



Promoting Agricultural Health & Safety

Manure storage poses invisible risks

Gases and odors may be a nuisance for many livestock producers, but they also can be a life-threatening danger when confined to buildings or manure pits.

Every year in Iowa, incidents are reported in which someone is overcome by deadly manure gases. These incidents have resulted in several deaths and many more illnesses caused by exposure to poisonous gases. This does not include economic losses from animals that die from the gases.

It is difficult to know when air quality problems will occur. The best precaution is to understand the sources of air quality problems, and what to do to reduce or eliminate them. This publication will discuss five common gases found in manure storage facilities, and other hidden dangers.

Common gases

Gases are generated as animal wastes break down. Gas builds over time, often rising to the surface and escaping into the air. Enclosed livestock areas must be ventilated, even on cold winter days, to remove moisture and gases. When ventilation rates fall below a minimum, or when conditions increase the release of gas to the air (such as pit agitation), serious problems can occur.

- **Carbon dioxide** is the result of animal respiration. **Carbon monoxide** is the result of using combustion equipment, such as heaters and gas-operated power washers, in a confined area. This equipment produces more carbon monoxide when engines don't burn cleanly.

At high concentrations, carbon dioxide and carbon monoxide can cause respiratory distress and headaches. At prolonged high exposures, these gases can be fatal. Federal standards set maximum concentrations at 5,000 parts per million (ppm), about 0.5 percent, for carbon dioxide; and 50 ppm, about 0.005 percent, for carbon monoxide.

Solution: These gases usually aren't a problem under normal conditions with proper ventilation. However, it's important to maintain some ventilation at all times, even when animals are not present.

- **Ammonia** is a troublesome by-product of manure decomposition. It is an eye irritant at levels above 20 to 25 ppm. When exposed to levels around 1,500 ppm, people begin to cough and froth at the mouth. Ammonia is deadly at 5,000 ppm.

Ammonia has a distinct odor, which humans can detect in concentrations as small as 5 ppm. It's common during winter months for ammonia levels to exceed 25 ppm, even under normal winter ventilation rates. Although it is debated by safety experts, 25 ppm is frequently recommended as a maximum acceptable level for ammonia. If your eyes burn when you enter an enclosed livestock facility, you know ammonia levels are at least 20 ppm.

Solution: Provide at least a minimum winter ventilation rate throughout the year. Water attracts ammonia, so frequent rinsing of equipment or leaving at least a half-inch of water in pits or on the floor can help.

- **Methane** is dangerous because it is highly combustible. At concentrations of 50,000 ppm or more (a level of 5 percent), methane can explode. Methane gas is produced as animal wastes decompose, and warm temperatures accelerate this process. Another problem is that this colorless, odorless, tasteless gas is difficult to detect. Methane is lighter than air and will accumulate in the top of unvented areas, such as closed pits. The maximum allowable concentration is 1,000 ppm, or 0.1 percent.

Manure storage safety

How much do you know?

1. Which manure gases can you readily smell?
 - a) ammonia
 - b) hydrogen sulfide
 - c) carbon dioxide
2. How deep are most manure pits?
 - a) 4 ft.
 - b) 8 ft.
 - c) 12 ft.
3. The ammonia level is at least 20 parts per million (ppm) if your eyes burn. True or false?
4. How much hydrogen sulfide can be fatal?
 - a) 10 ppm
 - b) 100 ppm
 - c) 1,000 ppm
5. If you're pumping out a deep pit in a building and notice dead hogs, what could be the cause?
 - a) exposure to methane
 - b) exposure to hydrogen sulfide
 - c) exposure to ammonia
6. When someone is overcome by manure gases, try to get that person out as quickly as possible. True or false?

See answers on back.

Solution: Make sure all pits and manure storage areas are adequately ventilated. Prohibit all open sparks or flames in areas near pits or storage facilities.

• **Hydrogen sulfide** is the most dangerous gas found in enclosed livestock operations. It is responsible for most manure-related deaths of animals and people.

Within seconds of exposure, hydrogen sulfide can cause unconsciousness, which can be fatal. Concentrations as low as 1,000 ppm can result in death. The maximum allowable concentration is 10 ppm.

Hydrogen sulfide is heavier than air, so it will accumulate in underground pits or other low-lying, unventilated areas. Although its rotten egg odor can be detected at levels of less than 1 ppm, the gas will paralyze the sense of smell at higher levels.

Solution: Whenever you work in manure storage facilities, always assume hydrogen sulfide is present. Follow these safety precautions to minimize the dangers of hydrogen sulfide:

- Provide extra ventilation during agitation.
- Never enter a pit without precautions.
- If you suspect high hydrogen sulfide levels for any reason, leave the building immediately. Signs include the presence of sick or dead animals in the area, or a sudden headache or dizziness.

Other dangers

The large volume of liquid that must be stored in many manure systems is also a danger. Children and adults can drown in pits, commonly as deep as 8 feet. Pits typically have either very steep or vertical walls, making escape almost impossible.

For more information

■ For regulations regarding manure pits or livestock storage facilities, contact the Iowa Department of Natural Resources (DNR) or your local extension office.

■ For details about manure gases and their prevention, contact your local extension office for a copy of the Midwest Plan Service's *Waste*

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Pits are inaccessible if they're covered by slats, and outdoor pits with concrete lids pose few dangers to bystanders or workers. However, the cost of covering pits and the larger size of pits in recent years has led to increasing use of open pits, both earthen and concrete. Without protection, such as high fences and locked gates, open pits are potential hazards.

Another problem may be push-off ramps used in some dairy operations. A strong safety cable at the end of the ramp may prevent a machine from falling into the pit. Beef and dairy pits also may form unstable crusts that can get covered with weeds.

General precautions

Never try to rescue someone who is unconscious in a manure storage structure unless you have the proper equipment and knowledge of the situation. **Multiple deaths are common because rescuers succumb to the same gases as the victim.**

The immediate response should be to contact an ambulance or local emergency medical services. You may attempt a rescue if you are wearing a self-contained breathing apparatus, have a rescue line, and have another person at the end of the line to help.

Toxic odors and gases are natural by-products of all livestock operations. Persons who work in these environments must know that air quality problems can develop at any time. However, a cautious attitude and proper equipment can help you avoid a life-threatening situation.

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Facilities Handbook, MWPS-18. (Fee for publication.)

■ More information about manure pit deaths is available from www.cdc.gov/niosh/docs/90-103/.

Manure storage safety

What can you do?

- Learn the danger signs of toxic levels of manure gases.
- Post warning signs around manure pits and enclosed livestock facilities about the possibility of a contaminated atmosphere.
- Inquire about the rescue equipment available from your local emergency response team to handle gases that could be present in your operation.
- Maintain a fence around open pits and keep the gate locked at all times.
- Keep the area around earthen pits mowed and free of tall weeds.
- Never enter a manure pit alone.

Answers to quiz: 1-a and b; 2-b; 3-True; 4-c; 5-b; 6-False



Safe Farm is an Iowa State University Extension and Outreach project helping to make Iowa farms a safer place to work and live.

For more safety information, check the web at www.abe.iastate.edu.