The Principles of Aeration & Mixing Utilizing Process Aerator Technology

Energy and Operational Savings Equals Formula for Long-Term Sustainability

By Cheri D. Cohen

Aeration and mixing are necessary elements for aerobic biological wastewater treatment processes to maintain a healthy, stabilized biological population and thus, insure optimal treatment of the wastewater assuming there is adequate contact time and substrate available. In the design of wastewater treatment plants, aeration typically involves supply of both oxygen and mixing. Aeration is a large consumer of both energy and operational costs. The **Aire-O_2 Triton® aerator/mixer** is a process aeration technology that addresses both of these aspects and is environmentally friendly, which is a winning formula to help achieve long term sustainability.

Aeration technology choice is perhaps the most critical piece of a typical wastewater treatment plant accounting for anywhere from 25-90% of the total operating costs of the plant according to the U.S. EPA[1] depending on the type of aeration technology used and the layout specifics of the plant. Therefore, proper selection of this equipment is key to minimizing the life cycle costs of the equipment and thereby the overall carbon footprint of the entire treatment plant.

While all aeration equipment will supply oxygen and mixing to the treatment process, the techniques for doing so and their effectiveness vary widely and are sometimes misunderstood in the industry. A good example is the Aire-O_2 Triton® process aerator/mixer. The process aerator/mixer is a surface-mounted device introduced in 1996 that utilizes a directional mixer combined with a blower to inject fine bubble diffused air beneath the water surface. The mixer and blower operate independent of one another, which allow the air flow to be controlled to meet process requirements without any impact on mixing performance. The process aerator can be mounted on float assemblies, wall or bridge mounts and on a sliding rail system for SBR systems. The process aerator/mixer is manufactured by Aeration Industries International.

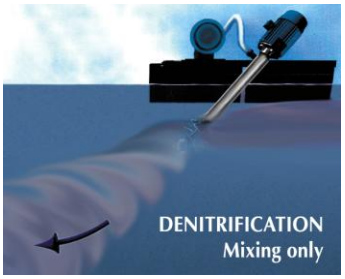
Aeration & Oxygenation

The biological processes are aerobic by nature and therefore require uninhibited access to oxygen. Oxygen is added typically through mechanical means to the process to maintain a positive dissolved oxygen (DO) concentration in the aeration basin.

A healthy, stabilized biological population consists of the Mixed Liquor Suspended Solids (MLSS) in the aerobic basin. Appropriate conditions (such as pH, alkalinity, temperature, lack of inhibitory agents, appropriate solids concentration, etc.) must be maintained in the aerobic basin to insure that the biological population is able to function optimally.

The Aire-O_2 Triton® process aerator/mixer creates an optimal biological environment in its nitrification mode or 'aeration and mixing' mode. Air is pressurized using the high efficiency regenerative blower and forced down a hollow shaft exiting from the diffuser in front of the mixing propeller which dramatically increases oxygen dispersion and bubble residence time. The average bubble size is 2.0 mm which is classified as fine bubble by the U.S.E.P.A

Dual-mode operation allows for process control for Biological Nutrient Removal (BNR) treatment for nitrification, denitrification and phosphorus removal by independent control of aeration and mixing modes.



Both aeration and mixing functions can be accomplished in one unit independently of one another. Thus, no separate mixers are needed for denitrification.

In the mixing mode, the blower is turned off which keeps solids in suspension and facilitates denitifrication. This allows for power savings when loads decrease by allowing the blower to be turned down or off based on oxygen demand while maintaining uniform solids suspension throughout the entire basin. These features make the process aerator/ mixer ideal for Oxidation Ditches and SBR systems

This process aeration technology is often misunderstood in the industry and erroneously categorized as an aspirator aerator, which it is not because it does not aspirator any air. Because of the 8-pole motor operation (900 RPM/60 HZ), air simply cannot aspirate down the shaft in operation. Instead air is forced down through the shaft using a regenerative blower. Adding to the confusion, some companies will add a blower to a standard high speed aspirator aerator. This does not increase mixing or oxygen transfer. These 'blower assist aspirators' can only operate in an 'aeration mode' only. The aerator will continue to aspirate when the blower is turned off. Hence, the process aerator/mixer is in a category by itself.

The Importance of Mixing

Mixing is essential to biological wastewater treatment. Mixing insures that all solids in the process are kept in suspension (hence the term suspended growth) which allows the biological population to maintain uniform contact with both the substrate and the oxygen supplied to the aerobic basin. Proper mixing also prevents wastewater from moving too quickly through the system, a phenomenon commonly referred to as short-circuiting, as well as aiding in the settleability of solids in the flocculation required before discharge.

Lastly, there must be adequate contact time or Hydraulic Retention Time (HRT) in the treatment process to insure that the respective biological processes are able to proceed to completion. This involves proper sizing of the aerobic basin relative to the plant flow rate.

The Triton process aerator has a proprietary designed mixing propeller that drives subsurface oxygen and mixing to 33 feet deep. This allows for deeper ditch and lagoon designs for a smaller carbon footprint. The strong, horizontal flow mixing creates greater treatment efficiencies coupled with 'flow linkage' to equally distribute oxygen dispersion and mix the wastewater around the basin as illustrated in the aerial figure. This can cut energy consumption up to 50% and prevents short-circuiting.

BNR & Energy Savings

The Heyburn, Idaho oxidation ditch system was upgraded in September 2009 for Biological Nutrient Removal (BNR) to reach an effluent goal of less than 5 lbs/day Total Phosphorous (TP).

Three up-front anaerobic basins operating in series and an additional oxidation ditch (three oxidation ditches total operating in parallel) were constructed incorporating Aeration Industries' aeration and mixing

equipment in combination with dissolved oxygen (DO) and dNOx™ oxidation-reduction potential (ORP) control equipment. First, the anaerobic selector basins select the bacteria responsible for biological phosphorus removal so phosphorous uptake can later occur in the oxidation ditches. Next, nitrification and then, denitrification is accomplished in the oxidation ditches to remove nitrates from the wastewater.

Utilizing the Aire-O_2 Triton® process aerator/mixers enables direct control of the nitrification/denitrification process using a single piece of equipment. The on-board blower on each Triton aerator/mixer is automatically turned on and off using ORP setpoints to cycle the oxidation ditches between anoxic (mixing only) and aerobic (mixing + aeration) conditions to facilitate a high degree of denitrification. This also saves on electricity costs without any negative impact to ditch mixing. Currently, the Heyburn, ID WWTP is operating successfully below permit at an average effluent of 3.3 lbs/day TP and 0.50 mg/l Ammonia.

Sustainability

The process aerators/mixer offers proprietary engineering to provide an energy-efficient aeration system that is both environmentally and operator friendly. The process aerator offers significant capital equipment savings, flexibility and eliminates large upfront installation costs.

The process aerator has very low maintenance due to its slow speed design, few wear parts and proprietary engineered water lubricated bearing. The manufacturer offers up to a 5 year warranty on the equipment. There are no complicated valve or gear reducers. Redundancy is a non-issue compared to traditional systems. A spare unit is a minor expense and compliments overall lower cost of ownership and sustainability features.

In a typical wastewater treatment plant today, aeration and mixing equipment is a huge consumer of electrical and operational expenses. Using a technology that adds savings to the bottom line and is environmentally and operationally friendly is a winning formula to achieve long-term sustainability.

[1] Design Manual – Fine Pore Aeration Systems, U.S. EPA, September 1989.

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