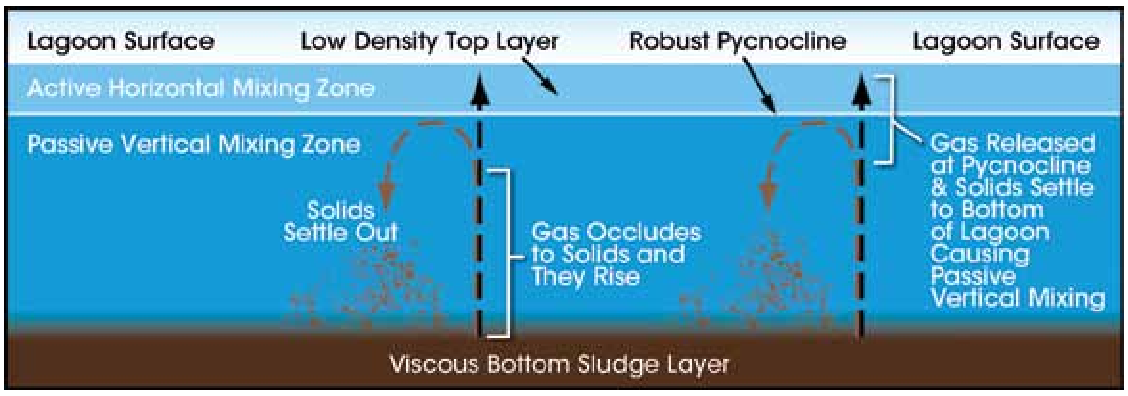
Biological Sludge Control

By Chip Bettle

Eliminating solids accumulation in wastewater treatment lagoons

Layered Lagoon System



A small municipality (estimated population 3,200) located in Bishop, Texas, experienced high levels of solids accumulation and ongoing challenges in meeting its discharge requirements. Its leadership team and engineer wanted to find a progressive, alternative solution to eliminate dredging, comply with discharge requirements and reduce the costs to the city while continuing good environmental stewardship.

Biological Control

Blue Frog Technology uses circulators to create radial outflowing currents requiring minimal energy consumption. Each circulator unit uses a 3-hp motor to move 7 million gal of water per day radially across the surface of the lagoon. A 30-in. floating baffle is used to redirect the horizontal flowing water downward from the lagoon's surface to the anaerobic zone at the bottom. Selected bacteria form synergistic anaerobic biofilms in tight, mineral-based granules on the bottom of the pond, forming a granular sludge bed reactor (GSBR) over the entire pond bottom.

When two adjacent radial streams intersect, equal and opposite horizontal flow vectors form a "hydraulic wall" that turns the current until it plunges to the bottom. Surface biosolids are delivered to the GSBR, liquefied and then turned into gas by the bacteria immobilized in and on the granule.

Produced gas rises and gently mixes the water column.

Continuously feeding the granules increases their productivity, partially offsetting the slower rate of reaction of anaerobes versus aerobes.

Once the granular sludge bed reactor is established, bacteria will grow and die in direct response to the level of nutrient loading coming into the lagoon. This automatic biological control mechanism is ideally suited for the natural fluctuations in flow that characterize municipal sewage lagoons. Biological control also is much more cost-effective than instrument control of the additional aeration horsepower associated with traditional oxygen-adding strategies.

The initial level of solids at Bishop prevented the boom from installing as engineered until two weeks later, once surface sludge was digested. Within four months after the start of biodredging, solids levels declined approximately 31% and a progress report confirmed that within a five-month period, the municipality was meeting all of its discharge requirements.

Creating and maintaining distinct layers of water in the lagoon manages the odors generated by anaerobic treatment. The top layer of clear, sweet, circulated water acts like the lid on a container, keeping any odors associated with anaerobic treatment from escaping.

The modular nature of Blue Frog makes it possible to adapt to changing flows and the need for increased capacity by simply increasing the number of circulators and their inherent additional hydraulic walls. Each installation is custom-designed to match the specific lagoon characteristics and meet the desired effluent discharge parameters.

Natural Biological Processes

To be stewards of the environment, a focus must be placed on methods that have a positive impact on the receiving environment. There are new technologies available that utilize natural biological processes that enhance organic sludge digestion through biodredging.

Wastewater treatment lagoons are the oldest and most commonly used method for treating wastewater; however, there have been minimal advancements to improve their operation. Wastewater lagoons produce billions of tons of biosolids each year.

Traditional methods to remove biosolids from lagoons typically entail mechanical dredging, a process that can cause expensive damage to the environment and infrastructure such as liners and pipe. Disposal methods such as application onto farmland or landfilling are running into increased regulatory restrictions and public concerns about what is contained in the biosolids (sludge). Excessive buildup of sludge potentially can intensify odors and increase effluent concentrations of biochemical oxygen demand, total suspended solids, nutrients like ammonia and pathogens.

With the rise in environmental standards over the past 40 years, these collection and storage lagoons have been pressed into service as secondary treatment facilities through the addition of aeration. Aerated lagoons have greater treatment capacity, but are more expensive to operate than storage lagoons and tend to accumulate sludge, gradually robbing them of treatment capacity.

Mechanical treatment has emerged as an effective but expensive alternative to lagoons. In addition, they continue to generate large amounts of sludge and require highly trained staff to operate. Increasingly, more lagoon owners are faced with budget restraints and are unable to adopt mechanical treatment facilities; therefore, they are shifting their focus toward generating increased treatment performance from their existing lagoon systems.

Biodredging, on the other hand, is a biological process that digests sludge in situ and reduces its accumulation at the onset.

In Situ Sludge Digestion

Natural microbial systems are capable of recycling waste and turning it into gas. Specialized bacteria liquefy biosolids; other groups convert liquids into various acids. Still another group converts short chain acids into gas. Nature optimizes the process by creating a structured environment, called a biofilm, wherein the waste from one group is handed off as food to the next group in the chain.

Layering lagoons to mimic nature and transporting food (substrate) to immobilized biofilms faster can accelerate the gas-forming process, clean the water for discharge and digest sludge in the pond where it was formed all at once. The science behind biological systems is to select for preferred indigenous organisms, layer the lagoon and then provide periodic vertical currents to transfer surface substrate to the bottom biofilm for conversion to gas.

Anaerobic vs. Aerobic

Anaerobic treatment in sewage lagoons remains rare, presumably because of the fear of odor problems and the fact that aerobic treatment provides a faster overall treatment rate.

One of the key obstacles to improved lagoon performance is the conventional wisdom that supports aerobic versus anaerobic treatment strategies. By shifting the focus from aerobic to anaerobic lagoon treatment strategies, municipalities can be released from the restraint of high-horsepower aeration and the sludge generation that characteristically comes with it. Emerging technologies that embrace and enhance natural biological processes give municipalities an opportunity to increase the effective treatment capacity of their existing lagoons and meet effluent discharge criteria, while driving down the costs of sludge management. w&wd

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