Why Your Wastewater Operation Needs An Intelligent Aerator

Aeration is a critical part of the wastewater treatment process and one of its biggest energy consumers. As such, there is no reason why aeration should be left behind as plant processes and technologies become more advanced.

To learn how aeration is being carried into the 21st century, we spoke with Fluence. The technology provider gave us the skinny on where to save on aeration costs, the advantages of automation, and the future of aerobic processes.

Why is aeration such a critical process for wastewater treatment operations? Air (oxygen) plays an important role in sustaining the wastewater treatment process because the microorganisms alive during the activated sludge process depend on maintaining a concentration of dissolved oxygen in the wastewater for their respiration. The activated sludge process takes a long time to complete, and because it requires so much supplemental oxygen, it consumes a significant amount of energy.

It is widely acknowledged that there isn’t a process like the activated sludge process which offers the same efficiencies at such a low implementation cost and low operating cost. Treatment designers have deployed aerators as part of the activated sludge process for over 100 years. Our goal is to continue improving this process, used throughout the world, by supplying innovative technologies which operate at the highest efficiency possible.

How has aeration technology evolved over the years? What does the cutting-edge look like today? Mechanical aeration technology has been commercially available in two basic forms for many years: diffused aeration and surface aeration. Changes to aeration equipment and the resulting benefits have been mostly incremental over the last 60 years. The improvements consist of a series of many small benefits owed to advancements in material science, process analytics, implementation of regular maintenance programs, and the knowledge-sharing of plant owners and operators.

Cutting-edge technologies are those which closely couple process control function with present and future process data and are also easy to install, easy to use, and easy to maintain. Technology must also be “calm” and advisory in nature. In other words, it must not limit operator involvement by diminishing or eliminating the sense of being in control of the equipment and processes for which they are responsible. The interactive environment, or “user experience,” is critical for acceptance of high-tech and state-of-the-art equipment.

Traditionally, the goal of an owner-operator was preventative maintenance (replace wear materials before they fail, regardless if they still have useful life remaining). Over the last few decades, the goal shifted to predictive maintenance (replace wear materials just before failure, or at least order a spare part to have on the shelf in preparation of an approaching unknown failure date). Now, with the industrial internet of things (IIoT), artificial intelligence (AI), and related technologies, the goal is to provide prescriptive maintenance (the equipment monitors itself against specified design benchmarks, and if out of tolerance, the system will automatically adjust control and notify the owner-operator of the change and
The primary goal of the Fluence SmartAerator™ is to automatically optimize the aeration process by providing immediate energy savings, and extending this savings over the equipment lifetime. The SmartAerator provides owners and operators the ability to monitor and report on plant data and aeration equipment status, anytime, anywhere.

Why is automating aeration such an advantage for systems and labor?
Municipal wastewater treatment is a variable process which closely follows human time schedules. Morning bathing, afternoon lunch breaks, evening bathing, dishwashing, and laundry follow very predictable daily diurnal cycles. This means the oxygen demand load seen by a wastewater treatment plant will vary, consistently and frequently.

Traditional, unintelligent aeration systems are designed to run at the same output level 24/7. This means that the motors and aerators are unnecessarily providing oxygen for their peak demand levels, all the time, which is a waste of energy. This default state of automatically wasting energy for measurable parts of the day is common at plants throughout the world.

Industrial water treatment is often a less variable process, but depending on shift and weekend schedules, can include significant opportunities for reducing the waste of energy through excess aeration. It is possible to manually “turn down” the aerators by reducing their motor speed, which will reduce blower output or agitator speed, but this is very labor-intensive to support over a 24/7 period and often becomes a guessing game to determine the value of the turndown RPM.

Auto-optimization through AI learning provides maximum energy savings via a precisely-tuned adaptive control scheme found only with the SmartAerator. This AI uses the historical process information for the plant being controlled, not a generic algorithm using “close-enough” control theory. Reducing motor RPM also extends the life of the equipment (bearings, seals, etc.), which further reduces the total cost of ownership.

What benefits stem from the fact that Fluence’s SmartAerator is a branded product solution, as opposed to a traditional system that has been upgraded?
The SmartAerator offers product continuity built on extensive testing and investment to ensure maximum owner-operator benefit of the Tornado® surface aerator. The SmartAerator and its adaptive AI are an extension of Fluence’s innovative products, designed exclusively for the hydrodynamic performance of the Tornado in wastewater processes. This is starkly contrasted with traditional controls and traditional system upgrades which consist of a process-agnostic programmable logic controller and interface programmed by a system integrator or SCADA supplier. The SmartAerator provides the best energy savings without sacrificing oxygenation or mixing performance during all parts of the daily diurnal cycle, throughout the year.

How much money can an operation save through energy efficiency with the SmartAerator?
For a typical plant designed with a 20-year population growth plan, utility cost savings are estimated to be in the range of 20 to 50 percent. These typical systems could see a capital payback in as little as two years depending on their mixing requirements and average level of over-aeration.

What set of problems does population growth present to wastewater operations?
For municipal plants, planners typically implement infrastructure for longer time horizons and aeration equipment is often purchased and installed under these capex plans with capacity for the future (e.g. 20-year) process load. For aeration, the lack of population growth presents the problem, in terms of energy waste today.

How can the SmartAerator be adapted to factor for population growth?
AI learns. This technology learns to predict the future operating conditions based on the historical as well as real-time measurements of plant performance. At the same time, the SmartAerator adapts to spikes and peaks while tracking with average loads throughout daily/annual diurnal cycles. Whether its long-term gradual population growth, or a spike in the system due to halftime during the Super Bowl, the Tornado SmartAerator responds in real time to dips and peaks in the wastewater cycle.

What do you see in the future of aeration technology and automation?
New terms such as “digital water” are connecting the functions of mainstream society to water management methodologies and processes. Water treatment has traditionally been “behind the scenes,” but due largely to the progressive digitization and promotion of global water resource data over the last few decades, anything to do with water is now part of our everyday lives.

Innovative aeration process improvements are already being implemented to improve wastewater treatment using membrane aerated biofilm reactors (MABR) and algae. These processes provide supplemental oxygen at a rate which closely matches activated sludge microorganism consumption rates.

The ultimate goal is to provide distributed perpetual wastewater treatment that encompasses the complete water-energy nexus.