City of New Prague

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Company Background

The New Prague Wastewater Treatment Facility (NP WWTF), a Class A wastewater treatment facility, treats wastewater from more than 7,700 residents and discharges to Phillips Creek, a tributary of the Minnesota River. The facility completed the an upgrade's first phase in 2010 to better meet the effluent requirements set by the Minnesota Pollution Control Agency (MPCA). State-of-the-art technology was incorporated in its upgrade: parallel plate clarifiers, biological aerated filters (BAFs), membrane filtration, and ultraviolet disinfection. The second phase of the upgrade will initiate when the influent flow exceeds the facility's current capacity, which is designed for an average 1.83 million gallons per day (MGD) influent wet flow. The facility currently treats 0.85 MGD on average.

"The experience of working within the New Prague Wastewater Treatment plant has taught me the complexities of engineering that are seldom discussed in the classroom. Every day I looked forward to learning something new and using my abilities toward helping New Prague become more sustainable. I look forward to using the skills and knowledge I have gained as I continue my journey of becoming an environmental engineer." ~ EW

Project Background

The facility uses electrical energy to operate most of its technology, consuming approximately 2,183,200 kilo-watt-hours (kWh) in 2016. Electrical energy costs make up 76% of the facility's utility bills. An Environmental Protection Agency (EPA) energy assessment tool was used to determine the energy distribution throughout the facility. The top five energy consumers, in descending order, are odor control; sludge handling; BAF treatment; heating, ventilation, and air conditioning (HVAC); and internal pumping. These five processes alone make up 88% of the facility's electrical energy usage.

Based on feasibility and flexibility for improvements, equipment and procedure changes were investigated for odor control, HVAC, and BAF treatment. Common energy saving opportunities that are not specific to the facility were investigated as well. From those common opportunities, sealing compressed air leaks and upgrading lighting to light-emitting diode (LED) were found most promising.

Incentives To Change

As the purpose of the facility is to eliminate water pollution for the health and benefit of New Prague's residents, it is also within the facility's and residents' best interests to reduce its energy consumption and thus operating costs. The operating costs are meant to be covered by water and sewage user fees. However, the user fees have fallen short of the operating costs which must be made up through taxes. If MPCA regulations become more stringent as anticipated by the NP WWTF staff, the facility will have to expend more operating and capital costs; reducing energy costs could help offset the additional expenses. Increasing the energy efficiency would reduce costs to the city while aiding the global cause to reduce greenhouse gas emissions from energy consumption.

"The city of New Prague has always been cost conscious. That is why the city jumped at the chance to work with MnTAP to optimize our biggest energy consumer, the Wastewater Treatment Facility. We look forward to implementing Emily's recommendations and enjoying the energy savings."
~ Scott Warner, Wastewater Superintendent

Solutions

Odor Scruber and HVAC Reduction

The scrubber to the BAF gallery has the most potential for energy reduction. The scrubber fan sizing accomplishes 7.2 air changes per hour (ACH) in comparison to 4.8 ACH for pretreatment and 4.0 ACH for biosolids. Fan affinity laws were used to determine the reduced motor speed and energy consumption for the BAF scrubber to accomplish 4.9 air changes. Variable frequency drives (VFDs) are already installed on the odor scrubber fan and corresponding make-up air unit fans, allowing for easy motor frequency (speed) adjustments. These adjustments can be made at no added capitol cost. The make-up air unit fan speed was reduced the same amount as the BAF scrubber fan's reduction to keep the room pressure close to its original design point.

Reduce BAF Aeration

BAF cells require dissolved oxygen (DO) for the microbial community to live and degrade organic matter and ammonia, but a DO concentration of 0.5-2 mg/L is sufficient. The NP WWTF BAF cells have averaged 7 mg/L in the summer months, and likely achieve even higher DO when the weather is colder. The dissolved oxygen is provided by the BAF blowers. The blower runtimes can be reduced by changing the set points in the program that determine when and what mode each blower operates. The volumetric flow rate of air delivered and thus the power consumption can be reduced using VFDs. The reduction depends on the desired dissolved oxygen concentration within the BAF cells, which must be experimentally determined to best meet the effluent DO requirement of 7 mg/L. The BAF cell DO can be less than the effluent requirement because outfalls at membrane filtration, UV disinfection, and final outfall impart additional DO, but to an unknown extent.

Seal Compressed Air Leaks

Three air compressors provide compressed air for actuators and regulators throughout the facility. A common method to reduce energy consumption is to eliminate air leaks. An ultrasonic leak detection study done by Marcus Hendrickson from Southern Minnesota Municipal Power Agency was used to identify leaks and potential savings. An additional six leaks were found by spraying a soap and water mixture on hosing connections. Fourteen leaks were identified and repairs to those leaks are in progress.

Upgrade to LED Lighting

The lighting industry is constantly improving, making LED technology an appealing alternative for its reduced energy consumption to provide better quality of light. NP WWTF utilizes linear fluorescent and metal halide lighting, with some lights that must be on 24/7 to meet building lighting requirements. An LED upgrade would reduce the lighting energy consumption and costs, as well as improve the lifetime and quality of light provided.

Recommendation	Annual Reduction	Annual Savings	Status
Reduce BAF scrubber and MAU flow rate	106,157 kWh / 150 therms	$8,162	Implemented
Switch BAF and biosolids scrubber exhaust fans and reduce flow rate	21,035 kWh	$1,600	Under review
SCADA set point adjustment	147,609 kWh	$11,218	Implemented
Install VFDs to BAF blowers and set BAF DO to 4.0 mg/L	107,133 kWh	$8,142	Recommended
Seal compressed air leaks	13,820 kWh	$1,050	In progress
Install LED retrofits for interior lighting and LED wall packs for exterior lighting	28,613 kWh	$2,174	Recommended

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