

Dairy Manure Odor Perception and Management Series *Part 4: Mitigation options for manure-based odor control*

The previous three fact sheets of the series covered the basics of manure odor, human physiology of the sense of smell, and the options for quantifying manure-based odors. After understanding these initial concepts, it is possible to explore the potential strategies to reduce and control odor on the farm. Some more commonly used manure management strategies can effectively control odor from manure storages. Which strategy a farm chooses depends on budget, degree of need for odor control, energy use, and overall management needs.

Starting with odor control on the farmstead, manure storage is the main culprit. There are various strategies to manage the odors emitted, discussed here are: manure storage covers, composting of manure solids, surface agitation, anaerobic digestion and aeration of manure storage.

The second most likely source of manure odors on farm is field application of manure. This topic is discussed in Fact Sheet 6 of this series.

Farmstead odor control: Manure storage covers

A long-term manure storage is essentially anaerobic; therefore, it must be covered in order to prevent emission of the odors of partially decomposed manure. Covers can be either natural or synthetic and permeable or impermeable. Natural covers include a crust that forms from the floating solids in the manure itself, or a layer of straw that is manually added to cover the storage. Both options are permeable, meaning precipitation infiltrates and thus is added to the volume stored. Benefits include the low price-point of straw, but this option is not permanent, and it can add a significant increase to management needs, including re-application and use of a

chopper pump to agitate prior to pump-out of the storage.

Synthetic, impermeable covers include a High-density polyethylene (HDPE) cover (as seen in Figure 1) that is the most effective at reducing odor for manure storages, since it is an air-tight cover that captures the manure gases. With this option, there must be a gas handling system to release and responsibly deal with the gases produced. There does exist an option for energy producing potential, if certain parameters are maintained, but in the Northeast, energy production at this time is not economical.



Figure 1. Impermeable HDPE cover installed on an existing earthen dairy manure storage in New York State

Farmstead odor control: Composting

Composting of manure solids (in Figure 2) is a strategy that is used in conjunction with solid-liquid separation, where a separator machine removes a significant portion of solid matter from the manure and the liquid and solid effluents are handled separately. The odor production potential is reduced since the liquid that is stored has a much lower solids content, therefore the bacteria have much less to feed on and break down. Liquid storages can be covered for further odor control. The separated solids can be stored either covered or uncovered, and sometimes, especially in arid climates, placed in rows to break down and dry. The final solid product can be used as stall bedding for the cows, packaged and sold as a

soil amendment, or land applied to reincorporate nutrients to the soil.



Figure 2. Dairy manure compost windrows^[2]

Farmstead odor control: Surface agitation

Constant agitating the surface layer of a long-term manure storage can help with reducing odor, since it breaks up the natural crust that can form creating an anaerobic layer on the storage. One or several impeller agitators can be used depending on the size of the storage. One drawback of agitating the surface, however, is that the emissions of nitrous oxide (N₂O) are significantly increased, and this has implications for increased greenhouse gas emissions and surface aerated storages do have meaningful odor releases when they turn over.

Farmstead odor control: AD

Anaerobic digestion (AD) is a technology that intentionally stores manure in an anaerobic environment (without oxygen) in order to stimulate anaerobic bacterial growth and

activity in order to breakdown the organic material in manure. Methane gas is a byproduct of anaerobic bacterial activity, and this gas is captured and utilized for energy or heat production. For detailed information on manure-based odor control using anaerobic digestion, see Fact Sheet 5 of this series.

Farmstead odor control: Aeration

Very simply put, if manure is kept aerobic, the odor is generally reduced, since the microbial organism present in aerobic conditions produce less offensive odors than anaerobic organisms. However, this option is generally not pursued by farms since it is highly energy intensive. Storing manure actually encourages anaerobic breakdown of the manure, since everything below the surface is neglected access to oxygen; only the very top layer of the storage is kept aerobic. Therefore it is necessary either to bring oxygen to the lower layers in the storage (mechanical aeration, as used in wastewater treatment plants), or to bring the lower layers up to the surface (continuous pump agitation). Both options involve prohibitively high, continuous energy costs, as well as increased maintenance needs for pumps and motors.

Manure odor control on dairy farms is essential to maintain positive neighbor relations. When manure is stored long-term in order to apply nutrients in a timely manner, there are several strategies outlined in this fact sheet that assist with minimizing the release of offensive manure odors.

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REFERENCES

- [1] <https://lplc.org/on-farm-comparison-of-two-liquid-dairy-manure-application-methods-in-terms-of-ammonia-emission-odor-emission-and-costs/>
[2] <https://images.app.goo.gl/H8u9V5bQ6jbQmqVAA>

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