Confined Animal Waste-Lagoon Aeration

By some estimates there are over 250 billion gallons of animal waste disposed of each year onto farmland or into nearby waterways in the North American Continent. Concerns over pollution and water contamination have led to a growing number of government regulations as well as lawsuits filed by environmental groups against local feedlot operators.

Given that a single cow can produce as much waste per day as twenty humans, it is not surprising that waste disposal is a huge issue. In fact, a large industrial dairy or feedlot operation can generate as much waste as a mid-sized city. While cities spend millions of dollars each year to process and dispose of municipal waste, feedlot owners cannot afford such expenditures. Factory farms are thus limited to disposing the manure in uncovered manure lagoons or else spreading it on surrounding land.

The sheer magnitude of the waste often leads to its over-application onto nearby fields. The predictable result is a threat to the safety of the air as well as ground and surface water sources. The contaminants of concern are disease pathogens such as E. coli and salmonella and a host of air pollutants such as hydrogen sulfide, ammonia, volatile organic compounds, and particulate matter. In addition there are concerns over antibiotics, metals, and toxic substances in the waste.

Feedlot owner/operators use one of two methods to process animal waste. These methods are anaerobic digestion and aerobic digestion. Byproducts of anaerobic digestion include high odor, formaldehyde, mercaptans, aldehydes, and other compounds that can harm crops or soil. In contrast, aerobic digestion can produce liquid compost that can be highly beneficial to crops and soils.

The main function of an anaerobic lagoon is to remove, destroy, and stabilize organic matter, but not to “purify” the water. The advantage of this system is in its ability to concentrate solid wastes. High levels of gas and odor are evident near these types of lagoons. These systems are characterized by a relatively solids-free liquid zone located above a layer of bottom sediment.

The end products of aerobic digestion are mainly carbon dioxide and water. Virtually any degree of processing can be obtained in an aerobic lagoon since digestion is a function of time, oxygen availability, and carbon content.

Aerobic lagoons can be in the form of oxidation ponds or mechanically aerated ponds. Oxidation ponds depend upon naturally occurring dissolved oxygen from the air or from algae in the water. Because the oxygen demand is so high in a manure lagoon, the surface area of an oxidation pond must be large to enhance the air exchange at the water surface.

Mechanical aeration seems to be the more practical mode of treatment in a waste lagoon. The advantage of aerobic digestion is a reduction in volatile organic compounds, a reduction or elimination of odors, and a reduction of solids which are turned into carbon dioxide gas. Furthermore, oxygen is known to kill harmful pathogens. Aerobic digestion is said to turn the wastewater into a form of compost tea making it not only fit, but highly beneficial for spraying onto crop fields.

The level of aeration needed to turn a lagoon from anaerobic to aerobic will vary greatly from farm to farm. A pond is considered to be aerobic when the level of dissolved oxygen equals at least two milligrams per liter. It takes this level of oxygen to adequately support aerobic bacteria. Because of the size of many lagoons, and the huge burden of waste, it can take a multitude of aerators to reach this level of dissolved oxygen.

There are several types of aerators available to the confined-animal operator. These include bubble diffusers, venturis, paddle wheels, and self-aspirating aerators.

Air bubblers force air under pressure through a ceramic or perforated pipe diffuser which breaks the air bubbles into small sizes. These diffusers can produce macro- or micro-sized bubbles. Of the two, the micro diffusers are best, but they can easily clog, particularly in hostile waste water.

Venturi aerators, sometimes called air injectors, consist of a pump that forces the wastewater through a venturi which in turn draws air into the water stream. The challenge with venturi aerators is that unless the venturi throat (orifice) is large, it can clog with the solid matter which exists in a waste lagoon. Also, the impellers on the pump are known to clog with debris. Finally, venturi aerators are said to have a low oxygen transfer efficiency compared to other aerators.

Paddle wheel aerators are effective at stirring the lagoon, thereby breaking up the waste into smaller, more easily digestible sizes. However, older-style paddle wheels tend to inject large air bubbles which escape the lagoon water too quickly. Plus, the constant agitation can increase the stench of air in the areas around the lagoon.

Self-aspirating aerators inject dissolved oxygen into the subsurface regions of the waste lagoon. They do this by creating a low-pressure zone at the end of an air tube. In the process they create a mild current that circulates the water without stirring up the odor.

Self-aspirating aerators normally contain a propeller that turns beneath the water surface. However, the latest self-aspirating aerator on the market, which is offered by VaraCorp, LLC, uses a circular turbine instead of propellers. This aerator sheers the oxygen molecules making them extremely small and effective for ramping up aerobic populations. The result is an immediate reduction in odor along with rapid “digestion” of the solid wastes. Using state-of-the-art technology, this aerator can outperform aerators having up to seven times the horsepower.

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