CASE STUDY

DO Control Maximizes Oxidation Ditch Treatment Efficiency

By Shawn Brown

Process control is key to maximizing wastewater treatment efficiency while minimizing operating costs. Implementing the right process control system in conjunction with the right equipment can save money on electrical costs and equipment maintenance.

The wastewater plant for the city of Dawson, MN, uses a Tri-Oval® oxidation ditch from Aeration Industries for primary treatment of its wastewater. The plant was brought on line in November 2004. Wastewater entering the plant is a combination of approximately 60% municipal and 40% food processing wastewater from a local soybean processing plant. Influent quality is relatively constant because the wastewater plant receives wastewater year round from the soybean processor 24 hours/day, 7 days/week.

A view from the west end of the two-ring oxidation ditch at Dawson, MN. The DO probes are mounted in the foreground in the corner of each ditch near the center dividing wall.

The influent is prescreened using microscreens and then is evenly split between two oxidation ditches operating in parallel. Operating water level in each oxidation ditch is nine feet. Flow proceeds to secondary clarification and finally UV disinfection prior to discharge to the Lac Qui Parle River. Designed by Liesch Associates, the plant's average daily design flow is 380,000 gpd and its actual average daily flow is currently 177,000 gpd. Current average influent characteristics are 350 mg/l CBOD5, 250 mg/l TSS, and 23 mg/l ammonia.

Mixing and aeration in each oxidation ditch is accomplished using Aire-O2 Triton® process aerator/mixer units manufactured by Aeration Industries. Four units (three 7.5 hp units and one 10 hp unit) are installed and spaced evenly around the ring of each oxidation ditch. The process aerator/mixer units are not self-aspirating. Each unit is mated with its own regenerative blower that injects fine bubble diffused air into the water at the end of the unit while the unit mixing prop simultaneously provides horizontal mixing and dispersion. By introducing the air via a blower, the mixing becomes independent of the aeration and allows for direct control of oxygen levels by either turning on and off entire units or turning on and off only the unit blowers without sacrificing basin mixing energy.

A Foxboro Model 871 amperometric dissolved oxygen (DO) sensor is installed at the west end of each oxidation ditch to monitor the DO levels in the ditches to insure adequate oxygen is delivered to meet the biological oxygen demand of the wastewater. The DO sensors are linked to a Foxboro Model 873 DO analyzer, which is connected to a programmable logic controller (PLC). Operation of the process aerator/mixer units is controlled based on readings from the DO sensors and operational run time tracked by the PLC. This information can be monitored by the plant operators from an Allen Bradley PanelView 1000 Terminal in the plant control room.

A closer view of the DO probe location on the west side of the oxidation ditch and the bridge mounted process aerator/mixer units.

The current DO set point in the ditches is 2.0 ppm. A minimum of one process aerator/mixer is always in operation to maintain mixing and aeration in the basin. If the DO levels drop below 2.0 ppm a second unit is automatically turned on. A third unit is turned on if DO levels drop below 1.5 ppm and a fourth unit is turned on if the DO levels drop below 1.0 ppm. The PLC also monitors which units are in operation and rotates operating units once a day to insure all units have a similar total operational run time.

Brent Powers, Maintenance Superintendent for the city of Dawson, said more units are typically needed in operation in the summer when water temperatures are 65-75 degrees Fahrenheit versus the winter when water temperatures are 40-45 degrees.

"Typically the DO levels measured in the basin require one process aerator/mixer unit for operation in the winter and two units in the summer with the third unit turning on and off in the summer as the influent load (and hence oxygen demand) fluctuates during the day," Power said.

Currently the process controls are set up to turn off entire process aerator/mixer units. Due to the design of the units, more finite control can be implemented if the application requires higher mixing velocities but not as much aeration by automatically turning off the individual blower units.

Operation of the new oxidation ditch has resulted in a substantial electrical savings when compared to the original ditch that was installed at the plant. The operating water level of the original ditch installed in 1973 was only 4 feet. The ditch used brush rotor technology for aeration and mixing. Two brush rotors were installed. Each brush rotor motor was 25 hp and both units needed to operate continuously to supply the proper amount of mixing in the ditch.

With the new deeper oxidation ditch, more efficient process aerator/mixer units, and DO process controls, the city of Dawson can now realize average annual electrical savings of over $15,000 by only using the amount of mixing and aeration required by the process. Moreover, power dispersion to multiple, more efficient and smaller process aerator/mixer units around the ditch allows for operational rotation of the units and system redundancy, thereby simplifying operations and extending the life of the equipment.

The oxidation ditch has been operating well with very little attention required from the operators. Experience dictates that the membrane on the DO sensors must be cleaned once or twice a month to maintain consistent DO readings. This is an easy procedure involving removal of any material that may have wrapped itself around the end of the probe and wiping off the sensor's membrane to remove any biological growth that may affect the readings. The DO membrane itself needs to be replaced about twice a year. Plant effluent results have been excellent, averaging 3 mg/l CBOD5, 8 mg/l TSS, and 0.1 mg/l ammonia.

Brent Powers, Maintenance Superintendent for Dawson, monitors the DO levels in the oxidation ditch from the plant control room.

Automatic process control using DO sensors and PLC programming to monitor and control the operation of the process aerator/mixer units has allowed the city of Dawson to keep tight control over their treatment process. Implementation of the process control system has improved plant performance and saved the city money at the same time. WW

About the Author

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