4-1-2004

Types of Manure Storage

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Process Improvement for Animal Feeding Operations

AEMS
Agriculture Environmental Management Systems

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April 2004 (pr) AG/AWM-01-2

Introduction

The objective of this fact sheet is to help producers understand the characteristics of different types of manure storage facilities. Factors that might influence the selection of a particular type of manure storage facility are discussed. Manure storage facilities discussed include solid systems, slurry systems, and liquid (lagoon systems).

Commonly Used Manure Storage Facilities

Confinement, in either open lots or enclosed, roofed structures, is a common characteristic of modern livestock production systems. Manure storage facilities have evolved based primarily on the type and consistency of manure to be handled in the system.

Typical solid manure storage facilities

Typical solid manure associated with livestock production includes litter from poultry (usually turkeys or broilers), separated or scraped solids from swine or dairy operations, manure collected from beef feedlots, and other production schemes involving high amounts of bedding such as hoop structures for swine. Advantages in handling and storing manure as a solid may include less volume (high solids content), less odor (bacterial action producing odorous compounds is reduced at lower moisture contents), less runoff potential, and relatively high nutrient retention. Disadvantages may include more labor in manure collection and handling (mechanical vs. hydraulic handling), runoff management from storage areas, and labor/ equipment requirements (number of loads to haul and spread) for land application.

Solid manure storage facilities in low-rainfall (arid) areas may simply be well-drained areas where the material is stacked or stockpiled for subsequent spreading operations. Regulations may require that any contaminated runoff from these facilities be collected and disposed of in an environmentally sound manner.

In higher rainfall (more humid) areas, solid manure storage facilities usually have a concrete bottom and may have concrete walls to confine the solids and provide a “push” wall for stacking and loading. Examples of such facilities are picket dam storage for dairies and solids settling basins for swine or dairy manure. Contaminated runoff from such manure storage facilities must be managed in an environmentally sound manner. Solid manure storage facilities may be roofed to eliminate the effects of rainfall. Although a roof adds additional cost, the benefits of not having to collect and manage runoff, not adding moisture to the manure, and ease of solids handling during inclement weather may offset the additional cost.

Composting may also be an integral part of a solid manure storage system. In arid regions, beef and dairy manure may be composted in open windrows or piles. Poultry litter may be composted in stack houses that serve as both a composting and storage facility. Contact your local Utah State University Cooperative Extension Agricultural Agent, Natural Resources Conservation Service Office, or a qualified professional for design assistance in developing a solid manure storage system.

Typical slurry manure storage facilities

Many types of facilities are used to store manure in the slurry form. One type is the under floor pit in which manure is deposited directly into the pit through slatted floors. Such pits are usually partially or completely below grade and must be constructed to withstand earthen and hydraulic pressure from the outside when the pit is empty. Access ports for pumping and agitating the pit contents must be provided in sufficient locations to ensure that manure can be completely removed. Experience has shown that the effects of agitation are limited to a range of about 40 ft. Hence, access ports should be located at intervals of 40 ft or less, or individual storage pit compartments should have plan view dimensions of less than 40 ft. Pit access points should have appropriate safety barriers and signage to prevent accidental entry. Ventilation during pit agitation is important to ensure that harmful or toxic gases do not accumulate.

Slurry manure storage facilities not located under the production buildings may be fabricated or earthen structures. Fabricated manure storage tanks are usually either concrete or coated metal (glass-lined steel). Such tanks may be above ground, or partially or fully below ground. Manure is usually scraped or flushed from the production buildings and may flow into these tanks by gravity or be pumped into the tank from a collection sump or reception pit. Adequate agitation may be

necessary to suspend solids and facilitate complete removal of the contents of these manure tanks. If needed for odor control, fabricated tanks are usually the least costly to cover.

Slurry manure may also be stored in earthen structures or basins. Because storage volume can usually be obtained at less cost in an earthen basin, these facilities are often used when manure and wastewater volumes are relatively large due to wash water use or lot runoff. Earthen structures require a relatively high degree of planning and preliminary investigation to ensure that proper soil materials are available to create a seal and that the seal is constructed properly. Space requirements are greater with earthen structures due to the required berms and front/back slopes that have structural integrity and can be properly maintained. Maintenance requirements may be greater with earthen structures due to the need for maintaining and mowing a vegetative cover on the berm area and keeping it free of weeds, trees, and shrubs. Agitation is equally important in earthen structures, and access points for agitation and pumping may be part of the design plan. Some earthen storage units are partially or completely lined with concrete and built with an access ramp so that loading and hauling equipment can enter the basin. Earthen storage structures are more difficult to cover if odor control is needed.

Advantages of storing manure in the slurry form may include less volume (higher solids content compared to a lagoon), adaptability to tank storage either under floor or above ground, possibility of covering the manure storage facility to reduce odors, higher nutrient retention, and the potential to collect and transport hydraulically. Disadvantages may include higher odor potential (unless storage unit is covered), increased danger of toxic or combustible gas buildup in enclosed areas, number of loads or trips that must be made when the storage is emptied, and odor and runoff potential if the slurry is spread without injection or incorporation.

Typical liquid manure storage facilities

Liquid manure storage facilities (lagoons) are generally used when some treatment of the manure is desired to facilitate handling or reduce odors. Lagoons are designed with a permanent “treatment volume” facilitating the growth of bacteria that degrade and stabilize manure organic matter. They are earthen structures but are larger than those designed for slurry storage due to the additional treatment volume. Since bacterial activity is an important factor in lagoon performance, lagoons are designed on the basis of temperature and climatic conditions as well as manure and wastewater volume. Lagoons generally perform better in warmer climates due to increased bacterial activity at higher temperatures. Since they are earthen structures, site investigations for proper soil material, rock, or bedrock characteristics and water table elevation must be performed as part of the site evaluation. A seal on the lagoon bottom and sides must be constructed to meet permeability standards required by regulation or good construction practice. A source of dilution water (usually a pond or lake) may be needed to maintain the lagoon treatment volume. Adding dilution water reduces the effects of salts in the lagoon during periods of low rainfall when evaporation may reduce the treatment volume below the design level.

Advantages of lagoon storage of manure may include cost per animal unit, ability to store large amounts of manure and/or runoff, treatment of manure to reduce odors, and potential to handle manure with conventional pumping and irrigating equipment. Disadvantages of lagoons may include lack of appropriate soil materials for construction, the need for solids separation or sludge removal equipment if bedding or other non-biodegradable materials are present, aesthetic appearance and/or public perception, and relatively high nitrogen losses and greenhouse gas emissions.

Another common liquid storage facility is the runoff holding pond. Runoff holding ponds are different from lagoons because they are usually sized to accommodate runoff from a specific storm event rather than a long-term series of events. They are most applicable in arid regions where single storm events (such as the 25-yr, 24-hr storm) may be more critical than a series of widely-spaced lesser rainfall events. Proper management of runoff holding ponds includes pumping after significant rainfall events so that storage space is available for the next storm event.

Reference: Livestock and Poultry Environmental Stewardship curriculum, lesson authored by Charles Fulhage and John Hoehne, University of Missouri, courtesy of MidWest Plan Service, Iowa State University, Ames, Iowa 50011-3080.