AGRI-FACTS
Practical Information for Alberta's Agriculture Industry

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Ammonia Emissions and Safety

Livestock production is a major contributor of ammonia emissions. Ammonia (NH_3) is produced inside livestock buildings, in open feedlots, in manure storage facilities, during manure handling and treatment and when manure is applied to soils.

Ammonia in livestock facilities results primarily from the breakdown of urea (present in urine) by the enzyme urease (excreted in feces). In poultry, urease is excreted with uric acid.

Characteristics of ammonia

Ammonia has a sharp, distinct, penetrating odour detectable at very low concentrations. At moderate levels of concentration, ammonia can irritate the eyes and respiratory tract; at high concentrations, it can cause ulceration to the eyes and severe irritation to the respiratory tract (**Table 1**).

Table 1. Health effects of ammonia

Concentration (ppm)	Health Response
24 - 50	Nose and throat irritation after ten minutes of exposure.
72 - 134	Irritation of nose and throat after five minutes exposure.
700	Immediate and severe irritation of respiratory system.
5,000	Respiratory spasms, rapid suffocation.
Above 10,000	Pulmonary edema, potentially fatal accumulation of fluid in lungs and death.

Typical ammonia levels in well-ventilated, environmentally regulated buildings are 10 to 20 ppm with liquid manure systems and 50 ppm where manure and urine are deposited on solid floors. Levels can exceed 50 ppm with lower winter ventilation rates and reach 100 to 200 ppm in poorly ventilated buildings. High levels of ammonia are found particularly in solid manure systems.

Ammonia is lighter than air and can be easily removed from livestock buildings by proper ventilation.

Ammonia detection

Ammonia levels above 20 ppm are easily detectable. There are several methods of detecting ammonia and these include litmus paper, detection tubes and electronic devices.

Accuracy, ease of operation and calibration, and cost are factors to consider in the selection of ammonia detection devices.

Ammonia and health hazards

Ammonia poses a threat to both the animals and agricultural workers in livestock facilities. Ammonia is a significant respiratory hazard for workers who experience long-term exposure to this gas in constant average values greater than 25 ppm.

In addition to respiratory effects, ammonia can cause skin and eye irritation and displace oxygen in the bloodstream. Long-term exposure to ammonia can cause pneumonia.

Occupational contamination limits of ammonia

There are a number of guidelines and limits to ammonia exposure aimed to protect human health and safety. The American Industrial Hygiene Association (AIHA), the American Conference of Governmental Industrial Hygienists (ACGIH) and the National Institute for Occupational Safety and Health (NIOSH) recommend an exposure Threshold Limit Value (TLV) of 25 ppm for ammonia (based on 8 hour time weighted average).

TLV is defined as an estimate of the average safe airborne concentration of a substance that represents conditions under which it is believed that nearly all workers may be repeatedly exposed to day after day without adverse effect. The Occupational Safety and Health Administration (OSHA) sets 50 ppm as the permissible exposure limit (PEL) for ammonia.

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Threshold Limit Value for ammonia gas in Alberta:

- long term exposure (8 hours): 25 ppm
- short term exposure (15 minutes): 35 ppm

Options to reduce ammonia emissions from livestock buildings

1. Diet manipulation. Carefully matching feed to the nutritional requirements of animals reduces nitrogen excretion without affecting productivity.
2. Use ventilation techniques that create low air velocities around surfaces exposed to manure. Air speeds across manure-covered surfaces should be minimized since the amount of ammonia gas given off by manure is increased with air speed.
3. The type of floor area exposed to manure in animal housing facilities can have a significant effect on the emissions rate of NH_3. Emissions of NH_3 from the solid part of the floor can be reduced by using an inclined or convex, smoothly finished surface.
4. Proper management of feed and building hygiene.
5. Frequent removal of manure from livestock buildings or pens.
6. Physical (aeration), chemical (reduce or increase manure pH by manure additives) and biological (biofilteration) treatment of stored manure.

How to protect yourself from ammonia exposure

1. Provide a gas trap between the barn and any connected long-term manure storage (Canadian Farm Building Code 1983, Article 4.1.1.2).
2. Avoid long-term manure storage under slotted floors in fully enclosed barns, especially with negative-pressure ventilation. Instead, build the main storage outdoors or at least separate from the livestock part and remove the manure frequently from under the floors (Canada Plan Service).
3. Prevent manure from drying (i.e., keep manure in solution through pit recharge).
4. Do not enter a manure storage pit without respiratory protection even during normal conditions. Be prepared to wear a self-contained breathing apparatus (SCBA) where high concentrations exist such as during agitation and pumping of manure.
5. Provide maximum ventilation when agitating and pumping manure or if there is a strong smell of ammonia in the building.
6. Flush irritated skin or eyes with water and get fresh air; these steps are the best first-aid treatment.

Summary

Producers need to be aware of and informed about the dangers of being exposed to ammonia for long periods. All the measures to protect against ammonia exposure should be taken, and medical help should be sought if producers experience any illness related to their exposure to noxious gases.

For more information about Canada Plan Service (CPS), visit the website http://www.cps.gov.on.ca

References

Al Heber, D. Jones and A. Sutton. 2002. Controlling Ammonia Gas In Swine Buildings. http://www.cdc.gov/nasd/docs/. Accessed February 2004

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