Biological Treatment

Biological treatments can accelerate manure degradation and significantly reduce the odor potential of manure.

Since most odor-producing organisms function only in the absence of oxygen (anaerobic conditions), providing an oxygen-rich environment allows another group of organisms to grow that tend to produce fewer odors. Treating manure aerobically is a technically feasible alternative for reducing odor. However, these processes have not been widely adopted because of high operating and maintenance costs.

Drawbacks include high energy costs, biosolids production and potential release of ammonia and odor when aeration is poorly done or is intermittent. Due to the high energy cost of complete stabilization, lower levels of aeration are sometimes used to partially control odors. Composting, if properly managed, can significantly reduce odor from solid or semi-solid manure. It also reduces manure volume, stabilizes manure nutrients, and kills pathogens and weed seeds. Composting requires a supply of oxygen, adequate moisture, and a blend of material that meets a specific carbon-to-nitrogen ratio.

Anaerobic digesters optimize the bacterial decomposition in heated, mixed and oxygen-free vessels, and produce biogas. The biogas can be utilized in a gas engine/generator to produce electricity and heat. The effluent from a digester, while retaining its nutrient content, is relatively odorless. High initial costs and management requirements have limited their use on livestock operations, except on a larger scale.

Land Application

A significant amount of odor is emitted when livestock manure is applied to land, but the amount of odor depends on surface area (grassland vs. bare soil), application rates and method, weather, and the odor potential of manure being applied. Immediate injection or incorporation of manure into the soil immediately after application is important because most of the odor is emitted within the first three hours after application. The timing of manure applications in relation to neighbor's activity and weather characteristics should be adjusted to minimize the nuisance created. Treating the manure before application is another strategy to reduce odors.

Setbacks

An effective way to minimize odor nuisance to neighbors is to establish a sufficient distance between livestock operations and neighbors. Odor decreases exponentially with distance. Prevailing winds should be considered to minimize transport of odor to sensitive areas. Guidelines for estimating appropriate setback distances depending on land use have been developed by the University of Minnesota, Purdue University, and Michigan State University.

Producers should be aware of odor related regulations applicable to their livestock operations. Property line odor standards do not yet apply in Indiana and Michigan, but have been developed for at least four states already.

Contact Information:

Michigan:

www.msue.msu.edu/aoe/manure/

Indiana:

www.agriculture.purdue.edu/PAMS

About this Publication

This publication was funded by USDA Special Needs, Purdue University, and Michigan State University.

It was adapted in part from the Livestock and Poultry Environmental Stewardship project, funded by the U.S. EPA, coordinated by the University of Nebraska-Lincoln, and published by the MidWest Plan Service, 122 Davidson Hall, Iowa State University, Ames, Iowa 50011-3080. See <www.lpes.org> or call (800/562-3618) to obtain access to this and other lessons.

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- Mortality Management
- Inspecting Your Confined Feeding Operation
- Feeding Strategies to Lower N&P in Manure
- Building Good Neighbor Relationships
- Disposal of Farm Medical Wastes
- Manure Nutrient Recycling
- Environmentally Sensitive Field Characteristics
- Manure Applicator Calibration
- Odor Control Options for Confined Feeding
- Comprehensive Nutrient Management Plans

ID-310
E-2828

Best Environmental Management Practices

Farm Animal Production

Odor Control Options for Confined Feeding

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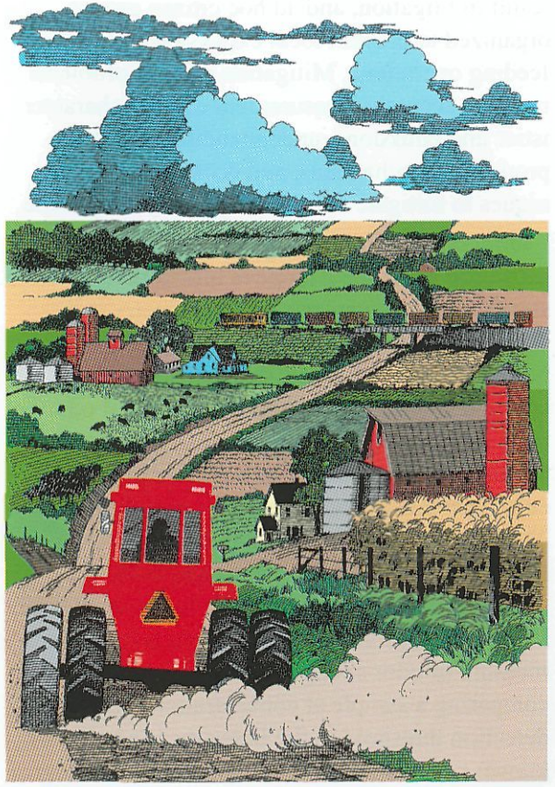

Best Environmental Management Practices

Farm Animal Production

Odor Control Options for Confined Feeding

Al Heber, Purdue University
Howard Person, Michigan State University

Odor emitted from confined feeding operations continues to be a problem for neighboring communities and residences. These problems often result in litigation, and ad hoc citizen groups organized to prevent local expansion of confined feeding operations. Mitigation of odor problems requires accurate measurement of odor characteristics and emissions, understanding of odor-producing mechanisms, and economical techniques to mitigate odor emissions and dispersion.

Odor concentration at a source is usually measured using the European olfactometry standard. The advantage of olfactometry is its direct correlation with odor and its use of a human's highly sensitive sense of smell. Odor concentration is defined as the number of odor units per cubic meter. An odor unit is defined as the amount or mass of odorous substance in a cubic meter at the odor detection concentration. The scentometer, developed in the 1950s, is a hand-held device that is often used to measure ambient odor levels in the field; however, it is not known for high accuracy. Odor intensity is another measure of odor strength that is determined by comparing a sample at concentrations above the detection threshold to the intensity of a series of known concentrations. Hedonic tone is the degree to which an odor is deemed pleasant or unpleasant. It is typically rated using a scale that ranges from -10, which is unpleasant, to +10, which is pleasant. Neutral odors are recorded as zero. The annoyance of an odor depends on odor strength, the flow rate of the source odor air stream, the hedonic tone of the odor, and the frequency and duration of odor exposure.

Odor emissions from animal production system originate from three primary sources: manure storage facilities, animal housing, and land application of manure, wherever there is microbial decomposition of organic wastes. Several methods exist to minimize odor emissions from livestock feeding operations.

Good farmstead and building hygiene and maintenance programs seem to reduce odor nuisance significantly. Regular cleaning and manure removal in buildings and quick disposal of mortalities contribute to reducing odor.

Certain diet manipulations can reduce excretion of nitrogen and other nutrients. Special diets can also reduce manure odor, although the effectiveness is not well established.

Odor emitted from solid manure is less than liquid manure because of its lower moisture content and lower microbial activity. Thus, methods that dry manure reduce odor nuisance. Examples include the use of circulation fans in pits of high-rise laying houses, ventilation systems that promote proper dunging patterns in swine houses, keeping floors clean and dry, and using bedding/dry manure systems instead of liquid manure systems.

Exhaust Air Treatment

The most promising air treatment technology for reducing odor from mechanically ventilated livestock building air is biofiltration, which uses microorganisms to break down gaseous contaminants. Biofilters can reduce odor by 50 to 90% along with ammonia, hydrogen sulfide, VOCs and dust. It is becoming very popular in northern Europe and has been demonstrated on several farms in the U.S. To use them, existing fans must be replaced with high pressure units. If fans are not in a convenient location for exhausting air into the biofilter, the necessary duct work can be prohibitively expensive.

Livestock building biofilters should use media available on the farm, such as compost, soil, and shredded wood to keep costs down. The media should be replaced regularly to maintain porosity and prevent clogging and nitrate saturation. The residence time of air in the media should be at least 5 seconds with a media thickness of at least 10 inches and a flow rate of 20 cfm per square foot. The moisture content of the media should be about 50%. An effective rodent and vegetation control program is also needed.

Wet scrubbers are often used to control industrial odors, but they require an extraordinary amount of water and are uneconomical for treating livestock building air. Likewise, ozonation, ionization, dry filtration, essential oils, and catalytic conversion are usually not economically viable because of the high air flow rates and relatively low pollutant concentrations of building exhaust air.

Open Manure Storages and Lagoons

A cure for odor emissions from existing storages and anaerobic lagoons is to trap the odors with a cover. These covers are usually permeable and consist of media of varying thickness. They biologically convert much of the odorous compounds to carbon dioxide and water before they are released into the atmosphere. They also reduce odor emissions by minimizing liquid turbulence and air speed over the liquid. Straw covers are effective in reducing odor but have a relatively short life on liquid surfaces whereas permeable geotextile membranes are more sustainable. Manure storage pits and tanks can also be covered with lightweight roofs.

Other design and management strategies exist to reduce odor from anaerobic lagoons. Manure loading rates can be reduced, the surface of the lagoon can be aerated, and odor-absorbing trees can be established around the perimeter of the lagoon. It also helps to load the lagoon frequently and uniformly rather than intermittently. Surface area can be reduced by having greater lagoon depths. Separating solids from influents also reduces the loading rate.

Chemical amendments such as manure additives do not significantly reduce manure odor. Part of the reason for this may be the lack of mixing when adding the products to a stagnant pit under the floor of a swine barn. Another may be that effective dosages are too high to be economical.

Open Lot Livestock Facilities

The primary predictor of odor emissions from open lot livestock facilities is the moisture content of the open lot or corral surface. The most important principle of odor control is avoiding anaerobic conditions by keeping (a) manure and other organic materials as dry as practical, (b) manure storages and surfaces exposed to oxygen, and (c) corral surfaces hard, smooth, and free of uncompacted manure. Stagnant water in a corral is a major contributor to intense, disagreeable odors. Outside pens that shed water rapidly and completely have the least potential to create odors.

Continuous manure removal from feedlots, even with animals present, reduces odor, as compared to manure accumulation of 120 days or more. Long-term stockpiling of manure should be avoided if possible. Manure should be kept dry (<45% moisture) to avoid overheating because when land applied, charred stockpiles can release intense, very disagreeable odors.