THE CASE FOR INTENTIONAL AERATION

Reducing Energy Costs through Biological Monitoring

by Pat Beamon

For decades, I have traveled all over the country helping operators, plant managers, and municipal leaders think more carefully about the operation and budgeting of wastewater treatment facilities. One of the most effective opportunities to reduce operating costs while improving system stability is found in the aeration system within the activated sludge process.

Across the industry, it has become common practice to run aeration systems twenty-four hours a day, seven days a week. While this approach may feel safe, it is often unnecessary and expensive. Aeration is typically the largest energy consumer in a wastewater treatment plant, frequently accounting for more than half of total electrical usage. Any reduction in unnecessary aeration can have a significant impact on operating budgets.

We strongly advocate for the use of Oxidation Reduction Potential (ORP) and Dissolved Oxygen (DO) monitoring to guide aeration control. These measurements provide valuable insight into what is actually happening biologically inside the aeration basin, rather than relying on fixed blower setpoints or rules of thumb.

In many facilities, DO and ORP levels are maintained much higher than needed. In my experience, some of the most stable and efficient activated sludge systems operate with DO levels in the range of 1.5 to 2.0 mg/L. In certain cases, even lower values can be effective as long as NPDES permit limits are consistently met. Running at lower DO levels reduces energy consumption and places less stress on the biological system.

When ORP and DO are monitored throughout the length of an aeration basin, a consistent pattern often appears. In the front portion of the tank, DO and ORP steadily increase as oxygen is introduced and microorganisms actively consume incoming organic material. However, in the back half of the basin, it is common to see DO plateau or even rise while ORP begins to drop. This drop in ORP is often caused by bacterial cells rupturing and releasing intracellular material back into the mixed liquor, which effectively increases the organic loading.

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Recognizing this pattern allows operators to respond appropriately. Aeration rates can often be reduced toward the back of the tank, easing biological stress and improving overall system stability. This approach not only benefits the health of the biomass but also delivers meaningful energy savings by reducing blower run time.

Another valuable practice is intentionally cycling aeration off for short periods. Giving the system time to slow down and recover can improve biological performance when done correctly. These decisions should always be guided by real-time DO and ORP data to ensure treatment objectives are maintained.

At Wastewater Process, LLC, we work with facilities to turn these concepts into practical operating strategies. Through process monitoring, instrumentation support, and biological treatment solutions, we help operators gain better visibility into their systems and make informed adjustments. Tools such as ORP and DO monitoring, combined with biological products designed to support healthy biomass, allow facilities to optimize performance rather than simply over-aerating for safety.

Aeration control also plays a critical role in biological nutrient removal. Nitrification and denitrification each require specific redox conditions, and understanding ORP trends helps operators create the right environment for each biological process without excessive energy use.
Optimizing aeration is not just about saving power. It is about understanding how your system responds, protecting the health of the activated sludge, and operating with intention rather than habit. Small adjustments, when guided by good data, can produce long-term gains in stability, compliance, and cost control.

In the next article, we will discuss what is required to achieve a more stable activated sludge system using lower aeration values, including the operational tools, monitoring strategies, and biological support needed to make these improvements sustainable.

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