New Luminescent Technology Brings Faster, More Accurate CBOD Analysis

by Bob Dabkowski, Hach Company

Measuring DO in the CBOD procedure was once troublesome and inefficient for lab personnel and operators alike at the Southside Wastewater Treatment Plant in Tyler, Texas. But all that changed when they adopted new luminescent technology that has eliminated problems with instrument drift, slow measurements, and frequent maintenance.

The City of Tyler, Texas, has two wastewater treatment facilities that together serve upwards of 150,000 people. The smaller of the two plants, the Southside WWTP, is an activated sludge plant that uses mechanical aeration to achieve advanced secondary treatment. The 9 MGD facility, with an average daily flow of more than 5 MGD, serves approximately 40 percent of the city's service area.

Carbonaceous biochemical oxygen demand (CBOD) testing at the Southside facility is one of the plant's most critical measurements and must be performed daily to satisfy NPDES permit requirements. The test had long been a troublesome and time-consuming procedure due to inefficiencies inherent with the dissolved oxygen (DO) probes the facility had used over the years.

Probe Problems

Mary Evans, lab technician at the Southside plant, recalls the frequent weekend telephone calls she used to get from operators frustrated with the problems of using membrane-based DO probes used in the CBOD analysis procedure. They complained about having difficulties with instrument drift due to membrane fouling, slow and unreliable calibration, and frequent maintenance.

"That's just the nature of membrane probes," Evans says. "The calibration, the instrument drift, the frequent maintenance—you have to pay close attention to all of those things. It's a hassle. And it adds time to your analysis."

Although Evans learned how to troubleshoot membrane probes and adjust to their idiosyncrasies, it was still a headache for her. But it was even more of a headache for plant operators, who typically run the test on weekends and holidays. "Whenever the probe messed up for the operators, it was like their worst nightmare because they weren't as familiar with it. It was a real problem."

Because of instrument drift, slow measurements, difficulties in obtaining consistent repetitive values, and other problems caused by membrane-based DO probes, the Southside facility was eager to participate in a beta study to evaluate the efficacy of a new type of DO probe for use in the CBOD and BOD5 procedures. The beta test results of the new probe, which uses a patented Luminescent Dissolved Oxygen (LDO®) technology from Hach Company, were highly positive.

The LBOD101 IntelliCAL® Luminescent Dissolved Oxygen probe clearly outperformed the plant's membrane based probe during the beta test. A highly innovative sensing instrument, the LBOD probe displayed little to no drift and required no maintenance—two factors that routinely plagued the plant's membrane-based probes.

The U.S. Environmental Protection Agency (EPA) has granted federal approval of the LDO method for use in DO calculations under 40 CFR Part 136.3 with the stipulation that EPA Regions may continue to exercise their authority over its use under 40 CFR Part 136.5. Based on the results of the pilot study, the Southside plant decided to switch from using their membrane-based DO probe to the new LBOD probe. The new probe does not require an anode, cathode or electrolyte like other DO sensors, nor does it require a membrane. These factors reduce maintenance time and costs, and assure highly accurate readings.

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Blank Depletion/Drift Problems Solved

Evans says that recent changes appearing in the 21s Edition of *Standard Methods for the Examination of Water and Wastewater* presents new and more stringent criteria for BOD_5 and CBOD analysis, especially related to blank depletion.

"Before the new criteria came into effect, we would measure a blank sample with every batch of CBOD samples. Five days later, when we took our samples off, we measured our blank again. The maximum recommended depletion allowed was .20 mg/L. However, if we exceeded that it did not nullify our analysis—the test was still okay to report. This is no longer the case," Evans says. "The Standard Methods now states that if the dilution water blank exceeds .20 mg/L, all data must be discarded for the tests using this dilution water or we must clearly identify such samples in reporting records."

The plant had difficulty meeting the new criteria for blank depletion using the membrane DO probe, due to either inaccuracy or instrument drift. "What I would see in my blank depletion using the membrane probe was a tendency to really push the limit. But now that we've switched to the LDO sensor, that's no longer a problem," Evans says.

"The new sensor is steady as a rock. You can take the same reading two or three times in a row, and you may get a minor variation, such as a .01 mg/L or a .02 mg/L difference, but compared to what we had been getting with our membrane probe, this new probe is very consistent," she says.

Southside plant personnel also like the fact that the LBOD probe barely displaces any water when entering the top of the bottle. "The other probes are larger and when you put them into the narrow neck BOD bottles. There's a tendency to overtop them, so you're losing part of your sample, part of your seed, and part of the nutrients that you've added, which can change your analysis," Evans says. "And when you pulled that probe out and put the stopper in, there was often an air-gap at the top. Then we'd have to add water, further diluting whatever our sample or standard was. But the LBOD probe displaces less water and there's less overtopping," Evans says.

Two-Fisted Testing

The LBOD probe plugs into a Hach HQ40d Digital Multi-Parameter Meter. The unit allows up to two simultaneous measurements (pH and conductivity, in addition to LDO), and includes an intuitive user interface with guided self-calibration.

"Since the meter can receive two probes at once, I have at times utilized both of our LBOD probes in my analysis and cut my time in half. For instance, if I have 30 sample bottles, I can run two side-by-side analyses using both probes simultaneously. In addition, the probe and meter lock in a lot faster than the membrane probes I've used. When we have lot of samples, it's a real timesaver."

In addition, the meter provides reporting data, including time and date, and sample and user IDs, enabling the operator to store and monitor previous readings. The meter also stores the last calibration and calibration history in the plug-and-play probe, reducing the need to recalibrate when switching between parameters. "Even though the LBOD probe rarely needs recalibration, we're required by regulatory agencies to calibrate it every day," Evans says. "But the calibration on this probe is simple, much easier than the units we've had before. It only takes me about one minute or so."

With the speed, reliability, and maintenance-free features of the new technology, Southside plant personnel have gained appreciably greater confidence in conducting critical DO analyses in the CBOD and BOD_5 testing procedures, Evans says. "Our operators have really appreciated us making the switch, essentially turning what was once often a nightmare for them into an easy, efficient procedure."

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