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Proper Lagoon Management

to Reduce Odor and Excessive Sludge Accumulation

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Livestock and poultry operations frequently use anaerobic lagoons as liquid waste storage and treatment structures. In a lagoon, organic waste is diluted with water and bacteria decompose the organic matter. During decomposition, solids that cannot be liquified by bacteria settle out as sludge. The treated liquid and dilution water, called effluent, are used by livestock and poultry producers as fertilizer. Effluent also can be recycled for manure handling in a flush system.

Efficiency

To be efficient, a lagoon must be properly designed. The size of a lagoon is based upon several storage volumes—sludge storage volume, minimum design volume for volatile solids loading rate (treatment volume to ensure bacterial decomposition of manure), volume of total waste entering the lagoon, and precipitation and runoff volumes. Designs also include approximately 2 feet of freeboard for embankment protection.

In a system with two-stage lagoons, the first cell (primary lagoon) is designed to hold the sludge and the minimum design volume. The second cell (second-stage lagoon) receives overflow from the first cell and has storage volumes for further treatment of volatile solids, total livestock waste, runoff, precipitation and freeboard. Plans for future expansion in the livestock or poultry operation also should be considered in determining the final size of the lagoon. A properly sized two-stage lagoon is easier to manage than a single-stage system and improves treatment efficiency by producing higher quality effluent for reuse (flushing or land application).

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Bacteria

In a properly functioning lagoon, two types of bacteria, acid formers and methane formers, are prominent. Acid formers convert biodegradable organic matter to volatile acids. Methane formers convert these volatile acids to methane and carbon dioxide. Under optimum conditions, a balanced rate of biological reactions by the two types of bacteria is achieved. Variations caused by environment (temperature fluctuations, for example), improper design and poor management will disturb this balance and cause excessive odor and sludge accumulation.

Management

When a lagoon is in operation, proper management is extremely important.

Start-up management is the most critical stage. It may take more than 1 year for bacteria populations to reach the level required to treat the wastes. A new primary lagoon should not receive any waste until the water level reaches 50 percent of the minimum design volume. Diverted surface water and roof drainage may be used to add water to the lagoon.

Warm temperatures stimulate bacterial growth. Therefore, manure should be added to a new lagoon in the spring when bacterial populations are increasing.

Remember, not all materials entering the lagoon are biodegradable. Keep sand and supplies such as metal containers, plastic, glass, and other nondegradable material from entering the lagoon. These materials not only reduce the functional life of the lagoon, but also damage the pumping and irrigation equipment during effluent removal.

Pumping

Pumping from the lagoon should be conducted annually, at least, to ensure that the bacterial activity is not inhibited. However, the draw down should not be below the level of minimum design volume. Install a stake or marking device in the lagoon to indicate this critical level.

Sludge buildup should be monitored periodically. If the lagoon is filling with sludge faster than the designed life of sludge storage, frequent agitation and pumping may be necessary. In addition, solids separation by use of mechanical separators or settling basins may be required to reduce sludge buildup.

Salts

Electrical conductivity, a measure of the level of salts, can be monitored to observe lagoon performance. An electrical conductivity range of 2,000 to 8,000 μmho/cm (micro mohs per centimeter) indicates acceptable levels of salt concentration. A level greater than 10,000 μmho/cm can indicate high salt concentrations in the effluent that will inhibit plant growth. At very low levels of 10 to 13 μmho/cm, the lagoon's anaerobic bacteria almost cease to function.

pH

Lagoon pH should be monitored and maintained between 7.0 and 8.0. A pH below 6.5 (acidic conditions) generates excessive odor and sludge production. A low pH may indicate an excessive loading rate; volatile acids form faster than they can be converted into the end products of methane and carbon dioxide. A lagoon that develops crust (e.g., dairy lagoons) usually indicates a high loading rate. To increase pH, add lime and mix it throughout the lagoon.

Other Criteria

Any intakes for recycling water or irrigation should be placed below the depth of floating solids or 1 foot below the water level.

Maintain all embankments. Check closely for minor damage that may lead to major structural problems. Berms should be covered with grass and mowed to reduce erosion and improve appearance. Do not plant trees near the embankment. Erosion caused by animal traffic should be checked. Grass should not be allowed to grow out over the water surface because this will interfere with pumping and increase the volatile solids load. Lagoons that may create a safety hazard for animals and humans should be fenced.

Keep records of all the design information, volume of the effluent pumped monthly, and any data (pH, sludge levels, seepage, etc.) collected. Records provide necessary information during emergencies and when trouble-shooting problems.

Definitions

Anaerobic
Absence of free oxygen.

Effluent
The treated liquid and dilution water from a lagoon, contains important plant nutrients.

Freeboard
The distance between the water line and the top of the lagoon's berm.

Lagoon
An earthen structure designed for storage and biological treatment of livestock or poultry waste. Extra water is added to the lagoon to achieve a high degree of dilution.

μmho/cm
Micro mohs per centimeter, a measure of the rate of electrical conductance.

Volatile Solids
A measure of the amount of organic matter present in the solids fraction of livestock waste.

Volatile Solids Loading Rate
The rate at which mass of volatile solids is added per day per unit of lagoon volume; expressed as pounds per day per cubic feet (lbs./day-ft^3).

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