SINK OR SWIM: A COMPARISON OF SUBMERSIBLE AND SURFACE MIXERS FOR ANOXIC AND ANAEROBIC TANK MIXING

With increasing requirements for enhanced nutrient removal, many wastewater plants are adding anoxic and/or anaerobic tanks in their secondary treatment systems.

There are multiple options for enhanced nutrient removal including, but not limited to, the A2O (Anaerobic, Anoxic, Aerobic) process, the UCT or MUCT (Modified University of Cape Town) process and the Bardenpho process. All involve the use of anaerobic and/or anoxic tank configurations in addition to the aerobic reactor with influent, recycle and RAS (Return Activated Sludge) at various locations in the reactors.

In these processes, mixers are needed to keep the phosphate absorbing organisms (PAOs) or denitrifiers in contact with the incoming wastewater to prevent settling of the biomass and to prevent accumulation of fats, oils and grease (FOG) on the surface in a scum layer. While performing this function, the mixer must avoid adding oxygen, since the presence of oxygen will cause PAOs to switch to metabolizing stored phosphates instead of taking up soluble, readily degradable BOD. Likewise, in anoxic tanks, oxygen will cause aerobic organisms to gain advantage due to their faster growth, and nitrates will not be utilized.

There are two prevalent mixer designs to consider: submersible and surface mixers. Each has its own features.

Submersibles: worth the hassle?

Submersible mixers are currently the more prevalent of the two designs. They can be mounted on a wall bracket with a hoist to be raised for service. Submersibles are typically low-speed mixers with an integral gearbox and motor assembly.

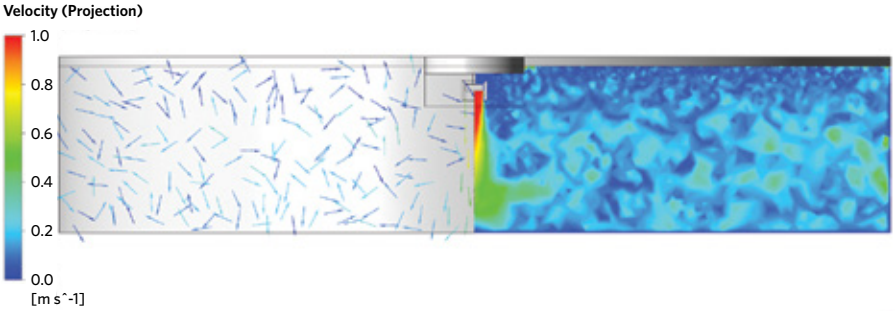
Aqua-Lator® Direct Drive Mixers are an ideal solution for anaerobic and anoxic tank mixing in wastewater treatment applications.

Submersibles are available with either standard or large impeller blades. The small-blade impeller is typically lower in cost. The large blade impeller is more efficient, and comes at a higher cost. When evaluating these two submersible options, it's important to understand energy costs. Often, the energy savings of a large impeller mixer may not actually offset its higher lifetime cost.

Submersible mixers can be set up to create either a clockwise or counter-clockwise liquid movement in the tank. This can require more than one mixer in many tank configurations. Care must also be taken to prevent short-circuiting the mixed liquor. This can occur if a weir inlet and outlet are used, as is often the case when an existing aeration basin is repurposed for mixing.

COMPARISON OF MIXER TYPES

Type of Mixer	Mounting	Drive	Motor Cooling	Required Accessories	Ease of Maintenance	Frequency of Maintenance	Mixing Efficiency	Costs
Compact Submersible	Wall Bracket	Direct	Water	Moisture Thermal	Moderate	Moderate	Medium	$$
Direct Drive Floating	Surface mooring cables	Direct	Air	None	Easier	Less frequent	Medium	$$
Low Speed Submersible	Tank floor or guide posts	Gearbox	Water	Moisture Thermal	Moderate	More frequent	High	$$$



A 3HP Aqua-Lator® Direct Drive Mixer installed in a 45 ft. diameter. by 9 ft. deep tank shows that 0.5 m/s are prevalent throughout the tank, far exceeding the 0.2 m/s velocity typically recommended to keep activated sludge in suspension.

In addition to configuration concerns, submersibles have maintenance needs. Their low-speed operation requires gear reduction, which means additional parts that can fail. They're also vulnerable to both leaks and overheating, and typically require moisture and thermal sensors to protect them. If the area around a submersible becomes covered with rags or stringy material, for example, the motor will not be able to cool itself, and the problem will not be apparent until the motor's thermal unit trips. And if a leak is not detected quickly, the entire unit could need to be replaced.

High-speed surface mixers: the low-maintenance, high-performance alternative

High-speed surface mixers, which float on the surface of the tank, are an alternative to submersibles for anoxic and anaerobic tank mixing. Although high-speed surface mixers may be higher in cost than small-blade submersible mixers, they are usually lower in cost than large-blade mixers. In either case, high-speed surface mixers offer significant advantages over submersibles in performance and reliability.

Surface mixers are designed to last longer. With the motor mounted completely above the water line, directly connected to the impeller, water leaks are not an issue, and motors can last for decades with no maintenance other than periodic greasing. In the event a motor does fail, only the motor will need replacement, which can be done without draining the tank. The impeller is similarly designed for long life, precision cast in 316 or 15-5 stainless steel.

In addition to being more reliable, surface mixers are easy to install. Installation can be done on an existing tank with few, if any, modifications. There are a variety of mooring methods available to accommodate almost any type of existing or new tank configuration.

Once installed, surface mixers deliver better mixing performance. Mixing is directed downward and then spreads at the floor. The turbulent mixing created is less affected by inlet and outlet locations, and ensures complete mixing of the influent. The computer model above shows that 0.5 m/s areas are prevalent throughout the tank, far exceeding the 0.2 m/s velocity typically recommended to keep activated sludge in suspension. This model was created with a single 3HP mixer in a 45 ft. diameter by 9 ft. deep tank using CFD (Computational Fluid Dynamics) software. Any modern mixer manufacturer should have this capability within their engineering department.

Evoqua's Aqua-Lator® Direct Drive Mixers (DDM)

The Aqua-Lator® DDM from Evoqua Water Technologies, available in sizes from 3HP up to 75HP, is an easy-to-deploy, efficient high-speed surface mixer. A proven solution in mixing applications, the Aqua-Lator DDM provides the performance and reliability needed in anaerobic/anoxic tank mixing. These mixers can be added to almost any basin with few or no modifications.

With a wide range of ratings and materials, Evoqua has an Aqua-Lator Direct Drive Mixer to meet your needs. Evoqua has been designing and supplying mixers for decades, and has technical resources to analyze any situation and recommend a mixing solution.

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