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MnTAP

SAVING ENERGY IN WASTEWATER
CITY OF MONTEVIDEO

Challenge

Prior to this project, the city of Montevideo's Wastewater Treatment Facility was paying over $124,000 per year for electricity. The plant was identified as having high energy use through an energy benchmarking effort done in conjunction with the plant's electric utility. The city's Utilities Superintendent was interested in opportunities available for energy savings at his plant. He knew that dissolved oxygen (DO) levels were high in his basins, and wanted more in depth information on his options to save energy.

Approach

MnTAP analyzed the equipment and airflow being used for treatment in order to find solutions. The largest opportunities were found in tuning airflow, capacity, and detention time in secondary aeration, waste tank aeration, and digester aeration.

Results

Energy Savings: 626,300 kWh / yr

Cost Savings: $44,000 / yr

Reduce digester aeration and detention time

DO reduced to 2 ppm

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Results

Secondary Aeration: DO = 2 ($35,500, 412,800 kWh – Planned)

Montevideo is currently running three secondary aeration basins in series. The dissolved oxygen within the basins ranges from 9-11 ppm. This is very high, and is a sign that reducing aeration would save a lot of energy. Through additional testing, Montevideo staff was able to determine that there was no further treatment occurring between the second and third basins and that the third basin was unnecessary. Taking that basin offline will reduce the plant's day-to-day aeration needs. The VFD on the large centrifugal blower can't be turned down below 56 Hz before the blower starts surging. Because the blower can't be tuned any further to reduce aeration, the solution here is to take one basin offline and to install a smaller blower which will be able to generate the proper aeration for the two remaining basins. Maintaining a DO of 2 with a smaller blower will save the plant $35,500 per year in energy. This project is being planned for implementation in 2018.

Waste Tank Aeration: Staggered and Reduced ($12,200, 142,000 kWh - Implemented)

Biosolids from the clarifiers are sent to a waste holding tank prior to being thickened and then sent to the aerobic digester. Before the assessment, this tank was being aerated 24/7, with a blower speed ranging from 35 Hz when the basin was empty to 55 Hz when the basin was full. While this type of automated VFD speed change is good, the assessment was able to identify areas for improvement. MnTAP outlined a variety of strategies to reduce airflow and save energy.

Staff tested reducing airflow to the waste tanks to save energy. They found that they can turn the waste tank aeration off for a few days after emptying it, and then can leave the VFD frequency at 40 Hz for the rest of the time. By using this strategy, operators are saving $12,200 per year in energy.

Digester Aeration ($5,400, 65,000 kWh – Partially Implemented)

The Montevideo Wastewater Plant was running two digesters in parallel on offset schedules so that one tank would fill while the other tank was holding and digesting biosolids. Both tanks were being aerated on a 30 minute cycle. The study found that this strategy required enough air to be generated to serve both tanks while full and at design capacity. Additionally, overall detention time of the biosolids was much higher than is recommended in the Ten State Standards.

A plan was developed involving filling and aerating using only one digester, allowing biosolids to aerate as the tank fills and while the prior waste tank fills. Using only one digester reduces the minimum sludge detention time from 45 days to 15 days while reducing the required treatment volume from two tanks to one. The volume reduction should allow the blowers to run for only 15 minutes per hour, down from 30 minutes. Currently, the blowers are being tested at 20 minutes per hour, and they will be brought down slowly to ensure there are no adverse effects on treatment quality resulting from this change. This cycling reduces energy consumption and will save the plant roughly $5,400 per year in energy costs.

Getting Started with Energy Efficiency

Energy Efficiency and Renewable Energy Generation

Minnesota Wastewater Facilities

Benchmarking your wastewater plant is a great way to get a sense for the magnitude of savings potential for your plant. B3 Benchmarking for Minnesota Wastewater Plants can be completed here mn.b3benchmarking.com/WastewaterTreatmentPlants

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WASTEWATER TREATMENT EFFICIENCY – NORTHFIELD, MN

Challenge

Operators at the Northfield Wastewater Treatment plant understood that they were spending a lot of money on energy – roughly $310,000 per year. The team at Northfield is passionate about sustainability, and in 2017 they chose to address their energy challenge head-on.

Approach

Northfield contacted MnTAP about an energy assessment for some help in finding energy savings opportunities. After extensively digging through spreadsheets, sifting through data, and performing analysis, valuable information was uncovered that gave the team at Northfield what they needed to make changes to save significant energy in their wastewater treatment process.

Results

Potential Savings
1,259,900 kWh / yr
$93,300 / yr

Tune primary clarifier and take four BAF cells out of filtration

Time cycle digester blowers

Install and use VFDs on BAF Blowers

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Findings

BAF Treatment

Comparing treatment data from 2002 to data collected in 2017 showed that something was wrong. Influent BOD, TSS, Ammonia, and Phosphorus were very similar between the two time periods. However, in 2002, the plant was able to function with just four BAF cells in filtration – in 2017, the plant was running with eight.

Continued analysis showed that the main difference was the waste removal within the primary clarifiers. The primary clarifier TSS removal percentage had dropped from roughly 90% to 50%. The difference was being made up within the BAF cells in secondary treatment, at the cost of running four additional cells ($62,000 per year in energy).

Northfield operators were able to partially resolve this issue by turning their backup primary clarifier online, reducing the number of necessary BAF cells from 8 to 6. Operators are now studying their coagulant and mixing procedures to look for additional ways to get their primary clarifier to run at optimal efficiency. When the primary clarifiers are performing well, fewer BAF cells are needed to treat the wastewater. The two BAF cells taken offline so far will save the plant $30,000 per year. Operators are looking at options to take two more offline, which will result in a total savings $62,000 per year in energy.

Digester Aeration

The air being generated by Northfield's digester blower was compared to the Ten State Standards recommended digester aeration. This standard declares that air should be sent to the digesters at a rate of 30 scfm / 1000 ft^3 of sludge. That means that as the digester tank fills with sludge, the amount of air being sent to the tanks should increase, allowing the supplied airflow to match the required airflow throughout the sludge stabilization process. The assessment showed that, given the air generated by the digesters at Northfield, the blowers should run from 9 minutes per hour for a nearly empty tank to 42 minutes per hour for a full tank. Switching to this operating procedure from simply running the blower constantly will save Northfield 115,000 kWh, or $8,300 per year. Due to some piping issues, this change is scheduled for 2021.

VFDs

The blowers within the BAF cells at Northfield are run without VFDs. MnTAP was able to use an aeration model to determine what speed the blowers would need to run to maintain a Dissolved Oxygen (DO) level between .5 and 2 within the BAF cells. It was found that with four cells in filtration, the blowers could be turned down to roughly 50% speed and still maintain adequate DO within the cells. For the four remaining cells in filtration, this change will result in an overall energy savings of 250,000 kWh, or $20,000 per year. This upgrade is budgeted and scheduled for 2024.

Getting Started with Energy Efficiency

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ENERGY EFFICIENCY AT THE PELICAN RAPIDS WASTEWATER PLANT

Challenge

Energy efficiency is a noble goal at any wastewater treatment plant. When a plant can be run more efficiently, it saves energy and reduces operating costs. Unfortunately, it isn't always obvious what to change in order to find these savings. Operators at the Pelican Rapids Wastewater Plant were ready to test changes in order to save energy. With some help from MnTAP, the operators were able to identify, test, and implement savings opportunities resulting in large scale savings for the plant and the city.

Results

Reduce Digester Blower Speed

Turn off Digester Blowers after Emptying Basins

Save Energy 145,000 kWh / yr

Reduce Costs $11,600 / yr

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Findings

Reduce Digester Blower Speed from 45 Hz to 30 Hz (112,500 kWh, $9,000)

The Pelican Rapids wastewater treatment plant is running two digesters in series. The identical blowers serving these digesters are run with VFDs. Initially, the first was set at 75% speed (45 Hz), while the second was at 50% speed (30 Hz). The team was curious as to whether turning down the speed of the first blower would provide adequate aeration for treatment.

The operators tested turning the first digester to 50% speed to match the second, and found that treatment quality was not adversely affected by the change. The treatment quality actually improved, although whether that was due to this change or because of lurking variables is unknown at this time. The $9,000 in annual cost savings was a nice bonus.

Turn off Digester Blowers for 36 Hours after Emptying Basins (32,500 kWh, $2,600)

Through discussions relating to plant operations, it was discovered that the digester blowers are running 24/7. This means that after sludge is sent to storage and digesters are emptied, any air being generated is being sent into an empty tank, and is effectively being wasted. The operators decided to do some testing and determined that they are able to leave the digester blowers off for 36 hours after emptying the tanks with no adverse impact on treatment quality. The $2,600 per year savings made this no-cost operational change well worth their time.

Bernard Spragg. Pelican. Flickr.

Getting Started with Energy Efficiency

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WASTEWATER EFFICIENCY – PINE RIVER AREA SANITARY DISTRICT

Challenge

Staff at the Pine River Area Sanitary District were interested in reducing their operating costs. The plant manager, Andrew Schwartz, was aware that his oxidation ditches and aerobic digestion process used a lot of energy. Andy wanted to quantify that observation and to learn how he could operate more sustainably. He scheduled a MnTAP energy assessment to get these questions answered.

Approach

MnTAP staff came out to the plant to gather information on blowers, rotors, setpoints, and dimensions. This information was used to identify opportunities to optimize operations to save energy.

Results

Energy Savings:

51,000 kWh / yr

Cost Savings:

$4,100 / yr

Time cycle digester blowers to match required airflow

Maintain a DO of .5 behind the oxidation ditch rotors

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Findings

Adjust digester blower operation to match recommended airflow (33,000 kWh, $2,650 per year)

At the time of the energy assessment, the digester blower was cycling to run for two hours on, and one hour off. This type of cycling is a very good practice for wastewater plants looking to reduce aeration costs. MnTAP was able to determine that the airflow generated by the digester blower averaged to 397 scfm over the full blower cycle. This number was compared to the Ten State Standards airflow for the sludge, which recommended running between 151 and 252 scfm, depending on the sludge depth. MnTAP recommended that the plant reduce their aeration cycle times to better match the Ten State Standards values. Pine River staff made the change gradually over the course of several weeks. After weeks of testing, the plant reached a point where the digester started to develop some minor odors. The plant operators turned the cycle times back up to the last working test point (60 minutes on, 90 minutes off, 238 scfm averaged over the cycle). This testing allowed plant staff to optimize their digester blower cycling, resulting in savings of 33,000 kWh per year, worth $2,650 annually.

Reduce Dissolved Oxygen Level in Oxidation Ditches (18,000 kWh, $1,450 per year)

The staff at Pine River had already been maintaining a dissolved oxygen level of approximately 2 ppm within the oxidation ditches. This is very close to ideal, but there is some small opportunity for further optimization. Typically the dissolved oxygen level should be kept within the .5-2 ppm range to ensure that the microorganisms performing treatment stay healthy. For oxidation ditches, this value can be measured and maintained just behind the rotors that add oxygen to the water. This is the optimal way to maintain a healthy and efficient oxygen range within the ditches. By switching the standard operating point from 2 ppm to .5 ppm, the plant staff are reducing their annual energy usage by 18,000 kWh, worth $1,450 per year.

Getting Started with Energy Efficiency

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WASTEWATER POND EFFICIENCY ALTURA, MINNESOTA

Challenge

Altura is a small town of 491 people in Southeastern Minnesota. The town has an aerated pond system to treat wastewater. The wastewater plant manager is also the plant's only operator and also serves as the town's mechanic, first responder, and general problem solver. He suspected there was opportunity to save energy by removing aerators, but he didn't have the time to invest in figuring out the details. Instead, he contacted Clean Energy Resource Teams (CERTs) for help. CERTs had heard about MnTAPs work with wastewater treatment plants, and reached out on Altura's behalf to request an energy assessment.

As a result of that call, the City of Altura has the potential to save $14,000 per year in energy.

Results

Save Energy
173,000 kWh / yr

Save Money
$14,000/yr

Match O_2
Supply and Demand

Take Six
Aerators Offline

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Approach

Staff from Altura, CERTs, and MnTAP met for an on-site assessment to identify the opportunity for energy savings. The wastewater pond aeration was designed to handle large industrial loads from a large turkey plant. When that plant left town, the aerators stayed. These aerators use energy, which places an unnecessary economic burden on the town. At the time of the assessment, Altura was running 10 aerators for treatment. After digging through boxes of old files, the critical design information was pieced together. By comparing the current BOD loading of the plant to the design specifications, the solution became clear.

Results

The plant is expected to adequately treat wastewater with only four of the ten aerators online. This change will save Altura 173,000 kWh, or roughly $14,000 per year in energy.

The aerators are being removed from the pond system slowly to ensure that the change has no adverse effects on the effluent quality of the wastewater. As of this publication, two aerators have been removed from service, for approximately $4,680 in annual energy savings.

McGhiever, Whitewater River, CC3.0

Getting Started with Energy Efficiency

According to Energy Best Practices Guide: Water & Wastewater Industry, average pond benchmark scores for Wisconsin are 7,288 kWh / MG and 4,232 kWh / 1000 lb BOD; how do your ponds compare?

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