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## Safety Watch: Knock-down effect of hydrogen sulfide

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One year ago, a young Iowan died after exposure to manure gas in a 7,300-gallon spreader tank.

About one foot of slurry was in the tank when he climbed inside to investigate a clog in the spreader. Within 30 seconds, he collapsed.

His coworkers called 911 and attempted a rescue, but they were driven off by gases in the tank. Firefighters with supplied-air respirators safely entered the tank and retrieved the victim.

Eight years earlier, a 52-year-old Iowa farmer collapsed in the manure pit under his cattle shed. He and his hired hand had finished pumping out the 8-foot pit, and his intention was to retrieve a chain that had fallen through the slats.

The hired man ran 150 yards to the house to tell the farmer's wife to call 911, and he raced back to rescue his friend. He, too, collapsed and fell face down into a few inches of slurry at the bottom of the pit.

Both men were retrieved by first responders wearing supplied-air respirators. They were flown by helicopter to a regional hospital for emergency care. In the days that followed, both men died.

This event could have resulted in two more fatalities. The first emergency responder to enter the pit wore inadequate protection and became disoriented, but he managed to climb out. And, fortunately, a family member was stopped from entering the pit with two victims already down.

In the past 40 years, scores of similar ag fatalities have occurred in confined spaces designed to hold or transport manure and other organic waste byproducts.

What makes these environments so deadly? Toxic and flammable gases are produced by bacteria during decomposition of manure and other organic byproducts. Most of the gases remain dissolved in the slurry.

When the slurry is disturbed during agitation or pumping, the trapped gases are rapidly released into the air. In a matter of seconds, air concentrations of poisonous hydrogen sulfide (H<sub>2</sub>S) can increase a thousand-fold.

Flammable methane gas is also released. Methane can form explosive mixtures with air, resulting in flash fires or explosions in the presence of ignition sources such as pilot lights, electrical shorts, open flames, welding sparks or cigarettes.

Hydrogen sulfide is heavier than air and accumulates in low areas along the floor or the bottom of pits and tanks. It has a recognizable rotten-egg odor at very low concentrations, but higher concentrations deaden the sense of smell and cause disorientation.

This effect makes it impossible to perceive dangerous conditions without the use of a gas detector with a H<sub>2</sub>S sensor.

Hydrogen sulfide concentrations measured during and after manure agitation reach levels that can cause sudden unconsciousness ("knock-down effect") or death after just a few breaths.

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Only air-supplying respirators provide protection from H<sub>2</sub>S and methane. Face masks and common respirators with dust filters or gas cartridges are ineffective. Fatalities have occurred when workers wore these air-purifying respirators in a manure pit, thinking they were protected.

Awareness and planning can prevent these fatalities. Consider these steps in planning manure handling activities this fall:

- Identify manure pits and spreader tanks as confined spaces and post warning signs at building entry and pit or tank access points.

If you have employees or contractors whose primary language is not English, post signage that is bilingual or that shows a graphic depiction of the hazard.

- Train employees and inform family members, contractors and other workers who may be working nearby of the gas hazards associated with manure pit and storage tank confined spaces.

- Develop an emergency plan and share it with employees and family members before a potential emergency arises. An emergency plan should include carrying a cell phone when working away from buildings without phone lines. It also includes posting the rural address or coordinates in livestock buildings and other out buildings. This can save time and assist callers who may be distraught or unable to provide directions.

- Prevent others from entering the space while waiting for trained responders. In the heat of the moment, the natural urge to save a loved one is overwhelming. It can block recognition the existing hazard will also overcome a rescuer.

=Never assume that because a pit or tank has been entered previously without incident, it will be safe the next time. A high proportion of fatalities have occurred because a victim relied on their prior experience to conclude a space was safe.

- Fully ventilate the building or tank during and after pumping to dilute hazardous gases that are released. Operate all fans and fully open windows and curtains before starting.
- Prohibit entry of the building during pumping.
- Never bend down over a pit or tank access opening to check the progress of mixing. Since H<sub>2</sub>S is heavier than air, concentrations will be higher near this opening.
- Never enter a manure pit or tank without following confined space entry procedures to assure safety. These include being trained in confined space entry; having an emergency plan in place; and using gas-detection equipment to test the atmosphere before and throughout entry.
- Use a safety harness, lifeline and mechanical winch having capacity to lift the person entering.
- Use at least two observers trained in confined-space rescue.

For more information on manure storage hazards, visit Penn State Extension's Manure Pit Safety Fact Sheets (<http://tinyurl.com/jwb86gu>) or contact the Iowa FACE Program.

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