

WWTP Utilizes Online Instrumentation and SCADA to Keep Operating Costs Low and Effluent Quality High

Wastewater Treatment

An advanced level of wastewater treatment is provided for an average daily flow of nearly 8,000 m³/day. The flow sheet consists of equalization, preliminary treatment, primary settling, trickling filters, a 2-stage activated sludge system, and tertiary filters. The National Pollutant Discharge Elimination System (NPDES) discharge permit requires monitoring of pH, total suspended solids (TSS), and 5-day biochemical oxygen demand (BOD₅) in the influent and limits the pH and the concentration of TSS, BOD₅, ammonium (NH₄-N), and dissolved oxygen (DO) in the treated effluent.

The wastewater plant invested in SCADA and the WTW IQ SENSOR NET online process monitoring system several years ago. Selection of the SCADA component was easy on account of the previous experience of the Utilities Director in the power generation industry. Selection of the IQ SENSOR NET came about after a trusted associate brought it to the attention of the wastewater superintendent. The superintendent liked the IQ SENSOR NET system overall, especially the ability to measure up to 20 parameters on a single network. The original system installed consisted of a universal controller (2020 XT); seven sensors including two pH (SensoLyt®), three DO (TriOxmatic®), and two TSS (ViSolid®); a Modbus module for communication with the PLC; and a spare sensor connection cable for calibrating sensors in the lab.

Compliance

The most critical objective for any wastewater treatment plant is compliance with the discharge permit. Continuous measurements from a pH sensor in the influent and pH and DO sensors in the effluent directly satisfy discharge permit reporting requirements and verify compliance with discharge permit limitations. Additional sensors deployed in the treatment system enable operators to automatically control operating parameters to ensure cost-effective compliance.

Control

The activated sludge aeration system represents the bulk of treatment and the largest portion of operating costs. Therefore, as the superintendent puts it, "It seems unwise to not finetune the aeration system to the greatest extent possible."



An IQ SENSOR NET module mounted tank side along with sensors for continuous process monitoring and control.

Mixed liquor suspended solids (MLSS) concentration and dissolved oxygen concentration are critical operating parameters for the activated sludge system. If the concentration of either is inadequate, treatment performance degrades and discharge permit violations occur. On the other hand, excessive levels result in wasted energy and higher operating costs that must be passed on to ratepayers. A novel method is utilized to maintain the desired MLSS concentration in each stage of the activated sludge system by automated sludge wasting.



First, sludge is wasted every 8 hours on a timer. This is important to steady the operation of the biological system and reduce the potential for upset, especially over weekends and holidays when the plant is not fully staffed. Excess sludge from the first stage is wasted to the second stage; excess sludge from the second stage is co-settled in the settling tanks. Second, the amount of sludge wasted is based on the difference between the MLSS setpoint and the current reading from a ViSolid® sensor located at the tail end of each stage. Third, the amount of sludge wasted is adjusted based on the most recent ½ hour settling test result entered by the Operator to prevent too much or too little wasting if sludge settleability changes or the sensor calibration drifts unexpectedly.

Routine maintenance of the ViSolid® sensor is performed to ensure the highest accuracy. A singlepoint calibration is performed weekly by simply adjusting the sensor reading based on a laboratory suspended solids measurement from a sample taken near the sensor. The ultrasonic cleaning system prevents fouling of the sensor. However, for good measurements, the sensor is cleaned every three weeks by simply wiping it off with a damp rag. In total, maintenance requires not more than 15 minutes of operator attention per week. Dissolved oxygen setpoints are also maintained automatically. Modulating valves on the air supply piping to each of the 1st and 2nd stage aeration basins are adjusted directly in response to readings from TriOxmatic® DO sensors installed at the tail end of each stage. Implementation of DO control in the activated sludge system, in addition to other improvements including installation of a smaller blower, has allowed realization of substantial energy savings. In addition to verifying compliance with the discharge permit, measurements from the online TriOxmatic® dissolved oxygen sensor in the effluent are used to directly maintain compliance. An automated valve opens to increase air flow to the post aeration tank if effluent DO falls below the set point.

Monitoring

The IQ SENSOR NET system was expanded after the original project to provide online monitoring of the treatment process. It was a simple matter of purchasing additional sensors, mounting them into the desired locations, and connecting them into the existing IQ SENSOR NET network. Two VisoTurb® turbidity sensors were installed, one in the influent to the tertiary filters and the other in the final effluent channel to monitor the performance of the 2nd stage activated sludge system and the tertiary filters. The turbidity sensors detect small changes in the quality of wastewater before it becomes visually apparent. Operators trend the measurements from the online turbidity sensors to stay ahead of the process and enable proactive adjustments before bigger problems could occur.

Conclusion

The Utility has not raised user fees in 15 years. A big reason for that is the commitment of the wastewater department staff. It was their progressive attitude and desire to “stay ahead of the curve” that gave rise to the project to install the SCADA system and online sensors. The investment has paid off. At the time of project completion, user fees were above the median for the State. Today, user fees are 12 per cent below the median. A high level of performance is also achieved despite substantial industrial wastewater loadings.

Over 98% of TSS and COD is removed on average and monthly average effluent ammonia-nitrogen did not exceed 0.3 mg/L during the most recent three-year period.



Ultrasonic cleaning technology is capable of preventing biofouling of the sensors in very harsh conditions saving time and money on sensor maintenance.

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August 2021