Living in the Present

AN ARKANSAS CLEAN-WATER PLANT USES ONLINE WATER-QUALITY INSTRUMENTATION TO GET REAL-TIME VISIBILITY TO PLANT PROCESSES AND MAKE TIMELY ADJUSTMENTS

By Bob Dabkowski

The Rogers (Ark.) Pollution Control Facility has seen reduced process variability and energy and labor savings by operating in real time with online water-quality instrumentation.

Robert Moore, operations manager, began the quest in 1996 with online dissolved oxygen sensors for aeration control. Over the years, they added measurements to control alum dosing, blanket levels in the secondary clarifiers, and mixed liquor suspended solids concentration. They have also used secondary measurements to verify the control measurements.

Transparency from the real-time data allows the staff to respond to changing conditions quickly and correctly, ensuring compliance with a permit that includes a 1.0 mg/l total phosphorus limit.

BIOLOGICAL REMOVAL

The Rogers facility, in northwest Arkansas, is part of the Illinois River watershed. Point sources in the watershed from Arkansas to Oklahoma agreed to limit phosphorus in their effluent to protect the scenic river, and the Arkansas Department of Environmental Quality later added permit limits for phosphorus. The facility serves 50,000 people with an average flow of 7.5 mgd.

To remove phosphorus biologically, the Rogers plant uses three parallel trains of a Five-Stage Bardenpho system, which consists of an anaerobic zone, a first anoxic zone, an oxidation ditch for the aerobic zone, a second anoxic zone, and then an aeration zone.

The water then flows into circular secondary clarifiers and is polished by tertiary mixed-media filters before chlorine disinfection. In addition to its phosphorus limit, the plant must meet CBOD and TSS limits of 15 mg/l and a seasonal ammonia limit from 1.5 to 3.0 mg/l. To achieve these limits and operate in real time, the staff installed several DO, suspended solids, pH and ORP sensors, plus three phosphate and ammonia analyzers (all Hach Co.).

The Rogers (Ark.) Pollution Control Facility, in northwest Arkansas, helps protect the Illinois River watershed.

COMPLIANCE AND SAVINGS

In 1996, the plant installed polarographic membrane-based DO sensors in the oxidation ditch to control the DO level automatically. Until then, three shifts of operators were taking DO measurements every two hours and manually adjusting the water level and speed of the aerators. “The online DO sensors allowed for better control and removed the labor intensive manual measurements,” Moore says.

PHOTOS COURTESY OF GREG WILSON AT HACH CO.

Plant operator Armando Garcia checks reagent levels inside the instrument panel.

Share Your Idea

TPO welcomes news about interesting methods or uses of technology at your facility for future articles in the How We Do It column.

Send your ideas to editor@tpomag.com or call 877/953-3301

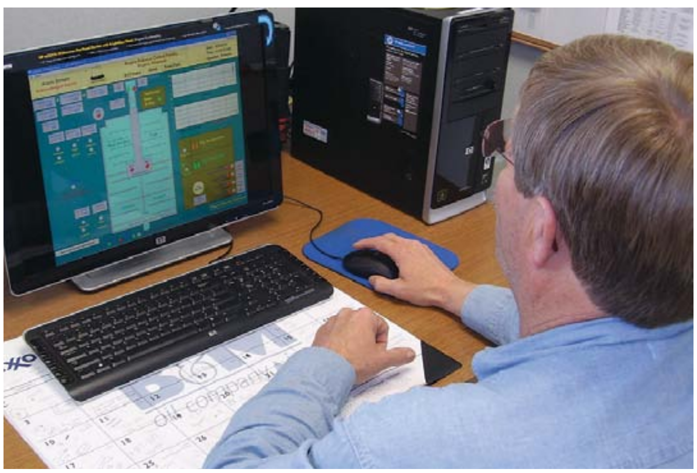
In 2003, the staff replaced aging membrane-based DO sensors with optical luminescent dissolved oxygen (LDO) sensors. “This new technology allowed for more precise measurement and faster response to changes in the actual DO concentration,” notes Moore.

The facility improved its control plan again by monitoring the oxygen demand between two sensors and using those values to set the speed and depth of the aerator blade. Comparing the energy consumption before and after that change became difficult due to an electric rate change and a plant upgrade, but Moore estimated an additional 15 percent energy savings. Two trains now have four sensors installed (two per aerator), and the third train is offline. Four more sensors will be added in the third train as increasing flow necessitates.

In 2002, the staff saw a pending effluent phosphorus limit and decided to meet the limit before it became a regulation. “The system was working well removing phosphorus biologically, but there were times when a chemical polish became necessary,” says Moore.

To capture these incidents in real time, the staff installed a phosphate analyzer after the oxidation ditch to alarm and control the alum feed pump if the concentration rose above 0.8 mg/l PO4-P. This allows enough time for the alum to precipitate the orthophosphate. The larger flocs settle out in the secondary clarifier, and the

Armando Garcia verifies instrumentation values.



Operations manager Robert Moore monitors instrumentation data on the plant's control system.

finer particles are removed in the mixed-media filter.

While the effluent limit is 1.0 mg/l, the facility aims to maintain a 0.5 mg/l total phosphorus concentration. "With alum costs rising more than 150 percent last year, controlling the dose is critical to managing costs," says Moore. "The Hach PHOSPHAX allows us to feed the exact amount we need to meet our goals — economic and compliance."

Another cost-saving measure was installation of Hach SONATAX sludge blanket level monitors in the secondary clarifiers. Moore and his staff now have a real-time view of the secondary sludge blanket, allowing them to keep the blanket below levels that would cause a secondary release of orthophosphate, and to watch for upsets during wet-weather events.

"Before these sludge-level monitors were installed, we would manually take core samples once a shift, three times a day," says Moore. "Now we only take core samples once a month to verify the online sludge level monitors." This further reduced labor costs and allowed the staff to focus on optimizing the process to meet tightening regulations.

REAL-TIME TRANSPARENCY

Other measurements the staff has found helpful include ammonia, ORP, and suspended solids in the mixed liquor and return activated sludge. The ammonia analyzers measure the mixed liquor and ensure that nitrification is complete. "With an ammonia limit of 1.5 mg/l, you don't have the luxury of incomplete nitrification, and the Hach AMTAX allows us to see small changes quickly," Moore says.

ORP is used in the biological nutrient removal (BNR) process as an environmental indicator and as a control measurement. In the anaerobic zone, Moore and his staff aim for an ORP measurement between -300 and -350 mV by controlling the mixers. This allows additional fermentation of the incoming wastewater, increasing the concentration of volatile fatty acids that the polyphosphate-accumulating organisms (PAOs) consume in an anaerobic environment.

The ORP also acts as an indicator of nitrate or dissolved oxygen entering the cell, either of which could inhibit the PAOs from releasing intracellular phosphate. "This ensures that we don't lose or inhibit biological phosphorus removal," says Moore. "Without ORP we wouldn't know how anaerobic that selector is."

In the anoxic zone, the target is -200 to -125 mV. It is controlled through a combination of the wastewater coming from the anaerobic zone and the internal mixed liquor recycle. "Even though we don't need to denitrify to meet our permit, the alkalinity and oxygen that come from denitrification make our system run better," Moore says.

Lastly, ORP sensors installed in the oxidation ditch verify the LDO sensor measurements and allow the staff to keep a very low DO concentration in the effluent of the ditch, ensuring anoxic conditions in the first and second anoxic zones.

Suspended solids sensors are installed in the mixed liquor and return activated sludge to manage solids inventory in real time. The staff has MLSS targets of 2,200 to 2,400 mg/l in summer and 3,500 to 3,800 mg/l in winter. "When we only measured TSS in the lab with grab samples, we would have once-a-week snapshots of the mixed liquor that could vary quite a bit," says Moore. "With the suspended solids sensors, we have eliminated that variability, and we have a much more realistic picture of what is happening in the mixed liquor in real time."

> "We used to spend about 27 hours per week manually taking process control measurements, and now we spend less than eight hours per week maintaining the instrumentation. Trading 27 hours a week for eight hours a week was a smart decision."
>
> **ROBERT MOORE**

SIMPLE MAINTENANCE

Maintenance of the sensor systems has been simple. "We used to spend about 27 hours per week manually taking process control measurements, and now we spend less than eight hours per week maintaining the instrumentation," Moore says. "Trading 27 hours a week for eight hours a week was a smart decision."

Always looking ahead, Moore and his staff see tightening of the phosphorus limits to 0.1 mg/l and total nitrogen limits being added to the permit in five years. To meet those limits, they are already investigating more instrumentation and control options. "The instrumentation has allowed us to see things developing in real time so we can make control changes," Moore says. "As our permit changes, we'll be able to change with it." **tpo**

ABOUT THE AUTHOR

Bob Dabkowski is a wastewater specialist for Hach Company, a licensed Colorado wastewater operator, and author of several papers, articles and application notes on wastewater treatment. He can be reached at 970/663-1377, Ext. 2191, or BDabkows@hach.com.

more info:

Hach Company
800/227-4224
www.hach.com