

Producers respond to H2S deaths



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"Seventeen head near Geneseo."

"Three head dead one day, four the next, in the same Illinois barn."

"Thirty-one steers were down, we lost 23."

"Eight more dead last night by Onslow."

"We had a guy on a ladder to the tank who was overcome and fell, but he came to after a few minutes. He was lucky."

These reports of livestock deaths and a manure hauler's close call, occurring over a two-week span in late October, were recounted at a community safety meeting organized to alert cattle feeders and custom haulers in Eastern Iowa of the risks of hydrogen sulfide (H₂S) exposure during manure handling.

The losses occurred at four sites in Eastern Iowa and Western Illinois during pump-out of slatted floor, deep pit cattle confinements. But the risk of deadly exposure is not limited to confinement buildings.

In August, 29-year-old Mike Biadasz — and 16 cattle — died from H₂S exposure during agitation of an open lagoon in Wisconsin. Weeks later, 16-year-old Jonas Hoover died after entering an emptied manure tank.

Wisconsin incidents bring the recent toll to at least 71 cattle deaths and two human fatalities in the tristate area.

Hydrogen sulfide — a toxic gas produced by bacteria during digestion of manure — is present in solution in liquid manure. Poor-quality well water and dietary ingredients such as distiller's grains or gluten can increase sulfur excreted from animals, resulting in greater production of H₂S.

When manure is disturbed or agitated, H₂S is released into the air "in bursts," says Dan Andersen, ag and biosystems engineering professor at Iowa State University. Air

concentrations can increase a thousand-fold, reaching deadly levels within seconds.

Typically, H₂S concentrations around undisturbed manure storage structures range from 0-3 parts per million (ppm). The gas is heavier than air and tends to pool in low areas, but air currents or turbulence in stirred manure can quickly disperse the gas into the breathing zone.

Signs of danger

In the Midwest, more H₂S-related fatalities have occurred in swine confinement operations than in cattle confinements. Many incidents have tragically involved multiple fatalities when unprotected, would-be rescuers attempted to assist an initial victim who had lost consciousness.

In 2005, Jason and Sherril Johnson experienced such a loss at their farm near Andover, Iowa. Dwight Johnson (Sherril's husband/Jason's father) lost consciousness upon entering an empty pit to retrieve a chain; their employee, Justin Faur, collapsed in an attempted rescue. Both died several days later.

On Oct. 22, the Johnsons lost 23 steers at their custom cattle feeding operation. The incident occurred in a four-year-old open confinement building with capacity of 720 head, in six pens over separate pits.

Johnson and his employees began pumping one of the pits that Saturday with cattle in the building, as they had done on other occasions.

"Within maybe 30 seconds" of starting the pump, he heard 1,100-pound steers dropping to the floor.

An employee immediately shut off the agitator and called for help. Coworkers got floor fans directed on 31 steers that were down along the east and west sides of the pen.

The employee — a volunteer firefighter — donned a supplied air respirator before entering the pen to move 80 unaffected cattle out and rouse eight cattle that were down but still alive.

Maquoketa DVM Mike Slattery submitted tissue samples

for toxicology testing, which confirmed death due to H₂S exposure. One steer was temporarily blinded but recovered the next day. Slattery expects the surviving steers to have no long-term effects.

As word of the Johnsons' loss spread, they learned of other regional incidents the week before. Slattery and the Johnsons quickly organized an impromptu "information sharing" manure safety meeting for neighboring cattle feeders and haulers.

Their aim was to raise awareness of the danger of H2S before others started emptying their pits, and to discuss recommendations to reduce risks through safe pumping and ventilation procedures, use of gas monitors and proper respiratory protection. They hoped that 30 local folks could attend on short notice.

Additional precautions were undertaken when pumping resumed Monday after the loss. Cattle were removed from the pen above the pit, and a large floor fan increased ventilation. At least one extra person remained at the pump-out as a spotter.

Personal gas monitors

We monitored conditions at the pump-out, tank fill area and nearby pens using H2S gas detectors. The pump operator, haulers and field applicators wore personal H2S monitors that provide low- and high-alarm alerts of rising concentrations.

We recommend all personnel involved in manure pump-out, hauling and transfer or equipment maintenance activities wear personal single-gas H2S monitors during these activities.

Low-cost, low maintenance monitors, such as SGC-Plus or BW Clip Real Time have a 24-month internal battery requiring no charging or replacement. The 24-month life can be extended by putting the units into hibernation or “sleep” mode during periods when the monitor will not be needed. At the end of the sensor lifetime, the unit becomes inactive and should be discarded.

Alarms provide a low- and high-alarm visual, audible and vibrating alarm when H2S levels exceed set points. When no gas is present, these monitors display months-of-life remaining; in the presence of gas, the monitors display concentration in ppm.

The highest concentration displayed is 100 ppm (the IDLH concentration), although actual concentrations may be higher. Users should exit the area when alarms activate and return only when alarms stop and concentrations read below target set points.

Personal single gas H2S monitors are available online from numerous online vendors including PKSafety, Amazon, Zoro, and at local industrial safety and agricultural supply stores. Prices range from around \$120-200.

Monitors confirmed the speed at which concentrations changed in the open area at the pump-out and tank fill area — increasing from 0 to 40, 50 and near 70 ppm in seconds, alerting us to clear the area. H2S concentrations near the pump-out spiked above 300 ppm on several occasions.

Monitors worn by haulers and applicators in the field also alarmed at the 10- and 20-ppm warning concentrations.

Johnson used a probe to measure H2S in the headspace below the slats. The alarms

“went nuts,” he said, when agitation started. We also observed elevated concentrations near pen areas where agitator jets pointed.

Information on recent incidents, health effects, safety precautions, H2S monitors and observed gas concentrations was shared with over 80 people at the Oct. 26 safety meeting led by Slattery in Johnson’s machine shop. Attendees included livestock producers, custom haulers, first responders and livestock, manure-handling and safety specialists from Iowa State University and the University of Iowa.

H2S (ppm) Effect

0.01-1.5	Odor threshold, “rotten eggs”
2-5	Nausea, eye irritation, headache
20	Headache, dizziness, fatigue, memory loss
100	Immediately dangerous to life and health, loss of smell
500-700	Collapse, loss of consciousness in 5 minutes
700-1,000	Knock-down effect: rapid unconsciousness in 1-2 breaths, breathing stops, death within minutes
1,000-2,000	Nearly instant death

For additional information, visit:

<http://www.agronext.iastate.edu/immag/hottopics.html>

<http://themanurescoop.blogspot.com/2016/10/manure-agitation-tips-for-hydrogen.html#gpluscomments>

<http://www.public-health.uiowa.edu/gpcah/manure-gases/>

Note: This article has been corrected to reflect actual livestock losses of 17 cattle at an Illinois site and total livestock losses of at least 71 cattle in the tri-state area.

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