Factsheet

#25-021 | MAY 2025

replaces OMAFA Factsheet #13-029 of the same name

Methane Gas in Swine Barns

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INTRODUCTION

Although rare, explosions and flash-over fires from methane accumulation can and do occur in swine barns. The risk of methane fires and/or explosions in swine facilities increases due to various operational and design factors. This factsheet discusses managing the risk of methane accumulation in swine facilities.

METHANE

Methane is produced by a family of bacteria called methanogens. It is odourless, colourless and non-toxic. However, in concentrations greater than 50%, methane will act as a simple asphyxiate (i.e., its presence results in suffocation).

Methane is slightly soluble in liquid. Its low solubility in water suggests that manure can't store methane in the liquid phase, but a sufficient amount is stored in the form of small bubbles attached to manure particles. These methane bubbles are easily released when the manure is moved or agitated.

With liquid manure storage systems, always assume methane gas is being produced. Research shows that even in cold weather, methane bacteria will still produce up to 16 L of methane per cubic metre of manure per day. In warm weather, the bacteria produce more than 30 L of methane per cubic metre of manure per day.

Methane has a specific gravity of 0.5 compared to air — half the weight of air — so it will always rise up, collecting into storage headspace and unvented areas.

In an unvented area (closet, feed room, office or hallway) containing methane, an ignition source (switch, motor, welder, grinder, pilot light) can trigger a flash-over or explosion and lead to a fire. To minimize the risk of accumulating methane, continually ventilate all barns, rooms and spaces within barns, that have liquid manure storage or transfer pits, before a flammable level is reached.

MANAGING METHANE ACCUMULATION

The majority of swine facilities in Ontario produce and store liquid manure for long periods of time within a building that is often divided up into rooms or sections. These rooms or sections are emptied of all livestock but left with the accumulated manure underneath until they are needed again.

Ventilation and Flammable Limits

Unvented areas over or adjacent to liquid manure storages — storage rooms, hallways, feed rooms or an entire room or section of barn — will accumulate methane unless they are properly ventilated (Figure 1).

Figure 1. All rooms over manure storages should have ventilation operating at all times.

Methane will collect under the ceiling of these areas and divide into three flammable limits:

- an area above the flammable level at >15% methane mixed with ambient air
- a middle zone that is at flammable level, between 5% to 15% methane mixed with ambient air
- a zone that is on the bottom and below the flammable level at a mixture of <5% methane mixed with air

Any source of ignition is a threat, but the greatest threat is at the critical zone — the middle layer at a concentration between 5% and 15%. The most effective management practice is to provide continuous ventilation throughout the barn. Even if the barn is empty of animals, where liquid manure is present, provide at least two uniform air changes or more, per hour, to properly ventilate the facility.

Storing Manure

Any sudden release of methane gas can overwhelm the ventilation system of a barn.

Double-pitted barns are designed so the short-term storage is located above the long-term storage, and manure is drained periodically to the lower storage via pull plugs. If the lower storage is unvented to the exterior, the methane builds up in the headspace. When the upper short-term storage is drained, this methane is displaced by the incoming manure, moving up to the short-term storage.

Figure 2. This open pull plug hole is the suspected source of methane from the lower pit that resulted in a nursery barn fire.

Furthermore, if the pull plugs are left out, all the methane rises up into the room above and can cause an explosion or fire (Figure 2). The easiest solution for double-pitted barns is to ventilate the lower pit to the exterior so methane is removed as it forms.

Moving Manure

Some facilities move manure using a transfer pit under the hallway to an exterior pump-out pit. In some barns, there is a solid baffle between the transfer pit and the pump-out pit, and the transfer pit is not vented to the exterior.

Once the level of the manure reaches the bottom of the baffle, the unvented transfer pit becomes hydraulically sealed (Figure 3). Any additional manure will result in a pressure build-up in the headspace of the transfer pit. If there is a drain hole, cover plate or floor drain, the methane in the headspace will shoot out of the hole(s), under pressure, into the hallway or the room above. If the ventilation system is unable to handle this sudden inflow of gas, the flammable level is quickly reached.

In all cases, increase ventilation rates to their maximum any time manure is moved or agitated.

Figure 3. Pump-outs with baffles will cause the head spaces in unvented storages to become pressurized once the manure level rises above the bottom of the baffle.

Foaming Manure

Foaming manure is a combination of gas, methane bubbles, a surfactant, soap and a stabilizer: filamentous methanogens bacteria.

Dr. Bo Hu, University of Minnesota, has worked on this issue since 2010. One theory is soap is being formed from incompletely digested fats in the pig's diets. These fats form long-chain fatty acids, which are converted to surfactants and then soap by the bacteria present in the manure. The use of dried distillers grains with solubles (DDGS) for feed is suspected as the cause, although a survey in Ontario found that some barns have been experiencing foaming issues since before the common use of DDGS.

The methane portion of the foam makes up 50%–70% of the total volume. The foam itself can be several feet thick (Figure 4). If the foam is rapidly broken up by aggressive agitation or pressure washing, methane is suddenly released, overwhelming the ventilation system. Many swine barn fires in the U.S. Midwest have been caused by manure foam.

Figure 4. A manure pit cover that was pushed off by manure foam.

SUMMARY

These best management practices will greatly reduce the risk of methane accumulation in swine facilities:

- Always assume methane is being produced in liquid manure systems.
- Ensure sufficient ventilation is provided to all areas of the barn, including individual rooms.
- Vent all storage and transfer pits to the exterior to remove the methane as it is being produced and eliminate pressure build-up in the headspace.
- Treat any sign of foaming manure with extreme caution. Under no circumstances should the manure foam be aggressively knocked down or agitated.

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Published by the Ministry of Agriculture, Food and Agribusiness

ISSN 1198-712X
Également disponible en français (Fiche technique 25-022)

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