A COMPREHENSIVE APPROACH TO DISSOLVED OXYGEN CONTROL

Combined control is a strategy emerging as a strong alternative to traditional approaches for maintaining proper dissolved oxygen (DO) concentrations in the activated sludge at wastewater treatment plants.

At its core, this approach sustains DO concentrations at their setpoints using a smart design that constantly examines past and present conditions within a plant. It "learns" the system and adjusts the rate of change to calculate the amount of air required. The system then sequences multiple blowers, and makes valve adjustments where needed, to generate the proper process airflow.

Wastewater plants that face more stringent treatment requirements – such as those in high-population areas and with a proximity to more sensitive waterways – stand to benefit from a combined control strategy. This type of precision oversight is also a good fit for wastewater plant operators who are concerned with excess oxygen affecting phosphorus and nitrogen removal, or negatively impacting clarifiers.

A combined control approach is just one of a variety of methods available to address biochemical oxygen demand (BOD), the amount of DO required to break down organic material in wastewater.

Where Conventional Methods Fall Short

PID, short for proportional-integralderivative, is the most common approach to controlling DO at wastewater plants. It uses a series of loops operating independently to perform different functions, such as an air control valve tethered to a DO probe reading. PID works well when optimally tuned, but trying to cover a wide range of flow rates can be problematic. That's because PID is a linear control method, while wastewater isn't a linear process.

For example, consider a 2-1 swing in diurnal loading as related to the throttling capabilities of a butterfly valve, or oxygen exchange in the winter months compared to summer. Neither of those items are linear. However, PID attempts to resolve these DO aspects with linear solutions. Additionally, PID too often results in the system "hunting" by increasing or decreasing blower airflows, and overshooting or undershooting the required DO (think of a dog chasing its tail) to activate. Even with a time delay mechanism to start blowers, PID systems are always hunting rather than having a true understanding of where air needs to be applied.

Off-gas analysis, another approach to DO control, is based on calculating the oxygen uptake rate. The downside is that it requires a substantial number of analytical devices, which need to be regularly cleaned and calibrated. Any drift can cause bad data that could work counter to the DO strategy as well as increase energy costs.

Model-based systems are also being used for DO control. These systems bypass the shortcomings of PID loops by addressing diurnal loading and seasonal changes. However, the downfall is that modelbased systems require a significant amount of data to be collected prior to design. They also fail to adapt to longterm changing conditions because the baseline number for the model is static. So, as the population grows, the models become irrelevant.

Combined Control Based On Proof Of Demand

The combined control strategy provides dissolved oxygen to the activated sludge process by calculating the total airflow required (demand side) as well as the exact airflow required in each aeration zone (supply side) to maintain the DO at the setpoint. It then sequences the blowers and accurately adjusts the valves to distribute the airflow as required. DO is measured in each control basin, and the valve setting for each individual aeration zone is adjusted to achieve the desired DO setpoint.

This flow-based, most-open-valve method for air distribution allows the system to operate at the lowest possible pressure, which reduces energy consumption. Meanwhile, the proof-ofdemand equation, focused on what the biological process really needs, occurs in the background. Beware, though: Some less sophisticated systems will cycle blowers on and off without a "proof of demand" verification before turning on additional blowers.

The potential energy savings of combined control systems at wastewater treatment plants will vary based on plant layout and complexity. Generally, the system will yield a 20 percent energy savings when used in lieu of a typical PID system. For plants only using a baseline aeration control — setting airflow based on peak BOD requirements — the combined control system can reduce energy usage as much as 60 percent.

Precision administration of DO is key to running an optimal biological process. For plant operators interested in improving their processes, effluent, and energy usage, a combined control strategy for DO is worth evaluating.

Image credit: "Belebungsbecken - aeration tank," SuSanA Secretariat © 2011, used under an Attribution 2.0 Generic license: https://creativecommons.org/licenses/by/2.0/

AERZEN USA CORPORATION
108 Independence Way – Coatesville, PA 19320
United States
Telephone: +1 800-444 1692 – Fax: +1 610 380 0278
order-usa@aerzen.com – www.aerzen.com/en-us

AERZEN
EXPECT PERFORMANCE