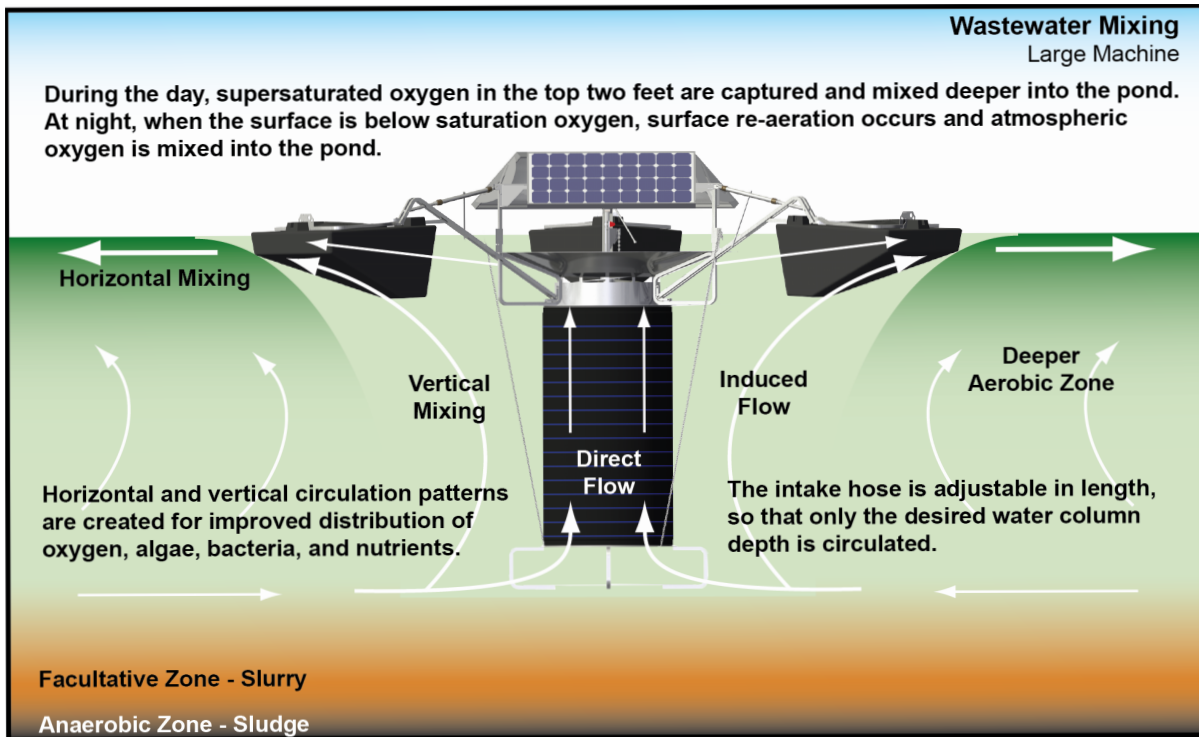


Mixing To Enhance Facultative Lagoon Treatment



Wastewater Lagoon Systems

In most lagoons, sunlight causes a hard stratification at 12 to 18 inches of depth. The top water is warmer and thick algae populations are producing supersaturated dissolved oxygen (DO). The DO gasses off at the surface and is not readily available deeper in the pond for use by BOD-reducing bacteria.

Meanwhile new inflow water may be short-circuiting straight across the bottom of the pond. Short-circuiting makes actual detention much less than theoretical detention time. Without proper detention time, the water does not have time to experience a good BOD and ammonia reduction.

SolarBee® & GridBee® floating wastewater mixers from Ixom Watercare can enhance or supplement your existing facultative lagoon system. Effective mixing often reduces effluent algae biochemical oxygen demand (BOD) and total suspended solids (TSS) (to under 10 mg/l) and usually ammonia (N), phosphorus (P), and pH. Better mixing can also help solve problems involving overloading, odors, and sludge buildup.

Major system upgrades can often be avoided by making cost-effective enhancements to the system already in place.

Primary Cell

Influent: Raw sewage with high carbon BOD (CBOD), high nitrogen, and high phosphorus.

Solution: Add SolarBee® GridBee® mixing to enhance the facultative process.

Results: SolarBee® & GridBee® mixers are installed to circulate the top 50% of the lagoon. These mixers can capture up to 400 lbs of DO per acre per day which would have otherwise been lost to the atmosphere. The more DO mixed deeper into the pond, the more DO available for BOD-reducing bacteria to use.

Influent short-circuiting is minimized or stopped altogether (depending on system design).

A thick well mixed oxygenated layer continuously destroys any hydrogen sulfide (H₂S) odors bubbling up from the bottom turning them to sulfate and resulting in durable odor elimination. At night or in cloudy weather when there is a DO deficit at the surface, surface re-aeration from SolarBee® GridBee® mixing can also add up to 225 lbs. of oxygen (O₂) per acre per day.

Continuous mixing also removes surface films from the pond caused by fats, oils, grease (FOG) and proteins from the BOD bacteria. This allows methane gas to

Learning (cont'd)



exit the pond much easier (as usually evidenced by up to 300 methane bubbles per square meter) across the entire lagoon. The increased methane release speeds up anaerobic digestion of bio-solids at the bottom. Better & more effective sludge reduction eliminates any need to ever dredge the ponds.

Ammonia reduction is improved as well by two mechanisms:

1) NH₄ liquid ammonium brought up by SolarBee® GridBee® mixing is pushed into the high pH surface water where it turns to NH₃ ammonia and gases off, plus

2) Less short-circuiting and longer detention times within the mixed ponds result in better nitrification & denitrification.

Phosphorus reduction is improved. Higher average pH in the pond together with consistent mixing helps phosphorus connect with calcium hardness forming a solid called apatite. Apatite is more dense and falls to the bottom of the pond.

Algae does not create new BOD problems either. Algae's two main growth limiters in lagoons are light (on cloudy days and at night) and carbon.

Carbon is supplied by BOD-reducing bacteria. Through respiration, these bacteria emit carbon dioxide (CO₂), which quickly becomes carbonic acid (H₂CO₃). Algae in the pond strips CO₂ from the carbonic acid causing a drain down of the entire carbonate alkalinity buffering pool. This ultimately leads to raised pH and a shortage of carbon.

As algae cells die or are eaten by daphnia that die, they fall to the bottom where they are mostly digested anaerobically through methane fermentation. Most of the carbon they contain leaves the pond as methane gas, a non-nutrient.

A smaller portion of the methane fermentation carbon re-enters the buffering pool as CO₂ and is converted back to

either carbonic acid or carbonates. This is usually referred to as "nutrient feedback" from the sludge.

Living algal cells (also considered BOD) are trapped in the top two feet and do not move forward into the next cell. When the primary cell is working correctly, 90% of the BOD reduction occurs there.

Secondary Cell

Action: Add SolarBee® GridBee® mixing to enhance the facultative process.

Influent: Influent composition is usually very low in comparison to the primary cell (only 10% as high of BOD, and less phosphorus and ammonia).

Results: Just as in the primary cell, circulation and beneficial algae growth result in large BOD, N, & P reductions. More & better reduction means less of them are passed to the final cell.

Effective ponds in series compound the beneficial effect. When both the primary and secondary cell achieve a 70% reduction of these nutrients, the amount passed on to the next cell is 30% x 30% = only 9%.

Final Cell

Action: Add SolarBee® GridBee® mixing to enhance the facultative process.

Influent: The influent has very little BOD (almost none) with reduced phosphorus and ammonia.

Results: The only BOD present are algal cells; however, algal growth is carbon limited and there is not enough to cause permit problems for BOD and TSS. Ponds with SolarBee® GridBee® mixing typically discharge less than 10 mg/l of BOD and TSS which is well under the standard 30 mg/l BOD and 45 mg/l TSS limits most jurisdictions have.

It is worth noting the potential for standard BOD testing to give false high & inaccurate readings due to nitrification. Most lagoon systems should go to CBOD testing to avoid these false high BOD measurements. For more information on false high BOD tests, please go to www.ixomwatercare.com/false-high-BOD

SolarBee® GridBee® mixing can add real treatment enhancement to your lagoon system. Please contact us to discuss how we can help you meet your treatment goals.