Power-Saving Probes

By Robert J. Geary

New luminescent DO probes aid a New York WWTP in aeration optimization, energy savings

The 2.5-million-gal-per-day (mgd) Oneida Wastewater Treatment Plant (WWTP) in Oneida, N.Y., has adopted new luminescent dissolved oxygen (DO) probes to provide accurate and continuous DO readings. This has removed the guesswork from DO control and allows for greater plant efficiency and energy savings of more than $90,000 per year.

The Need for Reliable DO Measurements

Reliable DO measurements can be deceptively challenging to obtain, considering the investment made in time, instrumentation and manpower often made to acquire them. Even as technology has improved, many of the various permanent and portable DO probes available still require substantial maintenance and labor for proper operation, forcing plant personnel to simply work through such frustrations to obtain necessary DO measurements.

The impact of working with unreliable or labor-intensive equipment, however, goes much deeper, affecting plant efficiency and operating costs. DO readings provide valuable information to operators concerning current plant performance. During aeration cycles, low DO levels can result in incomplete breakdown of organic matter and create an ideal environment for proliferation of filamentous bacteria. High DO levels are a sign of over-aeration and wasted energy.

A local dairy provides 40% of the biological load for the Oneida WWTP.

Plants that cannot get reliable or timely DO readings often end up compensating by adjusting blowers to higher settings as a safeguard to ensure that there is sufficient air for the biological processes, thereby wasting power. The key to reducing energy costs is optimizing the aeration process, which requires accurate and timely DO measurement.

Oneida WWTP

The Oneida WWTP has faced its share of challenges with process and portable DO probes. Several years ago, the plant employed floating DO probes in its aeration tanks.

"They were a maintenance nightmare," said Bob Gleasman, plant operator. "Every few hours, one of these probes would foul and we would have to clean it and recalibrate it. We eventually just took them out."

Galvanic membrane handheld DO probes were an improvement, but they were no panacea, according to Gleasman. "We didn't have any real problems with handheld probes, but using them for acquiring data for aeration control was very time consuming. An operator had to go from tank to tank every day, taking measurements, and at each tank we would have to wait for the probe to finally stabilize before we could record the reading—it was just a hassle."

The Oneida facility, a two-stage activated sludge plant, serves approximately 12,000 customers, including a local dairy that provides about 40% of its biological load. Following bar screening and grit removal, the flow enters two primary clarifiers to settle out heavy organic material. The flow then enters two contact tanks for removal of carbonaceous biological oxygen demand (BOD).

"Our typical influent BOD levels run about 200 to 300 mg/L," Gleasman said. "But there are times when the dairy's output causes significant spikes in our BOD, and it can get as high as 500 to 600 mg/L. Approximately 90% of BOD is removed in the first stage of the process. In the summer, we also get 60% to 80% removal of TKN [total Kjehldahl nitrogen] in the first stage."

The flow then moves to the activated sludge second stage for removal of nitrogenous BOD.

DO Readings at Oneida

As in virtually all WWTPs, DO measurements at the Oneida treatment facility provide plant operators with critical process control data, and these readings are especially crucial in the aeration process, where adjustments to air supply can either save or waste valuable energy.

The Oneida plant's hassles with attaining accurate, timely DO measurement did not end until Hach luminescent DO probes were installed as part of a plant upgrade in late 2006. Unlike galvanic membrane probes that actually consume oxygen during the measurement process, the luminescent DO sensor relies on light transmission to determine DO levels, so it requires no membrane or reagent. In addition, the probe is self-calibrating and does not require frequent cleaning because the system produces accurate DO readings with some organic buildup on the sensor.

A total of nine luminescent DO probes were installed at Oneida WWTP. "We installed one probe in each of our two contact tanks and our six aeration tanks. The pole-mounted luminescent DO probes are immersed approximately 1 ft from the surface in each tank," Gleasman said. "We also installed a process luminescent DO probe to measure DO at our chlorine outfall."

The probes are continuously read by Hach sc100 controllers. The controller has a built-in data logger that collects measurements at user-selectable intervals (1 to 15 minutes), along with calibration and verification points, alarm history and instrument setup changes for up to six months. The controller is designed to receive data from up to two sensors simultaneously, and plug-and-play capabilities and multiple-parameter functionality allow operators to switch probes easily between different processes.

The controllers communicate with the plant's SCADA system. Plans are for the plant to automatically control the blowers based on the current DO readings. Currently, operators manually regulate the amount of air going into the tanks based on the real-time DO measurements provided by the process luminescent DO probes.

"The luminescent DO probes are a definite improvement. We don't have the constant maintenance issues that we had with the floating probes, which had to be cleaned daily, and we don't have an operator tied up for long periods taking DO measurements at each of the tanks with a handheld," Gleasman said.

Technology Benefits

In addition to installing the process luminescent DO probes, the Oneida facility installed three new 125-hp variable flow blowers to replace the single-speed centrifugal blowers that had been operating at the plant since 1982. The luminescent DO probes are providing operators with continuous, accurate DO

Three new 125-hp variable flow blowers replaced single-speed centrifugal blowers.

readings to adjust the new blowers for incremental increases and decreases in air supply. Improvements in DO measurement and blower control have combined to boost plant aeration efficiency, resulting in a 20% to 30% reduction of the power bill. This works out to approximately $90,000 to $120,000 in power savings per year. The plant anticipates further power usage reductions once DO-based automated blower control is initiated.

The probes are proving to be hardy process instruments that require little maintenance. "We have to wipe them off with a damp cloth once or twice a week during the summer, and maybe once a month in the winter," Gleasman said. "Also, according to Hach recommendations, the probe's tip should be replaced once a year. So far, though, most of our probes continue to perform accurately using their original tips."

In more than two years of operation at the plant, the new sensors have proven their worth in terms of accuracy and reliability. Though the Oneida plant had suffered through its share of difficult instrumentation for process control, combining process luminescent DO probes and variable flow blowers has delivered aggravation relief to plant personnel and energy savings to the city.

The blowers are the biggest power consumers at the plant, and operators no longer have to run them excessively high to play it safe. The new process sensors have eliminated the worries about maintaining effective DO levels. WWD

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