Manure gas can be deadly

It’s unpredictable and can kill quickly – even in spaces you’ve entered before without incident

By Brian S. Aldrich, Nellie J. Brown and Eric M. Hallman

It’s a day like any other on the dairy. Morning milking is done, and you’re emptying the manure reception pit. Your nephew told you that new parts for the pump arrived yesterday, and he plans to haul the pump out and work on it in the afternoon. But while he’s cleaning the parlor, the pump clogs when the pit is nearly empty. You decide not to wait.

You’re not worried about entering the pit, even with no one around. You’ve done it many times before with no problem. But today is different.

As you climb down the ladder, your chest feels heavy. You’ve entered a confined space where there is no ventilation. You get to the bottom of the pit and take a few steps toward the pump, but you can’t remember what you came down to do. You stop to think. Your eyes start to burn and tears stream down your cheeks. You’re panting and can’t seem to take a deep breath. You’re only vaguely aware that there’s a problem. In another minute, you’re unconscious.

Three things save you. Your nephew walks past the pit and sees you lying face up. He knows that victims of manure gas are often would-be rescuers who rapidly succumb to asphyxiation, sometimes in quick succession. He doesn’t attempt a rescue but calls 911.

When you wake up later in the emergency room, you remember only sketchy details about what nearly killed you. Severe injury and death from exposure to manure gas isn’t a common occurrence on dairies. But even one death or one survivor with permanent lung damage or, in the worst cases, brain damage, is too many – especially when it can be prevented.

What’s in manure gas?

Some microorganisms that live in manure pits and other

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Access OSHA Part 1928 Occupational Safety and Health Standards for Agriculture at this website: www.osha.gov/pls/oshaweb/owastand.display standard group?p toc level 1&p part_number=1928

The standard covers such things as rollover protective structures (ROPS); field sanitation for hand laborers, including potable water; and moving equipment and machinery, with standards for PTO shields.

oxygen-deficient environments can break down manure and produce manure gas, which contains carbon dioxide, methane, hydrogen sulfide and ammonia. All of these gases are colorless. (See Table 1 for other important properties and hazards.)

<table>
<thead>
<tr>
<th>Gas</th>
<th>Odor</th>
<th>Weight Compared to Air</th>
<th>Hazards</th>
<th>OSHA Permissible Exposure Limit (ppm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carbon Dioxide</td>
<td>No smell</td>
<td>Heavier</td>
<td>• Displaces oxygen</td>
<td>5,000</td>
</tr>
<tr>
<td>Methane</td>
<td>No smell</td>
<td>Lighter</td>
<td>• Displaces oxygen</td>
<td>5,000</td>
</tr>
<tr>
<td>Hydrogen Sulfide</td>
<td>Rotten egg smell</td>
<td>Heavier</td>
<td>• Flammable</td>
<td>20</td>
</tr>
<tr>
<td></td>
<td>at low concentrations</td>
<td></td>
<td>• Poisonous</td>
<td></td>
</tr>
<tr>
<td></td>
<td>but deadens sense of</td>
<td></td>
<td>• Paralysis of diaphragm with first breath</td>
<td>20</td>
</tr>
<tr>
<td></td>
<td>smell above 150 ppm</td>
<td></td>
<td>at 1,000 ppm</td>
<td></td>
</tr>
<tr>
<td>Ammonia</td>
<td>Pungent</td>
<td>Lighter</td>
<td>• Irritation of eyes and respirator tract</td>
<td>50</td>
</tr>
</tbody>
</table>

Table 1. Characteristics of manure gas.

The air contaminant limits shown in this table are derived from 29 CFR 1910.1000, OSHA’s standard on air contaminants. This standard covers general industry and the construction industry, but it has not been extended to cover agriculture. This information is provided for advisory purposes only.

1. The OSHA permissible exposure limit is the concentration in air that is considered safe for human exposure during an eight-hour day and a 40-hour workweek, for a work lifetime.

2. Neither OSHA, NIOSH, nor the ACGIH has established exposure limits nor limits “immediately dangerous to life and health” for methane, as it is biologically inert and produces its effects by causing asphyxiation as a result of oxygen deprivation. The concentration of available oxygen is the limiting factor.

3. This is a ceiling value and is the maximum exposure allowed over an eight-hour shift; except that a person can be exposed to 50 ppm for 10 minutes only once if no other measurable exposure occurs during that eight-hour shift.

Carbon dioxide and hydrogen sulfide are both heavier than air and will tend to settle and accumulate in low, confined areas. Methane and ammonia are lighter than air and may accumulate underneath ceilings. The effects of ammonia range from irritating to corrosive; hydrogen sulfide is poisonous.

The concentration of hydrogen sulfide in manure gas is variable and can’t be predicted. Agitation and splashing release this gas from liquid manure into the atmosphere, thus its concentration in manure gas can change quickly and with little advance warning.

Hydrogen sulfide can burn the lining of the lungs in just a few breaths. Exposure to concentrations of 1,000 ppm is rapidly fatal. Eye and lung irritation occurs at 10 to 20 ppm. Hydrogen sulfide deadens the sense of smell at 150 ppm, so don’t assume the gas is gone if you can’t smell it after a few minutes.

Methane can displace all or part of the atmosphere in a confined space, and the hazards presented by such displacement vary greatly. With only 10% displacement, methane produces an atmosphere that is adequate for respiration, but can explode violently. By contrast, with 90% displacement, methane will not burn or explode, but it will asphyxiate an unprotected person within about five minutes.

Oxygen deficiency especially targets brain cells, which need 10 times the oxygen of other types of body cells. Normal air is 21% oxygen. As the level of oxygen drops below 19.5%, which is the minimum safe level, judgment and coordination become impaired. Loss of consciousness occurs at 8 to 10%, and an atmosphere of 4 to 6% oxygen is rapidly fatal.

What is a confined space?

When manure gas is produced in a confined space without ventilation, it displaces air, creating an atmosphere with insufficient oxygen to support human life. Covered manure storage and collection pits, digester tanks, covered lagoons, upright storage tanks and tanker spreaders are examples of places where manure gases can accumulate to produce a deadly atmosphere. The atmosphere can also be hazardous in an open manure pit.

The Occupational Safety and Health Administration’s (OSHA) Confined Space Standard (29 CFR 1910.146) regulates work in confined spaces. Confined spaces are those that have limited or restricted means of entry or exit, are large enough for a person to enter, and are not designed for occupancy. Confined space openings can be small and barely big enough to fit through or large like the top of some manure pits.

Manure gases are most dangerous when they accumulate in confined spaces

Even though confined spaces on your dairy may not be inspected by OSHA, it’s a sound – and humane – practice to protect yourself and employees from the dangers of confined spaces.

Protect yourself

Do not enter a manure pit or confined space unless absolutely necessary. If you must enter, follow these precautions before entering to avoid severe injury or death:

1. Never enter a manure pit or confined space unless someone can keep watch over you. A coworker “buddy” outside the storage area should maintain contact with the person inside.

2. Before you enter the space and during the time anyone is in the space, test the atmosphere inside the pit or confined space.

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