AMMONIA FACTS

Oregon Hazardous Substances Emergency Events Surveillance System (HSEES)

What is ammonia?

Ammonia is considered a dangerous chemical because of its corrosive nature and the potential for permanent health effects from exposure. Ammonia [NH_3] is a non-flammable colorless gas with a distinctive odor familiar to most from some window cleaners or animal urine. Ammonia gas can be dissolved in water (called aqueous or liquid ammonia) but quickly turns back to gas form (anhydrous ammonia) when exposed to open air[1]. Ammonia occurs naturally in the environment as well as being one of the most produced inorganic chemicals in the world today. The main uses of ammonia are for production of fertilizers, explosives, and polymers (around 80% of the ammonia produced is used as crop fertilizer) [1]. In addition, the qualities of anhydrous ammonia (it turns to a very cold liquid under pressure) make it an excellent refrigerant. Although ammonia was replaced by haloalkanes such as Freon in smaller refrigeration units, the contribution of the latter to ozone depletion has increased the use of ammonia for refrigeration.

Oregon has 306 registered facilities that produce, process, or use ammonia as of 2008[2]. The on site quantities range from 1 gallon or pound to over 2.5 million gallons or pounds depending on the form. In 2005, ammonia was among the top 15 chemicals involved in Hazmat team responses[3] and total on and off-site releases of ammonia in Oregon was over one million pounds/ gallons[4].

Industries that commonly use ammonia:

o Frozen fruit, juice, vegetable processing facilities
o Cold storage warehouses
o Fertilizer manufacturing
o Meat, poultry, and fish processing facilities
o Truck and rail transportation
o Wineries and breweries
o Dairy and ice cream plants
o Chemical product manufacturing

What are the heath effects?

Ammonia is toxic and may be fatal if inhaled, ingested, or absorbed through skin[5]. Exposure to ammonia can cause irritation, frostbite, and serious chemical burns on the skin, in the mouth, throat, lungs, and eyes. Other common symptoms include headache, shortness of breath, nausea, and vomiting[6]. These effects are due to its irritative and corrosive properties. Some people with conditions such as asthma or other pulmonary conditions may be more sensitive to the effects of ammonia.

Most individuals can smell ammonia at concentrations below 20 parts per million (ppm) in air, although repeated exposure to ammonia lowers the sensitivity to the odor[7].

Exposure limits for workers exposed to ammonia are set by the Occupational Safety and Health Administration (OSHA). OSHA permits exposure to ammonia up to 50ppm over an 8 hour workday[7]. NIOSH considers ammonia levels of 300ppm or more to be Immediately Dangerous to Life and Health (IDLH) [8].

Proper handling of ammonia

- Ammonia solutions should never be mixed with chlorine-containing compounds (e.g. household bleach), as toxic and carcinogenic gases can form (examples include chloramines, hydrazine, and chlorine gas). Anhydrous ammonia can have violent reactions with halogen compounds fluorine, chlorine, bromine and iodine, as well as with metals such as gold, silver and mercury[1].
- Ammonia should be stored in tightly closed containers or tanks in cool, well ventilated, and secure areas.
- Check equipment and safety relief valves regularly for wear. Do not take a chance on worn parts.
- If there is an ammonia spill or release, evacuate to an upwind location and contact emergency responders[5]. A full Self Contained Breathing Apparatus or SCBA is needed to enter the area to stop the release of ammonia. Do not attempt to re-enter the area. The area should be considered Immediately Dangerous to Life or Health until deemed otherwise by trained professionals[7].

Ammonia Incidents in Oregon

From 1993 - 2007 ORHSEES recorded a total of 3,187 qualifying chemical incidents in Oregon. Of these qualifying incidents, 240 (7.5%) involved a release of ammonia. 87.5% of the ammonia releases occurred at fixed facilities while 12.5% occurred during the transport of ammonia. A total of 67 of the 240 ammonia incidents required an evacuation order, affecting 3687 people. Evacuations ranged from one person to 500 people. Eight incidents called for a shelter-in-place order. There were 33 incidents involving injuries, with a total of 124 victims, an average of 3.8 victims per incident. There were a total of 141 individuals who received emergency decontamination, including emergency personnel, employees, and members of the general public during the 240 incidents.

Table 1. Summary of Ammonia Incidents in Oregon 1993 - 2007

	Fixed Facility (%)	Transportation (%)	Total
Incidents	**210 (87.5)**	**30 (12.5)**	**240**
Evacuations	64 (95.6)	3 (4.4)	67
Shelter-in-Place	7 (87.5)	1 (12.5)	8
People Receiving Emergency Decontamination	137 (97.2)	4 (2.8)	141
Incidents with Victims	29 (83.9)	4 (16.1)	33
Total Victims	109 (87.9)	15 (12.1)	124

Case Study 1

Highlights: 6 victims and 50 people evacuated

A cold storage food distributor experienced a ruptured refrigeration compressor leading to the release of 5658 pounds of anhydrous ammonia. Local officials closed the neighboring highway and evacuated the business and surrounding businesses for 5 hours as they attempted to control the anhydrous ammonia vapor release. Medical personnel and the fire department set up a triage and decontamination area to handle those exposed to ammonia. Three victims, two of which were employees, were transported to the hospital (one was admitted) and three others were treated and released at the scene. Symptoms included respiratory and eye irritation.

Case Study 2

Highlights: 2 victims, 13 people decontaminated, and 435 people evacuated

A manufacturing facility was performing maintenance on equipment when workers accidentally drilled into a pipe carrying ammonia. Approximately 435 people were evacuated, and two employees were sent to the hospital. The symptoms experienced by these 2 victims were nausea, thermal burns, and dizziness. 5 employees and 8 responders were decontaminated at the scene.

Case Study 3

Highlights: 6 victims and 50 people evacuated

A dairy product manufacturing facility was evacuated after a line break on a tank caused a leak of anhydrous ammonia. 10 employees were evacuated, and one passerby was transported to a local hospital with respiratory irritation. People downwind of the leak were advised to shelter in-place. Although the actual quantity of ammonia released was estimated at 6 pounds, the potential for a leak of up to 5,000 gallons was present. After about 1.5 hours, the building was turned over to its owners for clean-up activities.

Victims of Ammonia Incidents

The vast majority of victims were employees of the industry that experienced the ammonia release, representing 83% of those injured. The general public was the next most common group to suffer an injury due to an ammonia incident (13% of victims) followed by responders representing 4% of victims (Fig. 1)

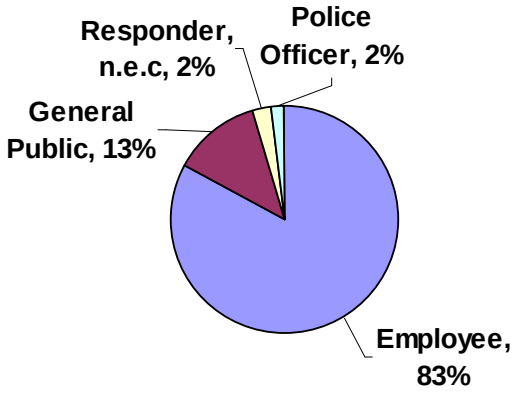

Fig 1. Persons injured in ammonia incidents in Oregon, 1993 – 2007 by classification

During these 240 ammonia incidents, 36% of victims reported suffering respiratory distress and 28% reported eye irritation (Table 2). Other common symptoms were nausea and vomiting (15%) and headache (14%). There was an average of 2.3 symptoms per victim. 34% of victims reported one or two symptoms while 32% reported 3 or more symptoms related to their exposure to the incident.

Affected Industries
The most common industries where ammonia release incidents occurred were manufacturing industries: frozen fruit, juice, and vegetable manufacturing (24, 10%), followed by misc. food prep and kindred products (19, 8.0%) and agricultural chemical manufacturing (18, 7.5%) (Table 3). Warehousing and storage had 16 events (6.7%) while dairy products processing had 15 events (6.3%). There were 18 events which had no or unknown industry information.

For the 33 events that reported victims, the most common industries were frozen fruit, juice, vegetable manufacturing (3 events with 40 victims), and groceries and related products (3 events with 38 victims).

Factors contributing to the incident are important indicators that can help inform future prevention and mitigation efforts. Information on contributing factors was not available during the entire time period of this analysis; 1996 is the first full year with data on contributing factors. For the 180 ammonia events that had data for contributing factors, the most common primary factor was equipment failure (95, 52.8%), followed by human error (30, 16.7%) intentional or illegal act (30, 16.7%), and other (25, 13.9%).

Table 2. Symptoms Reported During Ammonia Incidents, 1993 - 2007

Injury	Frequency	Percent
Respiratory irritation	102	36.0
Eye irritation	81	28.3
Gastrointestinal problems	43	15.0
Headache	39	13.6
Burns	11	3.8
Shortness of breath	3	1.0
Dizziness	3	1.0
Skin irritation	2	<1
Trauma	1	<1
Other	1	<1
Total	286*	100

*A victim could report more than one symptom

Table 3. Profile of Ammonia Incidents by Industry in Oregon, 1993-2007

Industry	Incidents (%)	Incidents w/victims	Victims
Frozen fruit, juice, vegetable manufacturing	24 (10.0)	3	40
Misc. food preparations & kindred products mfg.	19 (8.0)	1	1
Agricultural chemicals	18 (7.5)	0	0
Warehousing and storage	16 (6.7)	3	4
Dairy product processing	15 (6.3)	3	4
Illegal activity, meth-related	14 (5.8)	0	0
Industrial or misc. chemicals	12 (5.0)	1	1
Food industry n.e.c.	12 (5.0)	1	3
Truck transportation	9 (3.8)	2	11
Agricultural services, n.e.c.	6 (2.5)	1	1
Line haul railroads	6 (2.5)	1	1
Private households	6 (2.5)	1	4
Fresh, frozen seafood processing	4 (1.7)	1	1
Groceries and related products	4 (1.7)	3	38
Unknown industry	18 (7.5)	4	7
All others (< 1.5% of total)	57 (23.8)	8	8
Total	**240**	**33**	**124**

About the Oregon Hazardous Substances Emergency Events Surveillance (HSEES)

What is HSEES?

Oregon's HSEES system collects and analyzes data on hazardous substance spills and releases in order to determine how accidental spills, releases, and the injuries associated with them come about. The purpose of this work is to increase safety among responders, employees, and the public; to decrease the number and severity of release incidents, and to reduce morbidity and mortality due to incidents. The value of the HSEES system is its unique ability to provide feedback to the persons responding to and involved in these hazardous incidents in a timely fashion, so that information can be utilized to prevent future incidents and injuries.

Oregon HSEES goals:

- To characterize hazardous substances emergency events in the state.
- To describe morbidity and mortality associated with releases.
- To identify risk factors associated with morbidity and mortality.
- To develop strategies for reduction of morbidity and mortality due to hazardous substances emergency events.

History of the Program:

Oregon has participated in HSEES since 1992. The goal of this surveillance project is to reduce the morbidity and mortality resulting from hazardous substance emergencies, by describing the distribution of these emergency events within Oregon and the 14 other participating states; by characterizing the adverse effects experienced by employees, responders and the general public; by identifying risk factors associated with releases and injuries; and by developing strategies to reduce subsequent morbidity and mortality. We have built relationships with partners in federal, state, and local responder agencies; community organizations; and with principal hazardous materials incident reporting and data sources. We maintain and improve collaboration with partners to enhance the value of the HSEES system to the state, and to prevent releases of hazardous materials and their public health consequences.

TO REPORT A SPILL, call the Oregon Emergency Response System (OERS), toll-free, at 1-800-452-0311.

If you have questions or comments about the role of Oregon HSEES in monitoring chemical leaks and spills, please contact HSEES staff at (971)673-0440.

Resources:

1. ATSDR TOXFAQS; ATSDR Toxicological Profile for Ammonia, 2004
2. Oregon Community Right to Know Hazardous Substance Information System, Oregon State Fire Marshal, 2008
3. Oregon Hazardous Substance Annual Survey Report 2005. Available at: www.oregon.gov/OSP/SFM/Reports_2007
4. Oregon Hazardous Substance Information Survey Annual Report 2005. Available at: www.oregon.gov/OSP/SFM/Reports_2007
5. National Library of Medicine's WebWISER (wireless information for emergency responders) http://webwiser.nlm.nih.gov/getHomeData.do
6. Ammonia Facts, Texas HSEES program Available at: www.dshs.state.tx.us/epitox/hsees.shtm
7. Occupational Safety and Health Administration (OSHA) Satfety and Heath Topics: Ammonia Refrigeration
8. National Institute for Occupational Safety and Health (NIOSH) Pocket Guide to Chemical Hazards, 2006

DHS Oregon Department of Human Services

Hazardous Substances Emergency Events Surveillance HSEES

This fact sheet does not replace the material safety data sheet (MSDS) required for a hazardous chemical under the Occupational Safety and Health Act of 1970 (29 USC 651 ET SEQ.) and regulations promulgated under this Act.

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