2011 IL Operations Award Winner

Village of Antioch Wastewater Treatment Facility

By Jason Treat

Service area

The Antioch WWTF provides wastewater transportation and treatment services for the Village of Antioch, situated in Lake County, Illinois. The present service area has a service population of approximately 14,000 people. The village owns and operates 21 lift stations which transport wastewater to the treatment facility.

Wastewater treatment plant operations

The Antioch WWTF recently finished an upgrade of the entire facility. The old plant was completely abandoned, with the exception of re-using aeration basins for aerobic digesters, and using a circular clarifier as a gravity thickener.

The Antioch WWTF operates a biological nutrient removal (BNR) process, which is a version of the University of Cape Town (UCT) variation. The UCT process consists of anaerobic, anoxic, and aeration zones. The BNR process was chosen based on the need to meet permit requirements for the removal of BOD5, TSS and phosphorous removal and nitrification. The plant is rated to treat a daily average flow of 2.0 MGD, and a maximum daily flow of 9.2 MGD.

The WWTF uses a rotating drum screen to screen rags, trash and large solids in the influent. Screened flow continues to the BNR process, which again utilizes the UCT variation to reduce phosphorous in the final effluent. Prior to secondary clarification, alum is used to remove any remaining phosphorous prior to disinfection by UV and discharge to the receiving stream, which is the Sequoit Creek. Sludge is processed by aerobic digestion, and then dewatered using a two-meter belt filter process. Dewatered sludge is stored in a sludge storage barn, and land applied twice per year.

Following is a more in-depth description of the process:

The Antioch WWTF has a design average flow (DAF) of 2.0 MGD, and design maximum flow (DMF) of 9.2 MGD. The Antioch WWTF is a biological nutrient removal (BNR) facility. The BNR process is a single stage nitrification system, and is designed to remove phosphorous biologically, with chemical addition (alum or ferric chloride) as a final polishing step. Alum is currently used.

Raw influent flow enters the plant through a force main and into the headworks building where it is measured using an area velocity meter. Once the flow is measured, it is cleaned of rags and debris using a Lakeside Raptor fine screen. Flow leaves this building, and flows by gravity directly to the three aeration basins, which make up the BNR system.

The aeration basins consist of three zones: the anaerobic zone, the anoxic

zone, and the aerobic zone. The wastewater enters the anaerobic zone and is mixed with mixed liquor recycle from the anoxic zone. Here the influent wastewater and microorganisms are combined in the absence of oxygen, either free or in a combined form. In the absence of oxygen, the microorganisms release phosphorous while consuming and storing food.

The second zone of the UCT process is the anoxic zone. Here microorganisms are returned to the process from the final clarifiers as RAS. The anoxic zone is utilized to denitrify the RAS. The resulting mixed liquor is recycled to the anaerobic zone. This provides nitrate free mixed liquor to the anaerobic zone. Recirculation is accomplished by use of a variable speed axial flow submersible pump.

The third zone of the UCT process is the aerobic zone. The microorganisms continue to consume food, nitrify ammonia to nitrates, and also provide luxury uptake of phosphorous compounds.

Chemical feed is available to remove any remaining phosphorous, if needed.

Once the flow leaves the BNR process, it flows by gravity to the secondary clarifiers, where solids are allowed to settle. These solids are either returned to the BNR system as return activated sludge (RAS), or wasted to the gravity thickener where solids are allowed to settle, and eventually pumped to the aerobic digesters. Clear water flows over the weirs of the secondary clarifiers, and continues on to the UV system. The UV system consists of a Trojan ultraviolet system, where the DNA of the fecal coliform bacteria is altered by ultra-violet wavelengths, leaving the bacteria unable to reproduce. Once the flow passes through the UV system, it continues on through the Parshall flume, where it is metered before flowing to the receiving stream.

Biosolids are processed at the facility by the following methods: Approximately 30-40,000 gallons of waste activated sludge is pumped to the gravity thickener five days/week. The sludge is allowed to settle in the gravity thickener, and eventually pumped to the aerobic digesters (four total) at a concentration of 3-4%. The sludge is then pumped to the Komline Belt Filter Press, which is located in the dewatering building. The Belt Filter Press squeezes the water from the sludge, with average cake solids from the press averaging 18-20%. The cake is then stored on site in the sludge barn, and is hauled off site twice/year and applied to farm fields.

Discharge limits are as follows:

	Monthly Average	Daily Maximum
CBOD5	10/mg/l	20 mg/l
TSS	12 mg/l	24 mg/l
Fecal Coliform	400 per	100 ml
Ammonia Nitrogen		
April-May/Sept-Oc	1.5 mg/l	4.2 mg/l
June-August	1.1 mg/l	4.2 mg/l
Nov-March	1.5 mg/l	2.4 mg/l
Phosphorous	1.0 mg/l	2.0 mg/l
Copper	.034 mg/l	.055 mg/l
Silver		.005 mg/l

In-service training and upgrading of subordinate operators

Plant personnel are trained in both wastewater operations and laboratory procedures. The village actively supports the continual development of its employees. Examples of this commitment are as follows:

- The lab was recently updated with state of the art lab equipment, which allows for most routine plant process analysis to be conducted on site. In order to ensure quality control, staff went through a thorough training program, detailing and outlining proper lab methods and procedures.
- Plant personnel regularly attend seminars, outside training courses and workshops relating to wastewater treatment. Training on all of the plant equipment has taken place over the last year,

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and staff is familiar with all aspects of maintenance of the equipment.

- The village provides financial assistance by reimbursing employees for the tuition, fees and books associated with job-related education.
- The village sponsors employees' participation during typical working hours in outside workshops, seminars, conferences, classes and training. The employees are encouraged to stay abreast of the changes throughout the industry, and attend workshops frequently.
- Plant personnel are involved in various professional organizations, including Fox Valley Operators Association (FVOA), Central States Water Environment Association (CSWEA), and Illinois Association of Water Pollution Control Operators (IAWPCO). The village encourages involvement in these organizations, along with allowing and encouraging direct involvement in committee work.
- The operation of the facility is currently overseen by two Class 1 operators.

In-plant studies and routine operation data

The plant uses a single excel spreadsheet for keeping track of and reporting all discharge monitoring reporting (DMR) parameters. The spreadsheet automatically calculates all data and displays it into appropriate format, such as mg/l, pounds, min/max, etc. Once the information for the month is entered onto the spreadsheet, the DMRs are then submitted electronically to the IEPA. While other spreadsheets, bench sheets and other forms of documentation are used for gathering plant data, this single spreadsheet makes the task of gathering and reporting necessary DMR information simple, while allowing the operator a quick reference to critical operational data.

A supervisory control and data acquisition (SCADA) system monitors and controls plant processes and equipment. Dissolved oxygen (DO) levels in the aeration basins, for example, are controlled and monitored through the SCADA system, and blower speeds are increased or decreased in order to maintain a pre-determined DO range. This control allows for efficient and cost effective methods of operation of the aeration system.

Preventive maintenance, emergency operations and safety practices

The facility currently uses a computerized maintenance management system (CMMS) to ensure preventive maintenance (PM) is regularly performed on all major plant equipment. Completed PMs are entered into the system, and important information such as equipment hours, costs associated with maintaining the equipment, and parts are kept track of.

The facility also uses an outside vendor to perform regularly scheduled vibration analysis of major equipment. Once the vibration analysis is performed, detailed reports are provided which provide the condition of the equipment, along with any problems noted during the analysis. This allows for trending of the equipment to be done, which in turn allows for shutdown and repair of the equipment before any major damage is done to the equipment.

The facility has two sources of electrical feeds to the plant, and also houses a natural gas generator, which is used for emergency back-up power. The generator is exercised twice/month in order to ensure it is ready for use. Important information such as hours, oil levels, etc. is kept regularly to ensure peak performance. The village takes part in a capacity-based load response (CBLR) program with the electrical utility, in which the village may be called upon to use the generator to supply electrical power to the entire plant during high peak demand periods, thereby reducing the demand on the power grid. Taking part in this program ensures the generator is run under load, thereby eliminating the need to actually perform load bank testing on an annual basis. The CBLR also is a source of revenue for the village. CS