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COOPERATIVE EXTENSION

Annual Manure Removal Methods for Manure Storage Facilities

AEMS
Agriculture Environmental Management Systems

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Introduction

A well-designed manure storage facility must also be well managed to prevent environmental concerns from developing. Probably the single most important requirement in operating and maintaining a manure storage facility is to ensure that the facility does not overflow or discharge. Discharges from manure storage facilities may violate local, state, or federal regulations, result in large fines or penalties, and at the very least, represent a potential environmental hazard. Manure removal from storage according to the storage period selected is the most critical activity in preventing discharge. Many discharge problems have occurred because producers were unable to manage the activities necessary to remove manure from storage in a timely manner.

Solid manure

Solid manure is usually removed from storage using front-end loaders, scrapers, or other bulk handling equipment. The size of this equipment influences the time required to load hauling equipment. Hauling equipment includes truck-mounted beater; flail or spinner-type spreader boxes; and pull-type spreaders. The size or volume of the hauling equipment used influences the number of trips required to empty manure storage facilities. The hauling distance determines the time necessary to complete a trip.

Slurry manure

Slurry manure should be agitated before and during pumping of the manure from storage. Agitation equipment should be selected to provide sufficient homogenization of the slurry within an acceptable time. Agitation is usually begun several hours before hauling and continued during the hauling operation. Heavy-duty chopper pumps are usually used to load slurry hauling equipment. Hauling equipment includes conventional tank wagons and some box-type spreaders designed to haul slurry. The flow rate capability of the loading pump determines the time required to load, and the size or volume of the hauling equipment determines the number of trips that must be made. Hauling distance is an important factor in total trip time. Umbilical or “drag-hose” systems are also used in spreading slurry manure. This method offers the advantage of continuous flow, and the slurry manure is injected or incorporated into the soil during spreading. Emptying time with this method depends primarily on the pumping rate through the drag hose. The use of a flow meter is recommended with these systems to ensure that manure is applied at the proper rate.

Lagoon

Lagoons may or may not be agitated. If they are not agitated, considerable nutrient buildup in the sludge will occur and will be a factor when sludge is agitated and removed. Lagoon effluent is usually removed by pumping equipment that may be similar to irrigation equipment. Hand carry, solid set, stationary big gun, traveling gun, and center pivot equipment have all been used to land apply lagoon effluent. Drag-hose systems are also sometimes used to apply lagoon effluent. The pumping flow rate of the system is the primary determining factor in the time required to pump down a lagoon.

The Importance of Agitation

Agitation is the most critical operation in maintaining available storage in liquid manure systems. Failure to properly agitate will likely result in a continuing buildup of settled solids that are not removed. The result is less and less available storage as time goes by. Agitation of manure re-suspends settled solids and ensures that most or all of the manure will flow to the inlet of the pump or removal device. Additionally, agitation homogenizes the manure mixture and provides a more consistent nutrient analysis as the manure is being removed. The need for agitation may complicate nutrient analysis. Manure samples for nutrient analysis should be obtained after a pit is well agitated. In most cases, the results of such an analysis will not be available before land-applying the manure. In these cases, analysis results from prior pumping events can be used to anticipate the present analysis (and estimate proper application rate), and the present analysis, when available, can be used to calculate the nutrients actually applied.

Agitation of manure storage facilities releases gases that may increase odor levels and present a health hazard. Considerations should be given to weather and wind conditions, time of day, and day of the week to minimize the possibility of odor conflicts while agitating.

Slurry systems

Many types of agitators are available for agitating slurry systems. These include hydraulically or mechanically driven propellers or choppers, bypass devices on manure loading pumps, and others. Careful thought should be given to the design and configuration of slurry manure storage facilities so that they can be adequately agitated. Placement of the agitator (ports, annexes) and the volume to be agitated are important considerations.

Effective agitation at distances greater than 40 to 50 ft from the agitation device may be difficult to achieve in slurry storage facilities. Hence, consideration should be given to limiting "compartment size" to these dimensions, and providing adequate access for pumping and agitating each compartment. A slurry storage may require several hours of agitation before it is sufficiently mixed for pump out.

Under floor pits in confinement buildings are particularly susceptible to solids buildup if not properly agitated. Many under floor pits were not designed for convenient, effective agitation. To minimize solids accumulation and maintain the design storage period, an under floor pit must be adequately agitated at each pumping event. The type of agitator to be used should be considered in pit design. Some pumps are designed to operate in both agitation and pumping modes. These pumps can provide effective agitation if access to the pit is available as noted above. Experience has shown that under floor pits with pipes through the pit wall angled to the surface outside the building are difficult to agitate and empty. The practice of removing a load of manure from the pit by vacuum and then "blowing" it back into the pit usually does not provide sufficient agitation to suspend solids. The agitation and manure pumping system should allow agitation while manure is being loaded or pumped (as with a drag-hose system), as well as prior to pumping.

Most pumping equipment will not remove the "last" few inches of manure from the pit floor. This factor should be considered in designing pit depth and the associated storage period. If the pump intake is located in a sump in the pit floor, more complete emptying is possible. However, sumps can collect rocks and other debris that can cause pump damage.

Lagoon systems

In the past, it was not a common practice to agitate lagoons for pump down. The relatively large volume of lagoons and relatively "clean" water on the lagoon surface did not indicate a compelling need to agitate lagoons. However, as many years of experience was gained, the effects of sludge buildup and nutrient accumulation became more obvious and pronounced. Lagoons receiving significant amounts of bedding experienced high rates of sludge buildup. Sludge buildup will eventually displace needed treatment and storage volume if not periodically removed. Additionally, nutrients, particularly phosphorus, tend to concentrate in sludge and may represent a difficult management problem if sludge is allowed to build up over a number of years before it is removed. Sludge buildup in lagoons should be monitored, and sludge should be periodically removed if significant volumes accumulate in the bottom of the lagoon. Since lagoons are relatively large, agitation can be an imposing problem. Power takeoff (PTO)-driven propeller agitators are the best choice for agitating lagoons. These units are available in lengths up to 40 ft or longer and provide the greatest flow rate of any type of agitator. They also require relatively large power units (100-150 hp) to operate at full capacity. Large lagoons may require two or more of these agitators operating simultaneously at different locations around the lagoon to provide adequate mixing. Extremely large lagoons may require dredging equipment similar to that used in the municipal sector.

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.