to return him or her to work as soon as possible, even if on limited duty.

Preparing For the Worst

Training and prior planning are the keys to a successful emergency response, just as aggressive safety policies are the keys to prevention.

It is important to train employees on what to do if exposed to anhydrous ammonia, especially the need for quick and aggressive decontamination. It is equally important to plan escape routes and practice response procedures so that responding medical personnel can quickly and safely care for possible victims. ■

Health Effects of Ammonia

NH₃ CHARACTERISTICS:

1. TOXIC & CORROSIVE

TOXIC - has the effect of a poison [tends to destroy life or impair health]

Corrosive - has the effect of eating away or consuming

2. FREEZE BURNS - very cold (-28° F)

3. DEHYDRATING EFFECT - has a tremendous affinity for water

ACUTE & CHRONIC EXPOSURES:

ACUTE/SHORT-TERM EXPOSURES

1. Vapor exposures

A. Small amounts - irritant, corrosive effect may be noticed

B. Large amounts - toxicity, corrosivity, cold, and oxygen depletion are likely to occur

2. Liquid exposures -

A. freezing effect, highly corrosive, and dehydrating

B. if ingested may act as a poison, in addition to the other effects

CHRONIC/LONG-TERM EXPOSURES

1. Vapor exposures

A. Small amounts

B. Large amounts

FIRST AID FOR AMMONIA INJURIES



Ammonia Injuries to the Eye

Two types of exposures:

1. Liquid
2. Vapor

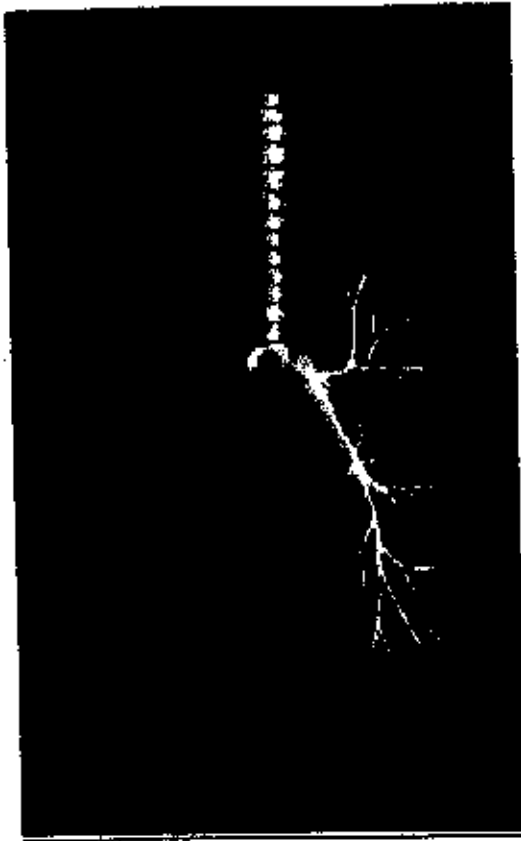
First Aid:

Flush the eyes with water for a minimum of 15 min.



Water, Water, Water, Water, Water, Water
and more Water...

Injuries to the Lungs



1. NH_3 will attack the soft tissues of the lungs initially causing discomfort, coughing etc.
2. Prolonged exposure in high amounts may cause spasm of the trachea and alveoli, leading to lack of oxygen .

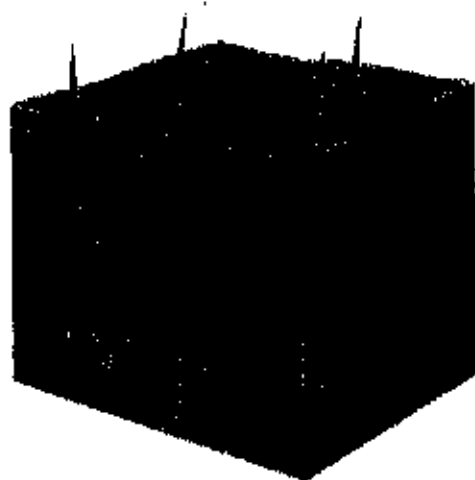
FIRST AID:

1. Get the person to fresh air as soon as possible.
2. Administer oxygen immediately
3. May give orange juice or citrus to counteract ammonia (unless contraindicated by your EMS protocols)
4. Patient may need to be treated for shock

- *Before you transport any person who has been injured by ammonia, be sure that the treatment administered is complete and that the person has been appropriately decontaminated, or has met pre-hospital protocols.*



Injuries to the Skin



1. Ammonia will attack the skin in several and will cause several effects to occur.
2. It has a tremendous affinity for water
3. It will act as a corrosive and spread out as it absorbs the moisture supplied by sweat glands.
4. It will cause a frost burn that may be full-thickness if it is a liquid exposure.

FIRST AID

1. Be sure that the clothes of the person are not frozen to their skin... *[Never attempt to pull off clothing if the person has been hit with liquid ammonia]*
2. Flush with water a minimum of 15 min.
3. Take care of shock concerns
4. Be sure of appropriate decon protocols