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SUCCESS STORIES

Doing It With Data

A Calgary Wastewater Treatment Plant Finds Real-Time Information on Effluent Quality Critical to Achieving Consistent Performance in Biological Nutrient Removal

By Dave Marsh

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In 1994, the Bonnybrook Wastewater Treatment Plant in Calgary, Alta., completed the first phase of an upgrade to biological nutrient removal (BNR) after several years of testing.

Bonnybrook was not the first treatment plant to upgrade bioreactors for nutrient removal: Other communities had struggled with the technology. Bonnybrook operators determined that real-time information on final effluent quality was important to the BNR processes and installed online process analyzers to provide the data they needed to manage the plant.

A decade of use affirmed that the analyzers were critical to successful BNR operation. Paul Do, senior process engineer, was deeply involved in the BNR design and implementation and in the decision to install the ChemScan process analyzers from ChemScan, Inc.

With the analyzer, “We obtain real-time and instantaneous indications of the plant’s final effluent quality, including TSS, ammonia, soluble phosphorus, nitrate and nitrite,” says Do. “Knowing the instantaneous final effluent quality, we can immediately take corrective process measures to improve process performance and final effluent quality.”

BNR comes of age

The Canadian government estimates that 25 percent of all water body contamination is nutrient-related. That has led to increasingly strict wastewater effluent limits for phosphorus and nitrogen. To remain in compliance while operating with constrained budgets, more operators are evaluating upgrades to BNR bioreactors.

BNR has come of age for various reasons. Coagulants such as calcium, aluminum and iron have become more expensive for treating wastewater from growing populations. BNR also produces less biosolids in a form more conducive to land application. In addition, a public that favors green technology perceives biological processes as friendlier to the environment.

BNR technology was in its infancy when Alberta Environment established new stringent effluent limits and forced treatment plants to meet a phosphorus discharge of 1.0 mg/l. Instead of launching a full-scale conversion, Bonnybrook tested BNR on a limited scale while continuing to rely on its tried and true method of precipitating phosphorus with liquid alum.

Calgary, Alberta’s largest city, was seeing steady growth that affected the operations of its two wastewater treatment plants. Bonnybrook’s chemical costs were steadily increasing — in 1985 they approached $2.6 million and were forecast to reach $3 million within seven years, when the city population reached one million.

Controlling costs was a primary reason Calgary invested in BNR. Today Bonnybrook (design capacity of 132 mgd) is the largest BNR plant in Canada and the largest cold-weather BNR plant in the world. It treats an average daily flow of 111 mgd, operating 10 state-of-the-art BNR bioreactors that employ biological phosphorus and nitrogen removal processes. Specifically, the plant uses the A^2/O BNR process with return activated sludge renitrification.

Monitoring effluent

Bonnybrook installed five ChemScan analyzers, which can monitor four key parameters in real time from two different sample points using a single central analyzer. Four analyzers monitor secondary effluent from the 10 bioreactor trains, and one monitors the combined final effluent before discharge to the Bow River.

When the analyzer monitoring the final effluent alerts the operators to deterioration in the process, they check the data from the other four analyzers to determine which bioreactor is causing the problem. The analyzers were a significant upgrade from the time-consuming process of grab sampling and lab testing to monitor the bioreactors.

The analyzers automatically collect samples and test them for specific chemicals using fully automated UV-visible spectrometry to measure absorbance levels across 256 wavelengths of ultraviolet and visible light.

"Before the ChemScan units, our wastewater laboratory staff had to expend much more effort, time and costs on wastewater sampling and analysis," says Do. "The reliable performance of the analyzers enables us to substantially reduce laboratory staff workloads and operating costs. At the same time, it's much easier for us to monitor and control the BNR processes. The analyzers provide valuable information for corrective actions, thus creating tremendous time savings and avoiding problems with wrong diagnoses."

Chemical savings

As with other cold-weather plants, Calgary wastewater contains insufficient quantities of short-chain volatile fatty acids (VFAs) needed to trigger the biochemical pathways involved in releasing phosphorus in the anaerobic zone of the biological phosphorus removal (BPR) bioreactors. As a result, the staff still applies small doses of alum to polish final effluent and ensure compliance with Alberta Environment permit limits.

"The ChemScan units helped us to achieve chemical savings," says Do. "We use the analyzers' soluble P results to instantaneously reduce our alum doses, and we are still able to comply with the total phosphorus permit limit of 1 mg/l. Our annual alum savings of around $2 million was due to both our BNR process and the analyzers."

With more than 10 years of experience monitoring the bioreactors, Do has no complaints about the process analyzers. He observes, "When they are properly maintained, they will keep on working smoothly, and reliably producing all the important parameters associated with a wastewater treatment plant's final effluent quality."

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