Air Quality Issues for Dairy Operations

Introduction

Dairy operations can affect air quality through emissions of gases such as ammonia and hydrogen sulfide as well as particulate matter, volatile organic compounds, hazardous air pollutants, and odor. These pollutants and compounds have a number of environmental and human health effects. They also produce carbon dioxide, methane, and oxides of nitrogen that have been associated with climate change.

Sources of gas emission include barns, feedlot surfaces, manure storage, silage piles, composting structures, and other smaller sources, but air emissions come mostly from the microbial breakdown of manure stored in pits or lagoons and spread on fields.

Odorous compounds generally contain either nitrogen (i.e., ammonia) or sulfur (i.e., hydrogen sulfide, the odor of rotten eggs). While not strictly an environmental concern, odor emission from farms may be the most common complaint producers hear. Odors used to be considered simply part of farming, but with increasing intensity in animal agriculture and increasing population of formerly rural areas, odor is becoming a serious point of contention between farmers and their neighbors.

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Ammonia has a direct, toxic effect on vegetation. When returned to the soil and water by rainfall, it disrupts ecosystems causing algae bloom in water bodies and acidification of soils. It is estimated that emissions from animal waste account for about one-half of the ammonia emitted in the United States annually.

Hydrogen sulfide is a colorless gas with a strong and generally objectionable rotten egg odor. It is produced in anaerobic (oxygen-deprived) environments by microbial decomposition of sulfur-containing organic matter in manure.

Methane and **nitrous oxide** are greenhouse gases that are known to contribute to global warming. EPA estimates that more than 30% of the nation's methane emissions come from livestock operations. Similar to sulfur, agricultural methane, is emitted during microbial degradation of organic matter under anaerobic conditions. Nitrous oxide forms via the microbial processes of nitrification and denitrification.

Emission control during land application is best done by direct injection of liquid manure below the soil surface.

Many of the complaints about dairy and other livestock operations are generated by odor. Odor is not caused by a single substance, but is rather the result of a large number of contributing compounds, including ammonia and hydrogen sulfide.

BMPs to control Air Quality

Emissions of odors and gases from livestock production facilities arise from buildings, manure storage, and land application. Eliminating emissions from one of these sources will likely not eliminate emissions entirely, as control technologies often address only one of the three sources. Many of the available technologies reduce emissions; none eliminate them. There are various BMPs that can be implemented to reduce gas emissions and odor from dairy operations

Land application has been and remains to be the predominant method for disposing of manure and recycling its nutrient and organic content. In general, designed objectives for managing manure do not include minimization of emissions of ammonia, methane or other gaseous compounds, but rather focus on odor and avoidance of direct discharge to surface water, and also land application rates that are beneficial to growing crops.

Emission control during land application is best done by direct injection of liquid manure below the soil surface. Solid manure is generally less odorous than liquid, but because it cannot be injected, rapid incorporation into the soil by disking or similar techniques is the best method to minimize odors.

Farmers should consult with non-farm neighbors before land applying manure to fields. Every effort should be made to avoid manure application on weekends, holidays, or during picnics and other gatherings. Also, prevailing wind direction should be considered.

Emissions from buildings can be reduced by inhibiting contaminant generation, or by capturing and treating the air as it leaves the building (e.g., by using biofilters). Frequent manure removal is an efficient way of reducing contaminant generation within the building. Other methods that can be used inside buildings include using bedded solid manure (i.e., manure mixed with bedding that creates a solid stack of material), chemical additives on animal litter, and diet manipulation. Other examples of BMPs to minimize odors and emissions from animal housing include setback distances from neighbors, trees planted around animal housing with attention paid to prevailing wind direction.

Manure storages include outdoor slurry storage, deep pits, anaerobic lagoons, and solid stacks. Outdoor open storage is the most apparent source of odors. Some control methods that have been shown to be effective when managed properly include:

1) covers (permeable and impermeable, natural such as barley straw or cornstalks, and synthetic)
2) biological control of lagoon (both anaerobic and aerobic)
3) composting.

Aerobic lagoons are continuously agitated in order to keep an appropriate amount of oxygen in the system. Anaerobic lagoons, when allowed to fully process waste, host micro-organisms that thrive without oxygen and will reduce odors when the digestion process is complete.

Composting is an aerobic biological process that turns animal waste into rich organic matter. Biological control and composting must be properly managed in order to be effective at controlling odors and emissions from manure storages.

Techniques to manipulate the manure to minimize emissions also exist but have certain limitations. For example, separating solids from liquid manure reduces the load on anaerobic lagoons, but also creates a second waste stream to manage unless the removed solids are composted. Anaerobic digesters reduce odors, but they also may not be economically feasible.

Resources

Copeland, C. May 2010. "Air Quality Issues and Animal Agriculture:A Primer". Congressional Research Service. www.ncseonline.org/NLE/CRSreports/10Jun/RL32948.pdf

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Powell, J. M, L Slatter, and T. Misselbrook. 2005. *Dairy Manure and Air Quality.* www.soils.wisc.edu/extension/wcmc/2005/pap/Powell1.pdf.

For more information visit www.umass.edu/cdl

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