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Death Due to an Accidental Ammonia Release — Southeast Alaska, June 2013

Initial Report

On June 24, 2013, an accidental anhydrous ammonia release occurred onboard a tender boat docked in Sitka, and caused numerous people to seek medical care for symptoms related to the exposure. Within hours of the accident, the National Response Center reported the release to the Alaska Section of Epidemiology's (SOE) Environmental Health Program.

Background

Anhydrous ammonia, a colorless gas with a pungent odor, is used primarily as an agricultural fertilizer and an industrial refrigerant. It is also a key ingredient for illicit methamphetamine production in makeshift laboratories. Under pressure, anhydrous ammonia is a liquid. If released under humid conditions, ammonia vapors expand rapidly and form a fog that is initially heavier than air—a phenomenon that increases the likelihood of human exposure.¹ Symptoms of anhydrous ammonia exposure include the following:

- eye, nose, and throat irritation;
- breathing difficulty, wheezing, or chest pain;
- burns, blisters, and frostbite; and
- pulmonary edema, and pink frothy sputum.

In 2012, the Alaska Department of Environmental Conservation reported 32 Extremely Hazardous Substance (EHS) releases; 23 (72%) of the releases involved anhydrous ammonia (Table 1).² The highest number of releases occurred in the Aleutians (16, 50%), followed by Cook Inlet (4, 13%), Kodiak Island (4, 13%), and Southeast Alaska (3, 9%).²

Table 1. Extremely Hazardous Substance Releases — Alaska, 2012²

Substance	# of Releases	Quantity (lbs.)
Ammonia (Anhydrous)	23 (72%)	21,382
Sulfur Dioxide	3 (9%)	14,850
Sulfuric Acid	3 (9%)	608
Hydrofluoric Acid	1 (3%)	40
Hydrochloric Acid	1 (3%)	4
Hydrogen Cyanide	1 (3%)	4
Total	32	36,888

Investigation

On June 27, two SOE staff members traveled to Sitka to investigate the anhydrous ammonia release incident. While in Sitka, the SOE team 1) interviewed the boat captain and crew, first responders, the harbor master, and occupants of buildings surrounding the release area; 2) identified persons who were medically evaluated and hospitalized; and 3) observed the tender's engine room and other parts of the boat. SOE staff reviewed medical records after the field trip.

The captain of the tender reported that the incident occurred while oil was being drained from the ship's ammonia tank in the engine room. The person who was operating the valve (Patient A) was reported to have accidentally opened the valve too quickly and roughly 50 pounds of anhydrous ammonia escaped directly onto the engine room. The captain (Patient B) was also in the engine room when the release occurred. Neither Patient A nor Patient B was wearing personal protective equipment (PPE). Patients A and B were quickly assisted to the top deck by another person (Patient C) who was working just outside of the engine room; he was wearing a carbon-filter respirator. All three were decontaminated with water on the top deck. A witness on the dock promptly called 911 to report the incident. Sitka Fire Department and Emergency Medical Services personnel responded quickly to the call, attended to injured persons, monitored the surrounding area for ammonia levels, and advised neighboring

businesses to keep their windows closed or leave the area. The tender was docked next to a seafood processing plant in a busy commercial and residential area of the community—the plant began evacuating workers immediately. The tender was towed away from the area <1 hour after the release occurred to prevent further exposure to the community.

SOE staff identified seven people (median age: 38 years; range: 10–82 years) who were exposed to the ammonia and consequently evaluated by a health care provider (Table 2). Patient A was transported to the Sitka Community Hospital and transferred to Harborview Medical Center in Seattle; he died on June 25. No other patients were hospitalized or died.

Table 2. Signs and Symptoms of Patients Exposed to Anhydrous Ammonia Release and Sought Medical Care — Sitka, June 2013

Patient	Proximity to Release	Signs/Symptoms
A	<1 foot	Acute respiratory failure, hypothermia, metabolic acidosis, severe chemical burns
B	<5 feet	Burns, cough, difficulty breathing, headache
C	<10 feet	Burns, cough, difficulty breathing, headache
D	<20 feet	Difficulty breathing, nausea, vomiting
E	<100 feet	Eye and respiratory irritation
F	<100 feet	Respiratory irritation
G	<100 feet	Eye and respiratory irritation

Discussion

One person died and at least six additional persons sought medical care due to this accidental anhydrous ammonia release. Many more persons probably experienced milder ammonia-related symptoms but did not seek medical care. Prompt action taken by Patient C at the time of the incident likely prevented Patient B from becoming severely injured or dying. Sitka emergency responders, fish processing plant staff, and community members also responded quickly to the event, which may have prevented further injuries.

This incident is an unfortunate reminder of the importance of having proper safety control mechanisms in place (e.g., a functional self-closing emergency stop valve in the pipeline) and wearing the appropriate PPE when working with anhydrous ammonia.³ This event also underscores the potential for anhydrous ammonia releases that occur in public areas to impact large numbers of people.

Recommendations

1. Persons working with anhydrous ammonia should assure that all industry-standard safety controls are in place; wear the proper PPE, which includes a full-faced respirator and impervious clothing; and have at least 5 gallons of clean water and a squeeze bottle on-hand.^{3,4}
2. Hazmat training and community response plans should be established and regularly practiced in communities to help ensure rapid, appropriate responses to chemical releases.
3. Health care providers and first responders should report chemical releases that impact the public's health to SOE (call 907-269-8000 Mon-Fri 8AM–5PM, or 800-478-0084 after hours).

References

1. U.S. Department of Labor. Ammonia Refrigeration Facts. Available at: https://www.osha.gov/SLTC/etools/ammonia_refrigeration/ammonia/index.html#physical
2. DEC. Spill Prevention and Response Program. Extremely Hazardous Substance Release Summary. Available at: [http://www.dec.state.ak.us/spar/perp/hazmat/CY12-EHS%20Releases\(Final-February2013\).pdf](http://www.dec.state.ak.us/spar/perp/hazmat/CY12-EHS%20Releases(Final-February2013).pdf)
3. EPA. Accident Prevention and Response Manual. Available at: http://www.epa.gov/region07/toxics/pdf/accident_prevention_ammonia_refrigeration.pdf
4. CDC. Anhydrous Ammonia Facts Sheet. Available at: <http://www.cdc.gov/healthcommunication/toolstemplates/entertainmentd/tips/anhydrousammonia.html>