**Manure Storage Pit Dangers:** Hazardous Gas Awareness

*Agriculture Workers Should Take Precautions Prior to Entering Manure Pits*

People entering manure pits without taking proper precautions are at risk of dying from high exposures to hydrogen sulfide gas. Guidance on manure pit operations from ASABE specify the need to monitor these spaces prior to entry. This alert provides general guidance on risks of entering manure storage pits.

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**Do not enter manure storage areas without ventilating and measuring gas concentrations.**

Four Midwestern farmers died in July 2015 from gas exposures when entering manure pits:

- Palo Alto County, Iowa: Son entered manure pit to make repairs, and father entered to rescue him. Both died July 25, 2015. [http://www.siouxlandmatters.com/story/d/story/palo-alto-co/38089/L8vsp-TP00OoWls_n4MX-g](http://www.siouxlandmatters.com/story/d/story/palo-alto-co/38089/L8vsp-TP00OoWls_n4MX-g)

People cannot smell hazardous concentrations of hydrogen sulfide (H₂S) and methane (CH₄), but concentrations may be high enough to decrease oxygen or paralyze breathing. Concentrations change over time, and understanding how much gas is in the manure storage pit before each entry is important to prevent death. Monitors for measuring gas concentrations are available and should be used prior to entry into any manure storage area.

It is important to pre-plan for entering these pits. Developing, training, and following a confined-space program is important to make sure that no one enters a manure storage pit without taking proper precautions. Critical steps to follow in this plan include:

1. Identification and communication of risks inside the manure pit
2. A plan to evaluate the air quality prior to entry and actions to take based on the readings: prohibit entry when dangerous concentrations exist
3. Designated observer, outside the manure pit, to watch and communicate with the entrant and to respond in an emergency
4. A plan of what to do in a crisis (knowing how to direct emergency responders to the location, notifying local responders ahead of entry in the event of an emergency, not to attempt a rescue without supplied breathing air)
5. A checklist of what equipment is needed and actions to take to prepare for and conduct an entry (communications, gas monitors, rescue equipment or local emergency responder support, ventilation fans)

See “Identifying Hazardous Gases” detailed alert for specific information on selection and use of direct reading gas monitors and health hazards of these gases.
Additional Information

The table below provides guidance on hazardous concentrations of manure gases. The “High Alarm” typically results in louder alarm than the low, or first, alarm. If you don’t have two alarm set points, choose the low alarm setting in the table. IDLH is the concentration that is “immediately dangerous to life and health,” which is established by NIOSH (the National Institute of Occupational Safety and Health). The IDLH values identify concentrations that are ACUTELY hazardous (Danger!). If the monitor displays concentrations that are at or above the IDLH, immediately leave the area. The actions indicated are for the acute hazards to the person conducting monitoring. To safely work in the area, concentrations need to be below the alarm set points, as indicated.

<table>
<thead>
<tr>
<th>Contaminant</th>
<th>Set Alarm Levels*</th>
<th>IDLH</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oxygen, % (at sea level)</td>
<td>Low Alarm</td>
<td>High Alarm</td>
<td>No IDLH: Leave if reach 19.5%</td>
</tr>
<tr>
<td>LEL, %**</td>
<td>5</td>
<td>10</td>
<td>Asphyxiant; watch Oxygen% changes</td>
</tr>
<tr>
<td>CO, ppm</td>
<td>25</td>
<td>50</td>
<td>1000</td>
</tr>
<tr>
<td>H2S, ppm</td>
<td>1</td>
<td>5</td>
<td>100</td>
</tr>
<tr>
<td>NH3, ppm</td>
<td>25</td>
<td>35</td>
<td>300</td>
</tr>
<tr>
<td>CO2, ppm*</td>
<td>5000</td>
<td>-</td>
<td>40,000 (4%) will displace oxygen</td>
</tr>
</tbody>
</table>

*Note: If you don’t calibrate the LEL sensor with methane, you need to know the response to the calibration gas and how it relates to methane. For example, calibration with pentane typically gives you %LEL readings higher than the true LEL. Check the operation manual for the sensor and monitor you have.

*If CO2 and %LEL reach significant levels, it will displace oxygen. Watch changes in Oxygen % as an indicator of significant concentrations of these two contaminants combined.

** See ASABE S607 Table 7.

Need more information?

An additional, detailed fact sheet ("Technical Guidance for Selection and Use of Monitors") provides specific information on selection, use, and general operation of these gas monitors. This is available on the “For Farmer” fact sheets on the GPCAH web site, at [http://www.public-health.uiowa.edu/gpcah/fact-sheets/](http://www.public-health.uiowa.edu/gpcah/fact-sheets/).

The faculty and staff of the Great Plains Center for Agricultural Health are able to help you with monitoring questions. Contact [CPH-GreatPlainsCenter@uiowa.edu](mailto:CPH-GreatPlainsCenter@uiowa.edu) for assistance. We are glad to provide hands-on training and education to groups of interested farmers, emergency responders, and agricultural outreach organizers to develop expertise to protect farmers and those working on the farm.
Links to More Information

*General Information on Manure Pit Hazards*
NIOSH has been providing information to prevent asphyxiation in manure pits since 1990. See http://www.cdc.gov/niosh/docs/90-103/

The ASABE is a professional and technical organization dedicated to the advancement of engineering applicable to agricultural, food and biological systems. This organization has developed standards to recommend ventilation (S607) and operation (EP470.1) of manure storage pits with safety in mind. Their recommendations include monitoring spaces prior to entry.


*General Confined Space Program Information*
Michigan’s Department of Licensing and Regulatory Affairs has provided a sample written program for permit-required confined space entry that can be customized for farming operations: http://www.michigan.gov/documents/dleg/deleg_wsh_cet5330_346240_7.doc

OSHA has developed training program to outline the confined space program (although this is for another sector, the images aren’t useful for agriculture, but the content is useful): https://www.osha.gov/Publications/2254.html

OSHA also provides assistance materials on confined spaces to all at: https://www.osha.gov/confinedspaces/index.html

*Gas-Vapor Monitoring References*


*FACE Reports*
These comprehensive investigations provide details of what happened that caused or contributed to worker fatalities associated with manure storage pit entry. As important as the sequence of events are, these contain recommendations to prevent these from happening in your operation.

Iowa farmer and employee died after collapse and attempted rescue in manure storage pit (http://www.public-health.uiowa.edu/face/Reports/PDF-Reports/2005IA024-025.pdf)

Iowa hog farmer dies from asphyxiation after manure pit agitation (http://www.public-health.uiowa.edu/face/Reports/PDF-Reports/Manure%20Pit%20Agitation.pdf)

Minnesota farm owner and son asphyxiated in manure waste pit (http://www.cdc.gov/niosh/face/In-house/full9229.html)

Minnesota hog farm co-owner and employee die of hydrogen sulfide poisoning in manure pit (http://www.cdc.gov/niosh/face/In-house/full9228.html)

Five family members in Michigan die after entering manure waste pit on dairy farm (http://www.cdc.gov/niosh/face/In-house/full8946.html)

*Equipment Rental Companies*
Google search “Gas monitor rental” to identify monitor rental services. Ensure that the company will provide calibrated equipment, written certification of calibration in the shipment, and operation manual. Request they set the alarms to the limits you need prior to shipping.