

## Dairy Manure Odor Perception and Management Series Part 1: Manure Odor Basics

For the modern-day dairy farm, the control of on-farm odors is more important than ever since people without a rural background are residing in the countryside and many do not understand or have tolerance for manure-based odors. Land application of liquid manure, especially if it has been stored for a period, in close proximity to neighbors, can be especially problematic. Management strategies exist in order to mitigate odor for both on-farm handling and land application. Land application strategies such as injection, can be used to apply manure in a way that reduces the exposure and/or release of manure-derived odorous compounds.

Manure odor emissions can originate from barns, manure collection, treatment, storage, and land application. As soon as manure is excreted, it begins decomposing and generating odors. When manure is kept aerobic (presence of oxygen) the odors released tend to be less offensive to most people as compared to when the manure goes anaerobic (absence of oxygen). Naturally-occurring microbial processes are involved in both aerobic and anaerobic decomposition, leading to the release of different volatile odor compounds. Incomplete digestion under anaerobic conditions leads to more offensive odors. Material used for cow bedding and use of manure storage pre-

treatment and management all impact odor releases, as shown in Figure 1.

**Aerobic decomposition:** a biological process that naturally occurs when oxygen is present, where aerobic microorganisms oxidize organic compounds. The gases emitted from aerobic microbes have less offensive odors than those from anaerobic microbes. However, it is generally not possible to keep liquid dairy manure aerobic, mostly because of the: 1) cost, 2) electrical demand to operate motors, compressors or blowers required to supply enough oxygen to facilitate the activity of aerobic bacteria, and/or 3) limited access to high-carbon materials needed to reduce sufficient moisture for manure to be naturally aerobic<sup>[1]</sup>.

**Anaerobic decomposition:** a biological process that naturally occurs in the absence of oxygen, where anaerobic microorganisms degrade organic compounds, converting organic matter to various volatile organic acids, producing comparatively foul smelling odors. Unless land applied frequently throughout the year, stored manure will naturally become anaerobic. Allowing the decomposition to progress to completion in a controlled, enclosed vessel (anaerobic digester), can actually result

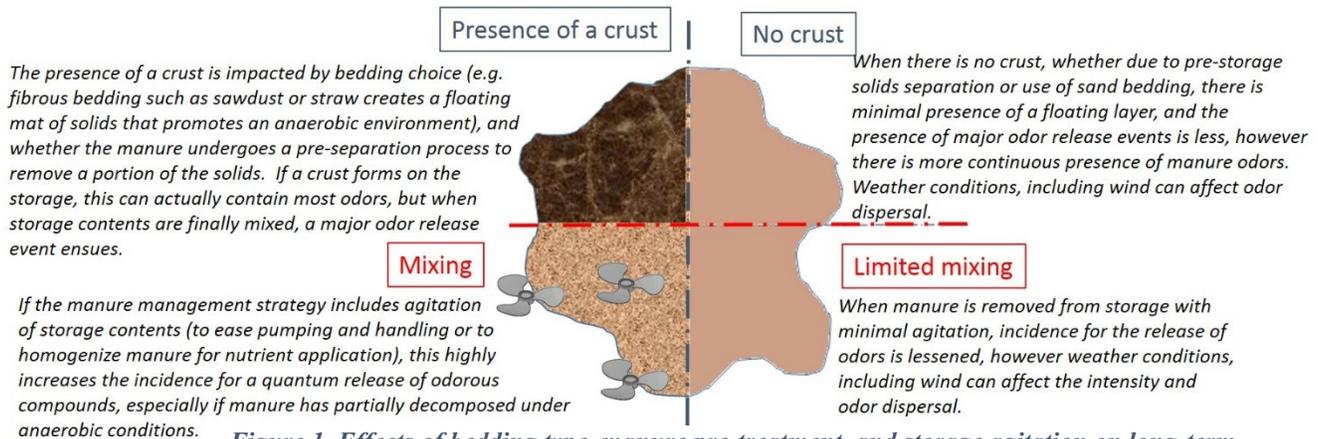


Figure 1. Effects of bedding type, manure pre-treatment, and storage agitation on long-term manure storage odor emission potentials

in less odor, since the final products are methane, carbon dioxide and a mostly “odorless” liquid effluent.

**What types of odors are associated with manure?**

Manure is a complex mixture of many different compounds, each with its own composition and therefore its own odor profile that contributes to the overall odor intensity. Identifying the individual odorous components is a significant challenge, since some are present in larger concentrations and others that are quite volatile may be present only in very minute concentrations.

In one of the few dairy-manure based odor investigation studies, 86 potential odorous compounds were identified, included sulfur-containing compounds, volatile fatty acids, ketones, esters, and phenol/indole derivatives<sup>[2]</sup>. In a separate study, manure was sampled from four different locations on-farm and the associated odors identified. Volatile fatty acids (VFAs), and short-chained fatty acids with less than six carbon atoms, were

found to be the main odor compounds, with acetic acid being the dominant VFA<sup>[3]</sup>. Figure 2 shows a few of the different odors associated with the smell of manure.

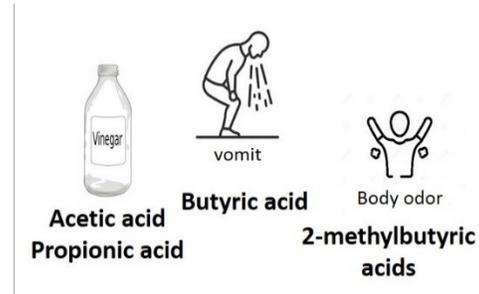


Figure 2. Volatile acids and their known smell associations<sup>[4]</sup>

Managing odor and odor release events on the farm should be part of a farm’s sustainability management plan since manure-based odors can cause neighbor relation challenges. Various manure management practices exist; each one has its own benefits and challenges that have to be considered along with capital and operation and management costs.

FACT SHEET SERIES

**Dairy Manure Odor Perception and Management**

Part 1: Manure odor basics	Part 4: Mitigation options for manure-based odor control
Part 2: The human sense of smell	Part 5: Anaerobic digestion and odor control
Part 3: How are manure odors quantified?	Part 6: Mitigation options for manure application
	Part 7: Positive neighbor relations

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  - [3] Page et al., 2015. Reduction of volatile fatty acids and odor offensiveness by anaerobic digestion and solid separation of dairy manure during manure storage. *J Environ Manage.* 2015 April 1; 152:91-8.
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