October 2021

Manure Pumping Safety Tips
Anaerobic organic matter decomposition releases ammonia, carbon dioxide, methane, and hydrogen sulfide. Although all are potentially dangerous, hydrogen sulfide tends to be one of the biggest concerns in these cases. Hydrogen sulfide has an intense rotten egg smell, so it is relatively easy to detect its presence, even in low concentrations. However, after breathing it for a short time, your sense of smell will become fatigued, and you lose the ability to detect it. Just as importantly, since we can smell it at such low levels, there is no clear indication of when it reaches potentially hazardous conditions that we can detect without using analytical instruments.

In many animal housing facilities, the manure pit is located below the facility floor. These gases are generally detectable within these buildings in low concentrations throughout the year; however, under some conditions, such as manure agitation, the gases can be released rapidly from the manure and reach potentially toxic levels for people and animals. Even in other systems, where the waste is stored outdoors, toxic levels of hydrogen sulfide can result near and in the manure storage under certain conditions, mostly limited to periods of manure disturbance such as agitation.

Multiple Levels of Control can help Reduce H2S Risks

- Diet and Water Management
  - What we feed our pigs and the amount of sulfate in water impact how much sulfur will be excreted by the animal. Knowing how much sulfur is in your manure and sulfate is in the drinking water can help determine how much risk an individual site has for higher H2S during pumping.

- Ventilation
  - Check over your ventilation system. I commonly see pit fans that aren’t functional. Ensuring the ventilation system is operational is key to success when managing hydrogen sulfide—if agitating a naturally ventilated barn, dropping the curtains, and utilizing the breeze reduces risk. In mechanically ventilated barns, 25 to 30 cfm per pig space are recommended. Before agitating, be attentive to dead zones in the barn for air movement or if a breeze pushes the H2S towards a solid end wall and, if possible, remove pigs from these locations. If not possible, stir fans can be used to improve air ventilation.
    - Often pit fans are removed to allow manure agitation. These areas will often become air inlets when they were designed to be outlets. Pump-out curtains (plastic tarps) should be hung to help block and minimize air exchange as clean air entering through the pump out displaces high concentration H2S air above the manure surface and lifts it into the animal zone.
    - Maintain elevated ventilation for at least 2 hours after agitation is stopped for the day.

- Agitation
  - Draw manure down two feet below the slats before beginning agitation. All manures will release hydrogen sulfide during agitation. Our goal is to minimize the amount that enters the animal breathing zone and exhaust it at roughly the rate produced. We want to avoid bursts of H2S release. This release can be caused by surface agitation, rooster tailing, and manure splashing against pit walls and pillars. As the manure surface lowers with manure withdrawal, make sure to drop the agitation unit and turn off upper agitation nozzles and all agitation when
subsurface agitation is no longer possible.
- Adjust agitation slowly as when new solids are churned up, a burst of H2S is often released.

- Monitoring and safety
  - H2S meters offer a low-cost method to determine levels coming out of pit fans. Monitor animals for signs of distress. Use lock-out tag-out procedures to keep people from entering the barn, post caution tape on the door, and alter those on the premises where manure removal occurs.

![Figure 1 and 2: A pump-out curtain, which can be made of a plastic tarp, can help limit air exchange during agitation.](image)
MANURE FOAM SAFETY

FIRE AND EXPLOSION PRECAUTIONS

- Fuel
- Oxygen
- Spark
- Foam
- Ventilation

**Oxygen:** from Air. Oxygen is always present. Once a fire starts, opening doors or windows can mix methane into the air and fuel the fire.

**Fuel:** Methane. Produced by anaerobic decomposition of manure and stockpiled in barn. Discussion of foam minerals, large amounts of water in the barn. Discourages include washing, removing falling into the pit, & agitation.

**Spark:** The ignition source that starts the reaction. Possibilities include: electrical connections, heater pilot lights, cigarette ash, & welding sparks.

**Foam:** Foam is the most common cause of fires in manure storage units. Foam breaks, causing large release of methane.

METHANE DISTRIBUTION FOAM DISTURBANCE

- Foam pools
- Methane at high concentrations
- Methane at flammable concentrations
- Barn air

VENTILATION AFTER FOAM DISTURBANCE

Ventilation After Foam Disturbance: Foam methane concentrations of 19% (700,000 ppm) methane has been reported and found most in the initial concentration. Three air exchange rates (27, 33, & 0 Air Exchanges per hour) were modeled to determine the time to reach safety levels. For 2400-foot barn dimensions of 20’ x 20’ x 20’ these would be ventilation rates of 6000, 65,000, and 50,000 cfm respectively.

MINIMUM VENTILATION RECOMMENDATIONS

- The explosive limit of Methane is 4.6%.
- Minimum Ventilation Empty Barn 1.6 cfm/pig space.
- Air distribution must be considered.
- Less than 50 feet wide no pit fan every 100 feet.
- Greater than 50 feet wide pit fans on both sides every 100 feet.

<table>
<thead>
<tr>
<th>Pit Fans On (4)</th>
<th>Pit Fans Setting (%)</th>
<th>Ventilation Rate (CFM)</th>
<th>Air Mixing Quality</th>
<th>Methane Concentration (ppm)</th>
<th>Flash Fire Risk</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>50%</td>
<td>2250</td>
<td>Very Poor</td>
<td>46,000</td>
<td>High</td>
</tr>
<tr>
<td>2</td>
<td>50%</td>
<td>4500</td>
<td>Very Poor</td>
<td>23,000</td>
<td>Medium</td>
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<tr>
<td>4</td>
<td>50%</td>
<td>9000</td>
<td>Poor</td>
<td>9000</td>
<td>Low</td>
</tr>
<tr>
<td>4</td>
<td>100%</td>
<td>18,000</td>
<td>Moderate</td>
<td>3500</td>
<td>Low</td>
</tr>
</tbody>
</table>

MINIMUM VENTILATION ON EMPTY BARN:

Supplemental heat is required to keep your barn of temperature while empty. The graph provides an estimate of the heating cost while maintaining various minimum ventilation rates.

The Manure Scoop
In this month’s installment we look back at a study from 2011 and 2012 up in Saskatchewan that looked at how the rate and uniformity of solid cattle manure application impacted crop yield under two fertilizer practices, manure application only and manure with supplemental urea fertilizer. This study is unique because it focuses on solid manure application uniformity with and without supplemental fertilizer. It used three different manure spreaders to give different manure application uniformities. Interested in how precision agriculture applies to solid manure, take a look [here](#).

### Check Soil Temperatures Before Applying Manure

While it can be difficult to find a balance between getting manure applied before the soil freezes and applying too early, delaying manure application until the soil is 50°F and cooling helps ensure nitrogen will be available for next year’s crops. This is especially important for ammonia rich manures, like swine manure, where nitrogen is readily available. While all forms of nitrogen can be lost, ammonia and nitrate tend to be the most mobile. Ammonia tends to be lost as a gas, making injection or immediate incorporation of manure important. The ammonia will react with soil particles and be held, rather than lost to the air.

Though most manures are pretty much nitrate free when applied, microbes in the soil will process the ammonium nitrogen turning it into nitrate. Activity levels of the microbes are controlled by the amount of ammonia present, water and oxygen in the soil, and the soil temperature. While all variables are important, let’s focus on the impact of temperature on microbial activity. A good rule of thumb is microbial activity doubles for every 18°F increase in temperature. This means soil microbes at 68°F are turning ammonia in the manure into nitrate two times faster than at 50°F and often have more time to cause the conversion to nitrate.

Find current 4-inch depth soil temperatures at [Iowa Environmental Mesonet](http://mesonet.agron.iastate.edu/). Learn more about the science behind 50°F and cooling nitrogen application at [The Manure Scoop](http://www.manurescoop.com/).

### Manure Applicator Certification Training

If you are in a commercial manure business (hauling, handling, or applying manure) or a confinement site manure applicator (a confinement with over 500 animal units), make sure your license is up to date before applying manure this fall. Three options are available to complete certification:

- Schedule a time to view a training video at your [local extension office](#).
- Complete [online training](#) and payment through the DNR.
- Make an appointment to test at a [DNR field office](#).

### Events

**Incentives for Sustainable Practices Webinar**

October 22, 2021, 1:30 pm