Bringing Efficiency And New Confidence To BOD_5 Analysis

By Bob Dabkowski

BOD_5 testing used to be a time consuming and inefficient procedure for the Nacogdoches, Texas, Wastewater Environmental Laboratory, requiring continuous instrument membrane replacements, and due to problems with instrument drift and slow measurements. With the adoption of new, breakthrough luminescent technology, however, BOD_5 testing for the lab has become more accurate and easier.

Biochemical Oxygen Demand (BOD) analysis is the test everyone loves to hate – and for compelling reasons. The test has a number of disadvantages: a five-day incubation period, extensive sample preparation and, often, difficulties in obtaining consistent repetitive values.

Most wastewater treatment plant laboratories currently use membrane-based probes to measure dissolved oxygen (DO) in the BOD_5 Procedure. Before the development of these probes, labs typically used a titration method, which was a lot more complicated and time consuming. Although membrane DO probes took some of the hassle out of BOD measurement procedures, they came with their own set of hassles, according to Jill Bolin, Laboratory Manager for the Water Utilities Department of Nacogdoches, Texas.

"We had a lot of drift on our probes because the membranes would constantly be fouling. This was causing major problems with our blanks coming in. We had calibration issues with the probes, too. We would always be cleaning, recalibrating the probes, and replacing the membranes to try solve the problems."

Bolin has been the laboratory manager for the city's water utilities department for the past 15 years and she recently received the Laboratory Analyst Excellence Award from the Water Environment Federation (WEF). Her laboratory analyzes the influent and effluent flows and wastewater treatment process controls for the wastewater treatment plant, as well as industrial effluent samples being discharged into the plant.

The Nacogdoches treatment facility is a conventional activated sludge process with a capacity of 12.88 MGD average daily flow and 25 MGD maximum 2-hour peak flow. Like virtually all wastewater treatment plants, daily BOD analysis must be performed to satisfy NPDES permit requirements. Bolin says the drift and calibration issues with the membrane-based probes were causing serious problems.

"Drift with our membrane probes was 0.2 to 0.3 mg/L in either direction -- and our blanks can only be a 0.2 mg/L out. So, if we put a sample on and it was reading 0.2 mg/L high and then took it off and it was reading 0.2 mg/L low, we are in big trouble, " she says. "When you take a BOD test off, if it's bad it's bad, there's not anything you can do about it because it's five days old and everything is out of holding time by then and all you can do is record the test as non-reportable. Regulators don't like to see that."

Investigating New Sensor Technology

Because water analysis efficiency and reliability play such an important role, many laboratories, such as the Nacogdoches Wastewater Environmental Laboratory, are continuously assessing new instruments and technologies that can aid in water chemistry analysis. To that end, the lab recently participated in beta testing a new BOD probe that uses patented Luminescent Dissolved Oxygen (LDO®) technology from Hach Company.

The LDO sensors offer specific advantages in accurate DO monitoring and control that membrane-type sensors do not provide. Because there is no membrane, there is no replacement due to fouling and no need to monitor and replace electrolyte solution. Unlike membrane sensors, the LDO probes do not consume oxygen in the process of measuring it, so measurement accuracy is improved. The operation of the sensor is unaffected by the presence of hydrogen sulfide, wastewater chemicals or heavy metals, or fluctuations in pH levels.

The Hach LBOD101 probe integrates a stirrer into the popular LDO101 probe, thus making it possible to introduce the benefits of LDO technology to the wastewater laboratory market for use in BOD_5 testing applications. The probe was designed to comply with the requirements of the United States EPAbBased BOD test methods: BOD_5 and CBOD tests. As such, the probe was designed to fit into standard 300 mL US bottles; the critical dimension is the bottle's neck size of 0.625 inches (15.875 mm).

Based on the results of its beta test of the new unit, the Nacogdoches laboratory has adopted the LBOD probe for BOD5 analysis, replacing the membrane-based probes and bringing a new level of confidence to this critical measurement.

As seen in the 5/29/08 edition of the Water Online (www.wateronline.com) newsletter.

Drift Eliminated

"I'm very happy with the LBOD probe," Bolin says. "It's not required, but we check its calibration once a week and it's always fine. We have no issues with drift and our blank problems have disappeared entirely. Instead of getting a 0.2 to 0.3 mg/L variance like we used to with the membrane-based probes, it's now something like .03 mg/L or less. Plus, the probe is very user-friendly."

Besides drift and calibration issues, another problem the lab was experiencing with the membrane-based probes was slow readings.

"Each one of our BOD tests has about 25 bottles to it and every day we take off a test and put on a test -- so, we're dealing with about 50 bottles a day," Bolin says. "Our membrane probes were so slow taking readings I actually had to use two probes at the same time just to get a BOD test done in a timely manner. The LBOD probe stabilizes and reads much faster -- a few seconds instead of a minute. It is a very big time-saver. Now I just use the one probe and by the time I write the number down from the last bottle, the new reading is ready." There is also no 30-minute polarization and warm-up time with the LBOD probe as there was with the old membrane probes.

Bolin says that one of her favorite user-friendly features of the new LBOD probe is how it doesn't displace much water in the BOD bottle.

"I can put the probe in the bottle, take a reading and then remove the probe without having to refill the bottles or make a mess on the countertop. By not displacing much water, it makes the test much easier and faster for us. When we put one of our old probes in the bottle a lot of water would come out, so the unit had this special little funnel that was supposed to capture the overflow, but it was more trouble than it was worth. The LBOD probe goes right in the top of the bottle and barely displaces any water."

The LBOD plugs into the Hach HQ40d Digital Multi-Parameter Meter. With this unit a user can take up to two simultaneous measurements (and readouts) of pH, conductivity, LDO® , and ORP. The HQd-series of meters has an intuitive user interface with guided self-calibration. The last calibration as well as calibration history is stored in the plug-and-play probe, reducing the need to recalibrate when switching between parameters. The system provides reporting data, including time and date, sample ID, and user ID, so that users can store and monitor previous readings.

"We save about 20 minutes per day by using the LDO probe and meter, compared to our previous membrane-type probe," says Bolin. "That would extrapolate out to approximately $1825/year in savings, which a sizeable amount for a lab as small as ours. In addition, we have been using LDO probes since July of last year, and in that time we have had only one day where we did not have an acceptable blank, and that was due to a dilution water quality problem. With our previous probe we had one or two days per month that did not have any acceptable blanks."

As seen in the 5/29/08 edition of the Water Online (www.wateronline.com) newsletter.

Today, metering probes play a vital role in wastewater treatment plant laboratories. Not only must this instrumentation provide accurate, repeatable measurement, it must also be easy to use and calibrate. The LBOD probe and HQ40d units have demonstrated these capabilities to the Water Utilities Department for the City of Nacogdoches, Texas, while also helping to provide for efficient BOD measurement and ease of operation, bringing a new level of confidence to a critical measurement.

About the Author: *Bob Dabkowski is a Wastewater Specialist for Hach Company and a Licensed Colorado Wastewater Operator. He is the author of several papers, articles, and application notes concerning wastewater treatment and has over eight years experience at Hach, advising process control & automation solutions. Phone: 970-663-1377 x2191. BDabkows@hach.com*