innovative turf solutions
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Improving Dairy Wastewater

Traditional Waterside Dairy Operations

The typical **dairy wastewater treatment** system has a "**separator**" screen that removes about 10-15% of the larger solids from the flush water.

The solids are returned as bedding for the cows, and the **dairy waste water** liquid flows to the first pond.

Typically, there are a series of ponds, which rely on **anaerobic** (without oxygen) **digestion** to degrade the solids.

The final **dairy wastewater** pond water is used for irrigation of the remaining property where corn or oats are grown as a feed for the cows.

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Due to the nature of this **anaerobically treated wastewater**, the water is very high in nitrogen in the form of **ammonia** and or **organic nitrogen**. This dairy waste water often needs to be diluted with fresh water to avoid the 'plant burn' associated with excessive nitrogen loading.

The **EPA is starting to enforce limits** on **nitrogen loading** due to its effects on groundwater as well as surface water runoff.

This concept of nitrogen loading limits a dairy to 5 cows per acre per day.

More cows would cause environmental impact to the groundwater and surface water runoff is the assumption.

The Problems

Solids steal hydraulic storage capacity:

Dairy waste water ponds are designed for the **hydraulic loading**, but not the solids loading transported with the flush water. The flush water has solids loading of 3,000 ppm suspended solids (measured). Assuming a dairy wastewater flow of 100,000 gallons/day, this equates to 2,500 pounds of solids per day. With this solids loading, a pond quickly fills up with solids and just as quickly, loses its hydraulic capacity to hold water. Therefore, when the wet weather hits, a dairy has limited options to store the extra water.

Solids need dredging for removal every few years:

The anaerobic ponds require a lot of time to degrade the solids that settle on the bottom. Anaerobic degradation of these solids require more time than is available, therefore, dairies require periodic pond dredging to remove the solids.

Economics:

The key to increased hydraulic capacity is to install more ponds or decrease the loading of the solids to the ponds. Adding more ponds is expensive and decreases the crop production because more of the dairy acreage is needed for the ponds. Since the solids are still allowed to enter the ponds, the cost for the dredging or draining/excavation of the solids remain.

By removing the solids, more capacity is available for the water. With the increased capacity and proper pond management, existing dairies can increase their pond capacity and have a better chance of maintaining compliance with the EPA discharge limits.

Where does this slime come from?

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The high levels of BOD in anaerobic pond water create a slime layer in the feed stalls from the flushing operations. The bioslime can cause the cows feet to soften and increase the chance of the cows contracting udder infections decreasing milk yields.

Similarly, the bioslime in the feed pens is the same slime that grows in the subsoil it the fields when irrigated with the anaerobic pond water. The bioslime actually seals the field and decreases the percolation rate. This is apparent from the standing water remaining in the fields after several days. The problem is the increase chance of surface water runoff containing levels of BOD and nitrogen compounds affecting the surround waterways.

Aerobic Treatment versus Anaerobic Treatment

Dairy ponds use anaerobic treatment (without oxygen) as a means of treating the wastewater. Anaerobic conditions are obvious from the continuous amount of gas bubbles off-gassing from the pond surface.

This process tends to cause odors, which can be a source of complaints from the surrounding property owner.

These calm yet odor-generating ponds are prime spots for mosquitoes to live and grow causing a further nuisance.

The conversion of the dairy pond from an anaerobic system to an aerobic (with oxygen creates a completely different environment. The use of surface aerators forces air below the water surface to add oxygen (aerate) and mix the wastewater and settled sludge.

The added oxygen creates a bacteria friendly environment; therefore, the time involved in solids degradation is greatly reduced. This process is even improved further by the addition of more microbes, and specially formulated enzymes. The bacteria require oxygen to degrade the waste. In the traditional pond method (anaerobic), the bacteria steal the oxygen from the sulfates and nitrates. This leaves behind sulfide gases (responsible for crop burn).

In the improved aerobic system, the aerators supply the oxygen thereby avoiding the odor and crop burn problems. The aerators also provide mixing energy; mixing up the sediment at the bottom of the pond. This decrease the amount of time required to degrade the solids, so decreasing the solids storage volume.

The Case Study

These are the facts to date from aerobically treating dairy waste at ABS Dairy in Livingston, California. The wastewater system has an existing 0.080 screen sized for a sump flow of 1,200 gpm. The equipment and results to date are:

1. (4) 10-horsepower aspirating type of aerators were installed.

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2. One 10-horsepower evaporator used for pond water level management. The evaporator is evaporating the final pond water at a rate of 10 gallons/minute or 14,400 gallons/day.
3. Microbes are added at a rate of 2 lbs/week as well as 2 cups of a specially formulated enzyme for enhanced BOD reduction and ammonia conversion.

Conclusion

1. Laboratory samples indicate a reduction in BOD of 50% (980 ppm to 490 ppm) and ammonia decreased by 20%.
2. The feed stall areas are free of the slippery bioslime.
3. Improved cow health in both feet and reduced udder infections.
4. Increase milk yield up 1,200 gallons/day due to more cows in production and more production per cow.
5. Increased crop yield due to improved growth rate without burning the plants. The oats were irrigated at 1-inch in height, which, with anaerobic ponds turned them brown and stunted their growth (evident by patchy and uneven growth rates). The aerobic water allowed the oats to maintain a healthy green color with a good growth rate.
6. Increased soil percolation rate with irrigation of pond water. The irrigation water percolated into the soils in a few days with full field flood irrigation as opposed to 10 days in the past. This will decrease the chance of surface water runoff contamination due to BOD, nitrogen compounds and other constituents that the EPA regularly monitors.
7. By removing the solids prior to the pond, more capacity is available for water storage and subsequent treatment. With the increased capacity and proper pond management, existing dairies have a better chance of staying in compliance with local environmental regulations.
8. The evaporator has allowed an increased water disposal rate in the winter, greatly decreasing rainwater capacity limitations.